For the purpose, as it would seem, of realizing the largest possible revenue obtainable from the valley there has, it is claimed, been permitted a largely indiscriminate devastation of the magnificent forest growth and luxuriant grasses that many years alone can repair.

In a matter of such grave importance as that sought to be investigated, the Senate could not have expected of the Secretary (without an appropriation, and with no power to send for persons or papers or to administer oaths) anything more than such an inquiry as has here been attempted, or anything beyond an expression of opinion whether the subject is worthy of further examination. With this understanding, it is submitted that from these communications it appears that there has been great and unnecessary spoliation of the Yosemite Park, and the park has been largely diverted from the public use contemplated by the grant; and it is recommended that an appropriate committee, with adequate means and power, be authorized to make further investigation and report.

Very respectfully,

JOHN W. NOBLE,
Secretary.

The PRESIDENT OF THE SENATE.

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52D CONGRESS, 2d Session. } SENATE. { EX. DOC. No. 68.

IN THE SENATE OF THE UNITED STATES.

MESSAGE

FROM THE

PRESIDENT OF THE UNITED STATES,

TRANSMITTING

Certain reports upon the condition of the Navajo Indian country.

FEBRUARY 14, 1893.—Read, referred to the Committee on Indian Affairs, and ordered to be printed.

To the Senate and House of Representatives:

I transmit herewith a communication of the 13th instant from the Secretary of the Interior, transmitting copy of reports of Lieuts. Brown, Gurovits, and Suplee, U. S. Army, who were charged with the duty of inspecting the Navajo country, so that the Interior Department could be advised as to the practicability of restraining the Navajoes within their present reservation and of furnishing irrigation and water for their flocks, together with report of the Commissioner of Indian Affairs upon the matter, with draft of an item of appropriation to carry the same into effect.

BENJ. HARRISON.

EXECUTIVE MANSION, *February 14, 1893.*

DEPARTMENT OF THE INTERIOR,
Washington, February 13, 1893.

The PRESIDENT:

On August 1, 1892, this Department had the honor to submit to you a communication from the Commissioner of Indian Affairs relative to the situation among the Navajo Indians in New Mexico and Arizona, wherein he recommended that the plan suggested by Gen. McCook to redistrict the Navajo country into suitable portions and to detail proper officers to thoroughly inspect the entire region, make a contour map of it, and submit a detailed report, so that this Department could be advised as to the practicability of restraining the Navajoes within their present reservation and of furnishing irrigation and water for their flocks, with request that the necessary instructions might be given to the honorable Secretary of War to carry out the recommendations therein contained.

I now have the honor to transmit copy of a communication of the 20th December last from the honorable Secretary of War, transmitting reports of Lieuts. Brown, Gurovits, and Suplee, U. S. Army, the officers charged with the duty, together with notes and explanatory maps, and also copy of a report of the Commissioner of Indian Affairs of the 10th instant relative to the same.

The cost of developing a water supply and system of irrigation sufficient to meet the actual and immediate wants of the Navajo Indians, upon the plans submitted by the military officers, is $64,000, and the commissioner submits a draft of an item appropriating this amount.

This matter is presented with the request, if it meets with your favorable consideration, that it be transmitted to Congress for early action.

As the papers and maps are quite voluminous, only one copy of the same is furnished, and it is requested that this copy be sent to the Senate and that the copy of the commissioner's report be transmitted to the House of Representatives.

I have the honor to be, very respectfully, your obedient servant,

JOHN W. NOBLE,
Secretary.

WAR DEPARTMENT,
Washington, December 20, 1892.

SIR: Referring to your letter addressed to the President on August 1, 1892, requesting, upon the recommendation of the Commissioner of Indian Affairs, that instructions may be given to this Department to cause a survey to be made of the Navajo Indian Reservation, in accordance with the plan suggested to the Commissioner of Indian Affairs, by the commanding general of the Department of Arizona, I have the honor to inform you that the survey has been made and there are transmitted herewith the original reports of Lieut. W. C. Brown, First Cavalry, Lieut. Odon Gurovits, Eleventh Infantry, and Lieut. E. M. Suplee, Second Cavalry, the officers charged with the duty, which reports are accompanied by notes and explanatory maps under separate cover.

It will be seen from the indorsement of the commanding general Department of Arizona, on the inclosed copy of the letter from the President to the Secretary on August 2, 1892, directing this survey, that the reports of the officers above mentioned have been carefully scrutinized by him personally and have received his approval in every particular. Should these reports and maps at any time be printed under the direction of your Department, I would be very glad if you would cause a few copies to be sent for the files of the War Department.

Very respectfully,

L. A. GRANT,
Assistant Secretary of War.

The SECRETARY OF THE INTERIOR.

EXECUTIVE MANSION,
Washington, August 2, 1892.

MY DEAR MR. SECRETARY: The President directs me to send you the accompanying letter of the Secretary of the Interior, with the accompanying papers, with directions that the orders be given that the surveys spoken of be made.

Very truly, yours,

E. W. HALFORD,
Private Secretary.

The Hon. SECRETARY OF WAR.

[First indorsement.]

WAR DEPARTMENT, *August 5, 1892.*

Respectfully referred to the Adjutant-General to issue the necessary orders to carry the President's directions into effect.

By order of the Acting Secretary of War.

SAM'L HODGKINS,
Acting Chief Clerk.

[Second indorsement.]

AUGUST 6, 1892.

Respectfully submitted to the Major-General Commanding.

R. WILLIAMS,
Adjutant-General.

[Third indorsement.]

HEADQUARTERS OF THE ARMY,
Washington, August 8, 1892.

Desired by the Major-General Commanding that these papers be referred to the commanding general Department of Arizona for the necessary action, under the President's order, relative to the surveys.

THOMAS M. VINCENT,
Assistant Adjutant-General.

[Fourth indorsement.]

ADJUTANT-GENERAL'S OFFICE,
Washington, August 10, 1892.

Respectfully referred to the commanding general Department of Arizona, inviting attention to the preceding indorsement.

R. WILLIAMS,
Adjutant-General.

[Fifth indorsement.]

HEADQUARTERS DEPARTMENT OF ARIZONA,
Los Angeles, Cal., August 18, 1892.

Respectfully referred to acting engineer officer of the department for report, suggestions, and as to the most expeditious manner of carrying out the orders of the President as to these surveys.

By command of Brig. Gen. McCook:

EDGAR S. DUDLEY,
Captain, U. S. Army, Acting Assistant Adjutant-General.

[Sixth indorsement.]

HEADQUARTERS DEPARTMENT OF ARIZONA,
ENGINEER'S OFFICE,
Los Angeles, Cal., August 22, 1892.

Respectfully returned to the assistant adjutant-general of the department, with the following report and recommendations:

In view of the well-known character and extent of the Navajo Reservation, it would be plainly impossible to do all the work recommended by Commissioner Morgan in his communication of July 30, 1892, in the limited time indicated therein. It would require at least two years for the completion of a topographical survey "so that a proper and correct map can be made of the 12,821 square miles which constitute the Navajo Reservation," a territory larger than the combined areas of Connecticut and Massachusetts. It would appear, however, that the survey is to be made "with a view to establishing and maintaining a system of irrigation and developing a stock-water supply sufficient for the Navajo Indians, together with suitable places for artesian wells,

bore wells to be worked by windmills, reservoir sites, or where springs, etc., may be developed."

As these places are limited in number and extent, it would seem sufficient for all practical purposes to report in detail upon all such localities, giving maps, drawings, etc. Such localities will, of course, be carefully marked upon the existing maps of the reservation, preferably the map of the Geological Survey, which was made with great care and labor, and which represents the topography very faithfully. I would, therefore, suggest that the most expeditious manner of carrying out the instructions of the President would be to send parties to such localities as appear to invite development of the water resources. I recommend that one party be charged with reporting upon all water flowing into the Little Colorado and the portion of the basin of the Little Colorado on the Navajo Reservation; also the Chinlee Valley as far north as the mouth of Cañon de Chelly.

A second party should be assigned to that portion of the reservation north of Fort Defiance, and to include that portion of the reservation east of the Cañon del Muerto and east of the Tunitcha, Lukachukai and Carrizo mountains. A third party should examine the northwestern portion of the reservation, including the remainder of the Chinlee Valley, the western slope of the Lukachukai and Carrizo mountains, and as far west as the boundary of the reservation. The San Juan River should be divided between the second and third parties. It is recommended that the officers in charge of these parties be instructed to locate upon the map of the Geological Survey the points at which any work recommended is to be done. That the surveys for the work be made in detail, and that, as far as possible, estimates of the amount of labor required for the work be made. It is not deemed practicable to form an estimate of the cost of an artesian well or bore well, as even the most reliable expert can not tell at what depth water will be found or the character of strata to be met with, and any estimate would, of course, be no more than a guess.

In case that it is possible to obtain sufficient water for irrigation, it is recommended that the plan for the system be elaborated. All officers should be cautioned, in reporting upon the feasibility of any site for a dam, reservoir, or irrigation system, that the sandy and porous nature of the soil should be taken into consideration, as well as the limited amount of rainfall and high evaporation, and consequently the difficulty not only of filling a reservoir, but also of preserving the water until the irrigation season begins.

It is suggested that the Interior Department be requested to furnish the necessary surveying instruments to accomplish this work, as there are not enough in this department to do it. There will be required three transits, three levels with rods, and three chains. It is desirable that stadia rods should accompany the transits. I recommend that special attention be given to excavating and protecting water holes and springs already in existence.

The following rainfall for certain points on and near the Navajo Reservation are given as a partial guide:

	Inches.
Fort Defiance, 1852–1860	14.19
Holbrook, 1886–1890	9.29
Winslow, 1888, 1889	8.57
Fort Wingate, 1862–1890	14.71
Kanab, Utah, 1872–1880	14.16

CHAUNCEY B. BAKER,
Second Lieutenant, Seventh Infantry, A. D. C.,
Acting Engineer Officer.

[Seventh indorsement.]

HEADQUARTERS DEPARTMENT OF ARIZONA,
Los Angeles, Cal., December 3, 1892.

Respectfully returned to the Adjutant-General of the Army, with reference to inclosed report and explanatory maps, by First Lieut. W. C. Brown, First Cavalry, the officer charged with the survey herein ordered. This report has been carefully scrutinized by me personally and receives my approval in every particular.

A. McD. McCOOK,
Brigadier-General, Commanding.

[Eighth indorsement.]

ADJUTANT GENERAL'S OFFICE,
December 13, 1892.

Respectfully submitted to the Major-General Commanding the Army, with report from the commanding general Department of Arizona, based upon the instructions of the Major-General Commanding, contained in first and second indorsements hereon.

R. WILLIAMS,
Adjutant General.

[Ninth indorsement.]

HEADQUARTERS OF THE ARMY,
Washington, December 15, 1892.

Respectfully returned to the Secretary of War with all the accompanying papers and explanatory maps made by the officer charged with this survey, herein ordered by the President.

J. M. SCHOFIELD,
Major-General Commanding.

FORT WINGATE, N. MEX.,
November 17, 1892.

GENERAL: I have the honor to transmit my maps and report on the water supply of part of the Navajo Indian Reservation, made pursuant to paragraph 4, S. O. No. 115, C. S., headquarters Department of Arizona, Los Angeles, Cal.

Very respectfully, your obedient servant,

E. M. SUPLEE,
Second Lieutenant, Second Cavalry.

The ASSISTANT ADJUTANT-GENERAL,
Department of Arizona, Los Angeles, Cal.
(Through W. C. Brown, first lieutenant, First Cavalry.)

LOS ANGELES, CAL., *November 29, 1892.*

SIR: I have the honor to submit the following report of surveys made under my supervision on the Navajo Indian Reservation, per paragraph 4, Special Orders No. 115, dated headquarters Department of Arizona, September 13, 1892:

In obedience to telegraphic instructions I reported at department headquarters on September 19, 1892, and then received verbal instructions from the department commander, as well as written instructions contained in memorandum dated headquarters Department of Arizona, September 15, 1892.

I arrived at Fort Wingate, N. Mex., on September 22, where Lieut. Odon Gurovits, Eleventh Infantry, reported to me on the same day, and Lieut. E. M. Suplee, Second Cavalry, the day following. The work of organizing three parties under

Lieuts. Suplee, Gurovits, and myself was pushed forward as rapidly as possible. The personnel of the parties under charge of these officers is given in their reports, which are forwarded herewith; my own consisted of one acting hospital steward, a lance corporal, and three privates, Troop D, Second Cavalry; four privates (Navajoes) Troop L, second cavalry; one civilian packer, and one teamster driving the buckboard, which was returned to the post on October 14; my transportation consisted of 11 pack mules.

To Lieuts. Gurovits and Suplee were assigned the northwestern and southwestern parts of the reservation, respectively, as stated in their reports, while I took the part the east of the mountains and the north and east of Cañons del Muerto and De Chelly on the south.

The instruments ordered from the engineer depot, Willets Point, with the exception of stadia rods, chains, and pins, were received on September 24, and all three parties left Fort Wingate on the following day, arriving at the Navajo Indian Agency at Fort Defiance, Ariz., on the 26th. The transits and levels received were considered both by my assistants and myself as being much heavier than desired for most of the work in hand, it being difficult to carry such instruments on pack mules and keep them in proper adjustment.

I accordingly telegraphed on September 22 to the commanding officer at Willets Point for three hand levels, three clinometers, three pedometers, and one aneroid barometer, leaving instructions at Fort Wingate to have these instruments forwarded to us upon their receipt. It was supposed that they would be shipped by express. They were, however, sent by registered mail on October 3, being received at Fort Wingate probably about the 9th, but the postmaster not notifying the adjutant that they were in the office for me, their arrival was not known until a week later, when by couriers they were distributed as rapidly as possible, reaching Lieut. Suplee and myself about October 22, but Lieut. Gurovits not until he had finished his work. The chains and pins in some way miscarried and were found by me at Fort Defiance on November 7. The stadia rods are strips of lumber 15 feet long and could not have been carried on pack mules even had I known of their being at Fort Wingate when we left.

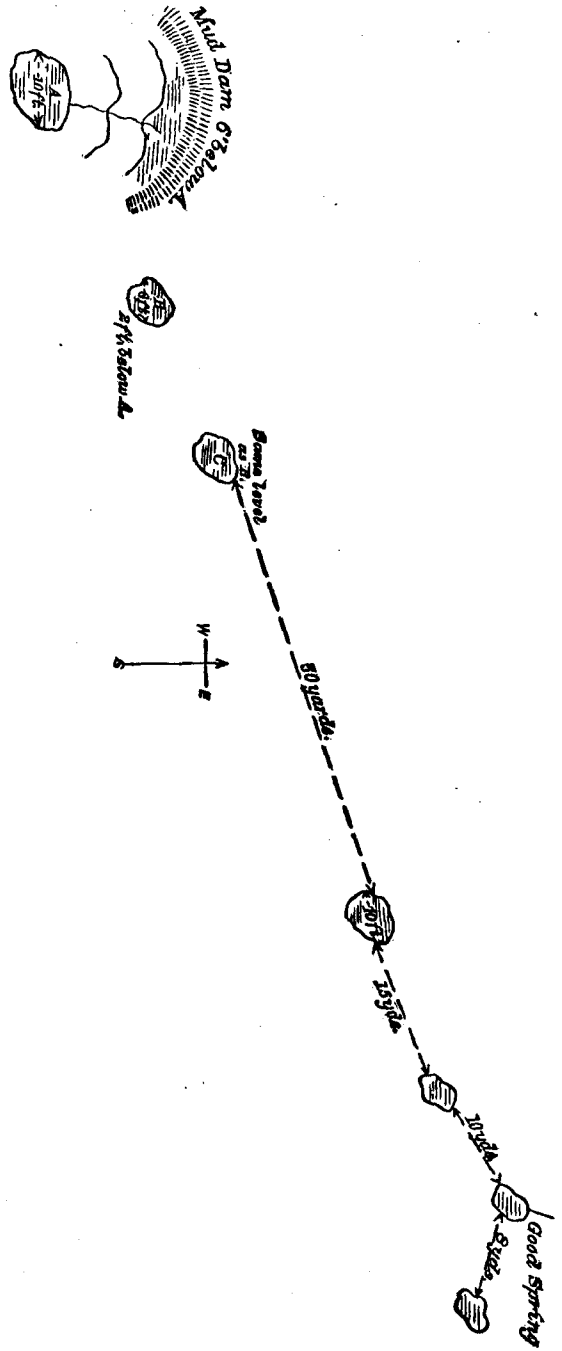
Learning that the agent contemplated a visit to the camp of Manuelito, chief of the Navajoes, on September 28, I accompanied him. Here I found the largest collection of Indian farms seen on the trip, the camp and farms extending over an area about a mile long by about one-fourth of a mile wide, with about ten to forty families, according to season. The water for domestic purposes was obtained from holes 3 to 4 feet deep in the sandy bed of a "wash." At this depth there is a stiff clay subsoil perfectly impervious to water. The method of irrigation here as in many other parts of the reservation, I found to be to flood the surface during the season when the snows are melting on the mountains, and water in streams and "washes" is plenty, holding it on the surface by means of small dams about 12 inches high, at a distance apart from 15 to 50 yards, depending on the natural slope of the ground. The water soaks through only as far as the clay subsoil, and one irrigation is found sufficient to raise a crop of corn. This is a place of importance and an artesian or bore well should be located here.

Manuelito was informed of the object of our visit, and with him I visited Heavymans Springs, where the herds were watered, some 5 miles to the west. Here was found an excellent opportunity of instructing the chief, and through him the Indians of his camp, in the proper method of developing these springs and storing the water from them. By a few minutes' work with the shovel the flow of two of the springs was materially increased under his own eyes, and he was shown how, by the labor of ten men for a day, a dam could be constructed holding a considerable volume of water and which would give the herds watering there relatively pure water instead of the muddy, polluted stuff which the large number of sheep, goats, and ponies watering here were drinking. The desirability of this he frankly admitted, saying that "goats would drink only pure water," but on the principle that "everybody's business is nobody's business," doubted whether his young men would do the work, but promised to talk to them about it. Seeing him some six weeks later, I questioned him in regard to the matter, but found, as I had suspected, that nothing had been done.

The condition of these springs is about the same as many others. Neglected partly because the Indians do not know how, but chiefly because they are too lazy and shiftless to care for them. While thus neglecting to care for what he has, Manuelito asks that the reservation be enlarged, which I do not think at all necessary. These springs lie in the bed of an extensive "wash," and as any improvements made would annually be wasted away by the floods, no work here is recommended other than to thoroughly dig out some half dozen springs which are found here and put in a small dam to hold water for stock. This will require about fifteen days' labor, but will last for the season only, for reasons above stated.

Manuelito's springs at his permanent home were next visited, and here were found

a series of mud springs, as shown in the sketch below. These are evidently very old and permanent springs, as I was informed that many years ago in cleaning them out one of the bones of an animal, evidently a mastodon, was unearthed.



All these should be cleaned out, and the best spring—which even in this dry season was running a little—should be protected by a low stone wall and the water piped into a trough.

Labor required, six days; material, wooden trough and 20 feet of inch pipe.

When this is done it is possible during the irrigation season there will be enough surplus water to irrigate a garden of about an acre of ground.

About 700 yards south of east of Manuelito's house in a shallow gully a water hole (slightly alkaline) is found. It will require but a few hours' work with a shovel to clean this out and thus furnish an additional watering place for stock.

To the southeast of this point is a low sandstone ridge sloping to the north, and from which a number of cañons issue, in each of which more or less water will be found. In three of these the water is alkaline, and on that account no work is recommended, as fresh water can be had in the vicinity. In their order from west to east these springs are numbered on the general map.

(4) Tom Terlino's place.—Tom is a Carlisle graduate; has a stone house, and will act as interpreter and guide for anyone working in this vicinity; has a small fresh-water spring near his cabin.

(5) Alkali.—Quite a strong flow, but no work recommended.

(6) Camp of October 1.—The location of this spring may be identified from the north by the black streaks caused by water flowing over the light-colored sandstone cliffs. This water is fresh and cold; tastes slightly of iron, and although at this season the flow would not fill a pipe larger than an ordinary lead pencil, the indications are that it could be considerably increased. The water here seeps out from between two certain strata of rock.

Work recommended: Clean out spring thoroughly and build a wall across cañon to keep out stock; then run an inch pipe 20 yards north to a trough which should be about 1 foot deep and rest on the ground. Labor required, two days' work.

A few hundred yards west of this, in a tributary cañon, is a water hole which by a few hours labor might be developed into a small spring.

(7) Alkali Creek—No work recommended.

(8) Fresh water spring, very small, but running water. One day's work will be sufficient to clean out this and put it in order. Put in water trough.

(9) Alkali Creek—Considerable flow of water, but no work.

(10) TOGKAY SPRINGS.

These are a collection of mud springs, which cover about an acre of ground, and are quite alkaline. The mud in these springs boils up, flows over and dries, forming a mound a foot or more above the general surface.

This is a place of some importance, and at one time there was an Indian store here. A bore well is recommended here deep enough to strike fresh water.

The Indians say that there is no water between this point and the eastern boundary of the reservation, and a bore well at or near (11) is accordingly recommended, bore wells to be worked by windmills, or better, artesian wells, if found to be feasible, should be constructed at (13) and (14).

At several points on the main road leading to the north belts of green sage were noticed extending east and west. At these places water is doubtless near the surface, and at least one of them about (15) a bore or artesian well should be located.

At our camp of October 2 (see Powell map) the water was obtained from two large water holes about 10 feet in diameter and 4 feet deep, dug by the Navajoes in the dry creek bed for use of their stock. A well, walled with rock, was also found here, but sand had drifted in, half filling it. No work is recommended here, but a bore or artesian well might to advantage be placed a mile or two below where the Indian farms are located. Here, too, if the ditcher mentioned below is provided, much assistance might be given the Indians by cutting a good irrigating ditch to make use of the water coming from the mountains in the spring and early summer.

At (16), (17), and (18) will be found alkaline springs which will suffice for water for stock as well as for domestic purposes.

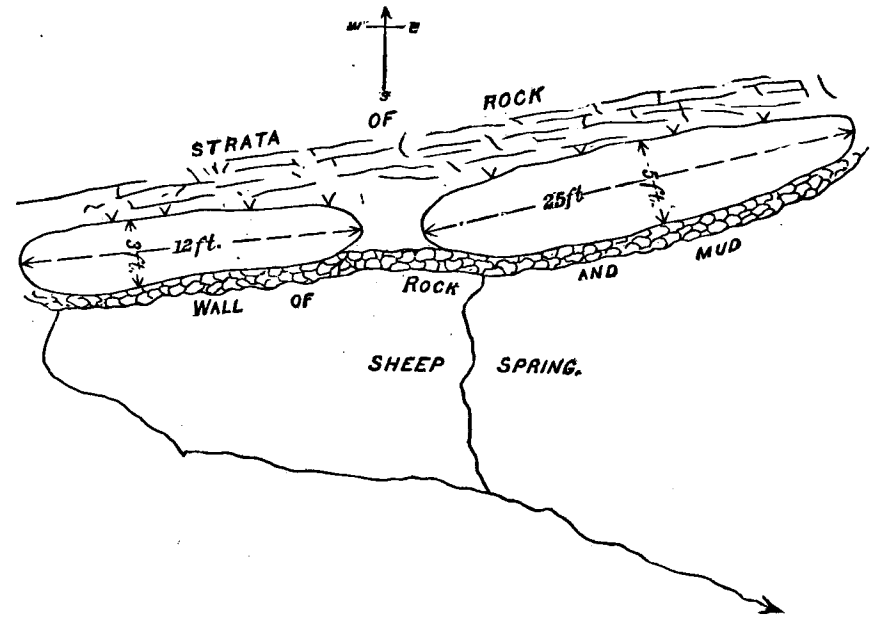
At (16) is a good adobe Navajo house, about 500 yards above which, and a little removed from the "wash" of the creek, are two water holes. A man can clean these out thoroughly in one day; a water-trough should be provided for use of stock. Good corn is raised about 2 miles below here on this creek or "wash," and here again facilities are offered for irrigation.

Half a mile further north (17) is a very small alkali creek, on the south bank of which, and one-third of a mile up the cañon, is a small, somewhat alkaline spring. A day's labor will be sufficient to dig this out which will probably increase the flow sufficiently to water 500 head of sheep. The water in the creek is muddy.

One-half a mile further north, on the north side of a hill, is another spring, very alkaline. This should be cleaned out, but a water trough is not recommended.

SHEEP SPRING.

This is a well-known spring and camping place. The Navajoes have built several stone and adobe houses here and made two small reservoirs to hold the water. They can be deepened and improved, and a low wall of rock and mud on the lower side will make a reservor large enough for all probable needs. Labor required: One man, four days.



Two bore or artesian wells should be put in at the locations marked on the general map between Sheep and Sulphur springs. This latter is also a well-known camping place and was once the location of the Chaco Indian trading store, the building of which still stands. The spring, quite strongly impregnated with sulphur, flows at the rate of about 5 ounces per second. It would be well here to put up a 2-foot wall, which would require the labor of one man for three days. If the wall is well built and proper means taken for carrying off the surplus water, a trough will not be needed. There is sufficient water here to irrigate a few acres in the valley below, but somehow it has not been utilized, probably because there is no wood to be had nearer than the mountains.

About a mile northwest of Sulphur Springs are two other fine sulphur springs noted on Powell's map. A few hours' work would be sufficient to clean out the one to the west and made a drinking place for stock.

The other spring or springs—for there are several of them—have a much greater flow; enough to irrigate several acres of ground were the Indians disposed to take advantage of it. Scarcity of wood is probably the reason why they do not do so.

The Chaco River was found to be dry, but there is plenty of water to be found in the bed, at a depth of from 3 to 5 feet, and occasionally it appears at the surface.

The river bed is from 20 to 200 yards wide, while the valley itself is in places a mile wide. The latter contains so much fertile land that it is thought that soundings might to advantage be made to determine the practicability of irrigation here by means of submerged dams.

At (20) along the east side of the Hog Back is another very fair sulphur spring, which, however, needs no attention, as the Navajoes have themselves constructed the necessary reservoir.

Powell's map here is in error, as the Chaco River is not more than 500 yards from the spring, and not several miles, as the map indicates.

Search was made for the water-holes in Bad Lands near 19, but they could not be found, though I did find several fine veins of coal in that locality. While I did not visit the extreme eastern part of the reservation, inquiry developed the fact

that the region is without water, and if a boring apparatus is sent up anywhere near this section of the country, it would seem advisable to bore wells at or near the points marked 21 and 22 on the general map.

On arriving at the San Juan River, where, as a matter of course, there is an abundance of water for stock, attention was directed to the matter of irrigation.

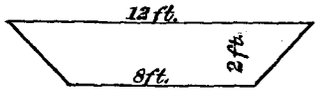
The advantages of ditches along the river are: (1) A permanent and abundant water supply. (2) The whites and Indians, in the section which I visited at least, are on quite amicable terms, and with the example constantly before them of the fine farms and orchards owned by the whites across the river, they are likely to advance more rapidly in agricultural pursuits than if left to themselves.

Here I secured the services of Mr. F. J. Coolidge, civil engineer, of Olio, N. Mex., one of the owners of the Coolidge ditch constructed on the opposite side of the river at a cost of $75,000. I learned that before this section was taken for an addition to the Indian reservation, the white settlers had constructed what is known as the old Virdin ditch. Locating a good heading about half a mile below the mouth of the Animas River, Mr. Coolidge ran the levels for me for a ditch which I have designated as the Francis ditch, which in its upper part coincides very nearly with the course of the Virdin ditch, only that it is much longer and covers a greater area.

THE FRANCIS DITCH.

This ditch was surveyed under my direction by Mr. Coolidge. As he has at hand a complete plant for constructing ditches, I requested him to make notes as we went along in order to be able to make a proposal for the construction of the ditch.

The length of this ditch is 56,628 feet and the grade assumed as 4 feet to the mile;



area irrigated, 2,317 acres. For a ditch of this cross section, 44,105 cubic yards of earth would have to be removed at a cost of—

10 cents per cubic yard	$4,410.50
Boulder work, 4,800 cubic yards, at 50 cents per yard	2,400.00
Gravel work, 1,120 cubic yards, at 50 cents per yard	560.00
	7,370.50
Flumes, head gate, etc	730.00
Total cost	8,100.50

The grade of this ditch will keep it well up on the side hills along the lower part, and later it may be found best to extend the ditch about a mile farther at a cost of perhaps $2,000, irrigating about 680 acres of mostly fine mesa land just below Fruitland post-office (Burnham), on the south bank of the San Juan

In order to get the water from the San Juan out onto the land where wanted, it was found necessary to go about 3¼ miles above (east) of the reservation line, and if the ditch is constructed it will be necessary for the Government to either condemn so much land as necessary to run the ditch here, or add to the reservation a triangular piece of land bounded on the south by an east and west line from the mouth of the Animas River west to the present eastern boundary of the reservation, and to include all land between this land and the San Juan River. The only improvements in this section are two small ranches.

Sandival's farm on the San Juan was next visited, and here was found an amount of work spent in the digging of ditches and building of fences which shows that these Indians are making earnest efforts to become successful farmers, and they certainly deserve encouragement. I find, however, that the Indian almost invariably makes a poor ditch heading, on which the efficiency and permanency of a ditch largely depends. Then, too, in order to handle only a minimum amount of earth, the cross section of his ditch is usually shaped thus:

and in consequence is constantly caving in, and annually requires a much greater expenditure of time and labor to put it in order than if the cross section were originally of the approved form, thus:

The Francis ditch will irrigate about 2,317 acres, and the cost as estimated by Mr. Coolidge will be about $8,100; in fact, he stands ready to put in the ditch for that amount, and can complete it, if desired, in about sixty days from the time the contract is awarded. Mr. Coolidge is a large property-owner in the immediate vicinity. I have every reason to believe that he would put in only good work and confidently recommend him when contracts are awarded.

The Sandival ditch will irrigate 760 acres on the south bank of the San Juan River. From the lower end of this ditch a line was surveyed directly across the river and valley, a distance of 1 mile, with a view to carrying the surplus water (and the ditch can easily be made large enough that there will be a surplus) by means of an inverted siphon (6-inch pipe) and irrigating about 640 acres of land on the north bank.

In the survey of these ditches, the construction of which is recommended, I am under many obligations to Messrs. F. J Coolidge, civil engineer, and J. E. Francis, the farmer employed here by the Interior Department, who I found most active and earnest in his efforts to assist the Indians in farming.

Leaving the San Juan for the mountains, I found at the point marked 23 on the general map, 4¼ miles northeast of the "Needle," a mud spring, which, from its location in the center of good grazing land, should be improved by being cleaned out and walled up for about 18 inches, on top of which should be put a wire fence to keep out stock. At least two water troughs will be needed. Work required, twelve days.

At our camp of October 14, 2½ miles west of the "Needle," is a small mud spring which should be cleaned out, walled up, and water-piped a distance of about 50 feet to a water trough. About six days' labor will be required.

A mile north of here, at the extreme western point of a rocky ledge running west from the "Needle," is another small mud spring which two days labor would put in proper condition by cleaning out, walling up and digging a small reservoir or putting in a small trough and covering the spring with large flat rocks or logs.

Another small spring of good water was found in a little cañon near 24. The water here comes from seepage through the sand rock. Two days' labor will be required to cut out a couple of small reservoirs for domestic use; the overflow to be caught in water troughs below.

A careful search will probably result in other small springs being found near here in the low sandstone ridge which trends north and south. A few miles west of here, at 25, a water hole was found in the dry bed of a stream. Drive wells could be located to advantage anywhere along here.

Springs were also found to the southwest, at the base of a landmark which I called "Mitten Rock" (26), from its resemblance to that article.

At our camp of October 15, water was obtained from a natural tank or basin in the sand rock. There is no spring here—simply water from the rains, caught in a basin in a "wash." The basin could easily be made to hold double what it does now by building a little rock and cement dam, 3 feet long by 18 inches high.

One day's labor will be required to put a mud spring at 27 in condition to make it a small watering place, while a bore or artesian well might to advantage be located at 28.

From this time on springs were found in abundance, and no special work is recommended other than that which may be done under the supervision of the farmers employed by the Interior Department to assist the Indians in farming.

East of the Lukachukai Mountains, in Black Horse's district, was found a running stream, along which were a number of Indian farms. Their ditch headings were very poor ones. but the indications are that there is an abundance of water during the irrigating season. The Indian name of this stream and valley signifies "Standing Red Rock" from a red sandstone butte in the middle of the valley, surmounted by a rock, which, in appearance, resembles a kettle. The headings of the Indian ditches are very poor ones, but about half a mile east of the rock above described there is a 20-foot fall in the stream, 20 yards above which is an excellent place for cutting a heading for a ditch which I have named Standing Red Rock ditch.

This ditch will irrigate about 2,645 acres of good land. Its heading as seen by the accompanying drawing is cut out of the solid red sandstone rock.

A cement dam less than 2 feet in height and about 25 feet in length will turn all

of the water of the creek, or so much as may be necessary, into the ditch, the surplus going over the top of the dam.

For the first thousand feet any grade can be given from the ordinary grade of .15 feet to 200 feet up to 5 feet for the thousand feet. In case the easier grade is assumed a great part of the ditch will run through the sand overlying the rock. This, however, is not recommended. To avoid danger from "wash-outs," and to secure permanency, it is recommended that the first thousand feet be cut in the red sandstone rock, giving considerable fall (say 4 feet to the ditch in this distance). The rock is soft enough, so that it can be worked with the pick. Blasting, however, would be more expeditious. The heading of the ditch is marked by lines cut in the red sandstone rock and stakes from 0 to 35 are driven every 200 feet. Beyond No. 35 the distance was obtained by pacing. The profile on same sheet as map of the ditch gives the amount of rock cutting that must be done even if only a .15 feet to 200 feet grade is given to the ditch. A steeper grade will necessitate correspondingly more rock work. The dam, though a small one, should be well built and run back into the sagebrush bank, which end should also be protected by rock and brush to prevent the possibility of the water washing around the west end of the dam. The only flume required is one of 25 feet shown on the map.

In connection with the construction of ditches I would earnestly recommend that a "New Era Grader and Ditcher" be purchased for use on this reservation, as the conditions here are particularly favorable for the use of an earth-moving machine of this kind. With the exception of the ditches on the San Juan River and that at the agency, they are mostly surface ditches almost from their very headings, and in making this recommendation regard is had, not simply to constructing the ditches already located, but there will be found an abundance of opportunity for constructing from the many little streams and "washes" issuing from the mountains additional ditches to irrigate tracts of from 20 to 500 acres of land each. As the Navajoes depend so largely for support on their herds, which require large tracts of grazing land, it will be seen that 1,000 acres under irrigation, in say ten different tracts, will be of far more use to them than where it happens to be in one solid body; hence the advantage to be derived from small ditches should not be overlooked. The manufacturers of this machine advertise that it will cut a ditch 8 feet wide at the top, 2 feet wide at the bottom, and 24 to 28 inches deep, at the rate of three-quarters of a mile a day. This is approximately the size of most of the ditches surveyed, and as the force required to run the ditcher is 3 men and 12 horses it will be seen that this machine would more than pay for itself in the construction of ditches regularly located, not to mention the cutting of laterals and many smaller ditches.

An area of nearly 2 square miles was found north of Luk-a-chukai Mountains, and another, about 1,000 acres, east of that mountain, both of which could doubtless be irrigated without great difficulty. The greater part of the expense would be for flumes across the numerous arroyas. Besides these there are numerous small areas on which the Navajoes have already started small farms, which by small ditches can be made quite productive. This valley (Standing Red Rock) is the district which Black Horse controls, and is one of the finest seen on the entire trip. Not a wagon or plow, however, was seen in the entire valley. There is but little encouragement for the Indians to engage in agricultural pursuits where all material must be packed on the backs of ponies; where all the plowing must be done with the hoe, and ditches constructed entirely with spade and shovel.

We next went east of Beautiful Mountain, where a survey was made of what I have designated as Tsa-a-no'-sti Ditch.

This ditch is a type of a number of inexpensive ditches which it is believed can be dug in the valleys adjoining streams or "washes" which come from the main range of mountains.

The heading of this ditch is almost identical with that of an old Indian ditch dug many years ago, but abandoned, evidently on account of a large arroya which some cloud-burst made between stations 12 and 13. This can be easily flumed and those below filled and the ditch embankment on the lower side at these places made considerably higher and thicker so that during heavy rains the water in the arroya will be run into the ditch.

As an aid to finding the heading of the ditch, it may be found at about the entrance to the canyon where the stream comes out of the mountains. On the north bank of the creek, about 20 feet from the ditch head, the tip of Mount Bennett can just be seen above the grass-covered hills, magnetic bearing 5° south of east.

Beyond Station 30, the line, if kept at its ordinary grade, .15 feet to 200 feet, would run up along some low hills. To avoid the expense of hillside work, therefore, the ditch should be run along their base. It is quite possible that the natural fall of the ground from 30 to "A," will be found so great that an arroya would be created by the rush of water through the ditch. This may be obviated by running the line in a "zigzag" between these points, making the distance greater and the

grade correspondingly less. Beyond "A" the ditch may be continued indefinitely as long as the supply of water will hold out.

On the south side of this stream a similar ditch may be taken out to irrigate about 600 acres of land. The heading should be just above an old Aztec ruin and about a mile below that of Tsa-a-no'-sti Ditch. This ditch would be somewhat more expensive—the deepest cut, 13 feet 3 inches, being near the bank of the creek and running off to "grade" at a distance of about 2,000 feet.

About 3 or 4 miles south of Tsa-a-no'-sti Creek is another one, parallel to it, and on which are a number of Indian farms. An inspection showed that while ditches could doubtless be constructed here to advantage, the cost per acre would be greater than at Tsa-a-no'-sti.

From Tsa-a-no'-sti the Tunitcha mountains were crossed to the Indian store at Tse-a-lee. Though snow set in by the time we reached the summit, rendering it somewhat difficult to accurately note the water supply in this section, enough could be seen to render it certain that there was an abundance of water for all the stock which would ever graze in these timbered mountains.

About Tse-a-lee is an open timbered country with an abundance of water, and a number of tracts of from 5 to 20 acres which a little labor in the way of ditching would transform into excellent farms.

TSE-A-LEE DITCH.

The principal body of farming land, however, lies immediately northwest of the store and can be irrigated by the construction of the Tse-a-lee ditch. This ditch will irrigate 350 acres and will require two dams at the heading. (1) A low dam of earth and logs, of which there is an abundance on the bank of the stream (see "A" on map and drawing of section); and (2) a masonry dam 14 feet high, the site of which is shown in the photograph attached to the drawing.

About all that was done here was to demonstrate the practicability of getting water out of the creek by means of these dams, and to pretty accurately measure the length of ditch and estimate the area irrigated. Two lines of levels were run and the natural fall of the creek was found to be about 1 foot in 65, and the fall of the land adjoining nearly as great.

Before the ditch is actually constructed a resurvey is recommended which it is believed will give an easier grade to the ditch and permit lower dams to be built, this with but little extra cutting near the head of the ditch.

The heading of the ditch can easily be found about 1 mile above the Tsa-a-lee store. As seen from the photograph, the creek here bends suddenly to the south and runs through a rocky gorge. A few miles south of Tse-a-lee is a much larger area of fine land where the Government years ago put in a ditch which it is said was never used; why, I am unable to state. This area was also reported upon by Lieut. J. M. Stotsenberg, Sixth Cavalry, who made similar surveys on the reservation some five or six years ago.

WHEATFIELDS DITCH.

The heading and first 1,500 feet of this ditch, are identical with the old ditch above referred to. There is no difficult work whatever on this ditch and all but the first thousand yards can be made with the ditcher. The creek at this point is a permanent stream, and flows even late in the autumn of this dry season at the rate of 2 or 3 cubic feet per second. The indications are that during the irrigation season there will be quite sufficient water for the entire area of 822 acres. If not, there is a basin about a mile to the east which could be turned into a reservoir by constructing a dam of earth and logs about 300 feet long and 20 feet high, which would hold about 10,000,000 of cubic feet of water.

It is not deemed worth while to consider this project, however, until it is demonstrated that the water in the creek is insufficient for purposes of irrigating either the whole, or such a part thereof as may be under cultivation.

Both the Wheatfields and Tse-a-lee areas are in a country to a greater or less extent timbered. At the heading of the ditch the sandy creek bed is about 300 feet in width, and a dam 2 feet high of earth and logs should be constructed. This can easily be done, as there is an abundance of timber in the vicinity.

South of Wheatfields Creek is Whisky Creek, along which the Indians have a number of small farms. A ditch here would irrigate possibly 300 acres and an abundance of water is available.

South of Washington Pass an educated and enterprising Indian named Chee has fenced in about 100 acres which he proposes to irrigate from a mountain stream. He has not, however, inclosed all the land at this place and there is still about 50 acres left, and probably during May and June sufficient water to irrigate it.

Northeast of Baigaichi Mountain Black Creek issues from the mountain and here Black Creek Ditch was surveyed and the area covered found to be 348 acres. Water can here be taken out of and carried away from the stream easier than from any of the other creeks. After irrigating this tract the surplus water should be returned to the main stream as the cañon below renders it impracticable to continue the ditch further. Water, however, can and should be taken out again below to irrigate as much of the several thousand acres available as the supply of water will warrant.

AGENCY DITCH.

The volume of water in Bonita Creek at the agency was found to be 6½ gallons per second and I am told that during the irrigating season there is about double this amount of water. The water supply is permanent and important by reason of its location at the agency where it is thought that all water not needed for domestic purposes and for watering of stock should be used for irrigation purposes.

I understand that one or two dams have been constructed above the agency on this creek and washed away. A dam, however, except a very low one, is not regarded as necessary, and water can quite as well be taken out by a flume at but little above the bed of the creek. The flume at present constructed is built of entirely too light materials, hence it is broken down in places and has never done service. It is possible, however, to repair this and make it carry quite an amount of water. It would be better, however, to have a more substantial flume constructed from lumber which can be obtained at the government sawmill not far distant at $15 per thousand feet.

There are a few acres of fine land just above the agency buildings which would make a fine garden; the water should then be carried half a mile or more below the agency, and used to irrigate as long as the water supply holds out, there being more land available than there is water to irrigate it.

Just over the ridge, east of the agency, a reservoir can be constructed to hold about sixteen and a half millions of cubic feet of water by building a dam 300 feet long by 30 feet in height. This can be filled from a flume 3,000 feet long running along the sidehill above the agency, as shown by the accompanying plans.

It must be admitted, however, that there is some doubt of this soil holding water sufficiently well that the reservoir can be filled from the supply in the creek, and before expense is incurred in building so long a flume and in the construction of a dam it is recommended that the ground be examined by an expert. What was done by me was simply to run the line of levels to determine the practicability of carrying water to the proposed reservoir and to estimate approximately its capacity.

During the irrigation season it is believed that the creek carries sufficient water to irrigate about 173 acres.

About 3 miles south of Fort Defiance at Black Moustache's cabin is a fine spring in a cañon difficult of access for stock. It might be well to build a 2-foot dam here, just below the natural rock bridge, and by means of about 150 feet of two-inch pipe carry the water out on the bank into a ditch where the soil is not so porous. Water would then be convenient for stock and the surplus could be used for irrigation. Two days' labor will be required here. Four miles southeast of this latter place is another small spring almost choked up by the drifting sand; a day's labor in cleaning out and putting in a water trough will be sufficient here.

In Gaudy's Valley, near the southern boundary of the reservation, there are several houses and a number of farms; but the Indians, for lack of water, are unable to live there in the dry season. A bore or artesian well is much needed.

In general terms it may be said that the mountain range, extending for 70 miles north and south through the reservation, constitutes in itself a vast reservoir, as the winter's snows melt and run down the numerous cañons and washes, at almost the very time when water is most needed for purposes of irrigation.

If whites were in possession of this country the greater portion of this water would be utilized. As it is now, however, the water runs from the mountains to the San Juan, and from the San Juan to the sea, and is of benefit to no one, while by a little expenditure of money and labor it might be diverted to the soil. The ditches, it will be seen, are most of them quite inexpensive, and would almost pay for themselves, even if the water were only used to improve the grazing. Their cross sections should be sufficiently large to carry an abundance of water during the season of freshets. If the land receives but one thorough soaking during May, it is of great help, and in some soils sufficient to raise a crop. The soil is generally sandy, but, so far as could be ascertained, quite fertile, and along the San Juan well adapted to fruit-raising. I give it as my fixed opinion, however, that it will be throwing money away to construct these ditches unless the necessary wagons, plows, and other agricultural implements are furnished, together with a sufficient number of active practical farmers familiar with irrigation, to assist and instruct these Indians in correct methods of farming.

If the ditches which have been located are constructed, not less than five good farmers will be required in the part of the reservation examined by me. These should be located about as follows: Two along the San Juan River, one above and one below Hog Back; one in Standing Rock Valley; one in Tsa-a-no'-sti, and take charge of all the farms to the south on the eastern slope of the mountains. One to have charge of farms at Tse-a-lee, Wheatfields, and all on the western slope of the mountains down to the immediate vicinity of the agency.

In addition to their other duties these farmers should have general charge of the springs and wells in or adjacent to their respective districts, under supervision of the head farmer at the agency. The oiling apparatus on the windmills will require attention about once each week.

Along the Chaco River where water is obtainable at only a few feet below the surface a few drive wells and hand pumps could be used to advantage.

Under the conditions as we find them here no wells except artesian wells can be expected to give entire satisfaction, and it is recommended that the country be examined by an expert with view to locating artesian wells where the indications are that flowing water can be obtained at no great depth; otherwise bore wells, with windmills to pump the water, must be substituted.

At least ten wells are needed in the district which I examined, and these should be artesian wells as far as practicable. Where this cannot be done bore wells with windmills must suffice. The cost of a bore well as given me by Mr. C. S. McIntyre, of Gallup, N. Mex., a man of much experience in such work, is about as follows for a 300-foot well:

Boring 300 feet, at $2 per foot	$600
300 feet 4-inch casing, at 65 cents per foot	195
300 feet 2-inch pipe, at 18 cents per foot	54
100 barrel iron tank	150
Windmill	125
Brass barrel or valve	5
Steel derrick	100
Sucker rods, 10 cents per foot	30
Total	1,259

Time required for boring, 30 days; time required for putting up windmill, &c., two weeks.

To this should of course be added cost of transportation and other incidental expenses. Three hundred feet is believed to be greater rather than less the average depth.

An aggregate of about 60 days' labor will be required on the springs. Indian labor can be obtained at from $1 to $1.50 per day, the Indians boarding themselves. In making all estimates the distance from the railroad should be taken into account, and it should be remembered that all supplies and forage must be hauled from thence in wagons.

In verifying the levels of the ditches already located, after they are dug, and before the water is turned on, which should be done to insure an even flow, a level and leveling rod should be supplied at the agency to be sent for use where needed. A Gurley farmer's or drainage level, with tripod and leveling screws (price $25), and a New York rod in four parts, which, when closed, is but 5 feet in length (price $20), will, it is believed, fulfill all requirements.

A couple of hand levels, which cost but about $8 each, will also be found most useful in making examination of ground with view to locating small ditches and laterals.

I cannot close without acknowledgment of the efficient work rendered by my assistants, Lieuts. Odon Gurovits, Eleventh Infantry, and E. M. Suplee, Second Cavalry, whose reports are forwarded herewith.

Very respectfully, your obedient servant,

H. C. BROWN,
First Lieutenant, First Cavalry,
In charge of surveys on Navajo Indian Reservation.

The ASSISTANT ADJUTANT-GENERAL,
Department of Arizona, Los Angeles, Cal.

Tabular statement of irrigating ditches located on Navajo Indian Reservation, by Lieut. W. C. Brown, First Cavalry.

Name.	Length.	Grade per mile.	Area irrigated.	Size of ditch, dimensions in feet. Top.	Bottom.	Depth.	Location of head.
	Feet.		*Acres.*				
Francis	56,628	4 feet to the mile.	2,317	8	6	2	Near head of Old Virdin ditch and one-third mile below mouth of Animas River.
Sandival	31,218	3.2 feet to the mile.	*962 †640	8	6	2	About 1¼ miles above heading Sandival's Indian Ditch.
Standing Red Rock	9,713	1 foot in 1,000.	2,645	‡3 §8	3 5	1½ 2	About 20 yards above falls which are 20 feet high, 4½ miles east of pot-shaped rock on red sandstone butte in center of valley.
Tsa-a-no-sti	20,583	15 feet to 200 feet, or 47.52 inches per mile.	1,100	8	5	2	Four miles above village, nearly identical with old Indian ditch on north bank; 300 yards above old cottonwood tree on bank 20 feet above head; the top of Bennett appears just over grass-covered slopes; entrance to cañon.
Tse-a-lee	16,500	About 15 feet to the mile.	350	6	3	1½	One mile above old store where creek turns south and runs through narrow rocky gorge (see photo).
Wheatfields Creek	13,047	.15 feet to 200 feet.	822	7	4	2	Identical with old Government ditch.
Black Creek	7,000	.15 feet to 200 feet.	348	6	3	1½	On north side and between new log house and tall finger of red sandstone detached from mesa.
Agency	10,000	.15 feet to 200 feet, or 47.52 inches per mile.	‖173	¶1 §3	1 2	1 1	Identical with present ditch or flume.

* South bank. † North bank. ‡ In rock. § In soil.
‖ Without the reservoir; with the reservoir, 811. ¶ Flume.

FORT WINGATE, N. MEX.,
November 17, 1892.

(Through First Lieutenant W. C. Brown, First Cavalry, the officer in charge):

SIR: I have the honor to transmit herewith report and maps of survey made in obedience to paragraph 4, Special Orders 115, Headquarters Department Arizona, September 15, 1892.

I was ordered September 16, by Field Orders No. 3, in camp near Flagstaff, Ariz., to proceed to Fort Wingate Barracks, Ariz., and thence to Fort Wingate, N. Mex., where I was to receive further instructions.

Arriving there September 20, I received, after the arrival of First Lieut. W. C. Brown, First Cavalry, September 21, detailed instructions to make a survey of the district assigned me, with a view to increase the supply of water for the stock of the Navajoes and, if the supply of water is sufficient, to irrigate arable land.

The field work to be completed by November 10, which date was designated as the date of return to Fort Wingate, where the reports were to be completed.

The district assigned me consisted of the northwestern portion of the reservation, including the part of the Chinlee Valley, the western slopes of the Luckachukai and Carriso Mountains, thence as far west as the boundary of the reservation. The San Juan to be divided between a party east of the Carriso Mountains and my party.

The area assigned to me consists of about 7,800 square miles and the 12,821 square miles constituting the entire reservation. To commence work I had to proceed north about 75 miles, and to return from west to east about 200 miles more. Total distance covered during the forty-six days in the field, about 1,061 miles.

Considering the object of the survey, the large area assigned to me, and the limited time, I concluded to adopt the method of "Hasty survey on horseback."

The "transit level, chain, and rod" were left by me at Fort Defiance. This method here is rough country allowing but about 8 square miles survey per day.

The clinometer and pedometer reached me in camp at Red Lake October 31, the day I finished my work. An "interpreter and guide," hired by the Interior Department, reported November 1, the day before I commenced to return to Fort Wingate. He was hired from the 19th October until returning with my discharge, at $2.50 per day.

Considerable trouble was caused by rumors spread by some one that the object of my and other parties was to take children away by main force and put them to school at Fort Defiance. Another rumor is spread by "white settlers" in the western part that I was to locate water with a view to allot springs to white settlers.

Many springs must have been covered up by "sandstones," and no doubt with the good will of the "older Navajoes" new springs could be located."

My recommendations are to locate and bore for wells at places where water would allow for existing grazing.

Around every spring for about 8 miles no water, but grass, is needed.

After reaching that point grass is sometimes abundant for miles.

Certain indications point to water at the places marked at from 150 to 500 feet deep. I also respectfully state that next season water and grass will be needed for about one-fifth more, having counted approximately the herds and flocks encountered while traversing my district. Furthermore, any work to be done ought to be given only to persons who are acquainted with the ground and conditions.

The work could and ought to be commenced at once.

Troughs are needed with every spring. There is a waste of water, and horses and sheep trample mud in the springs and prevent the full amount to come to the surface.

The distances and camps appear on maps and in itinerary.

Very respectfully, your obedient servant,

ODON GUROVITS,
Second Lieutenant, Eleventh Infantry.

The ASSISTANT ADJUTANT-GENERAL.
Department of Arizona, Los Angeles, Cal.

ITINERARY.

In obedience to orders received, I proceed from Fort Wingate, N. Mex., to make a survey of part of the Navajo Reservation. The commanding officer at Fort Wingate furnished everything called for by me, viz: One noncommissioned officer and three privates of Troop H, Second Cavalry; four privates of Troop L, the latter being Indians; a civilian packer with the pack train of H Troop, Second Cavalry (12 mules), was also detailed for duty wirh the detachment.

Camp
September 25. □ 1.
I left Fort Wingate, N. Mex., and arrived at Rock Springs at 4:30 p. m. 21 miles.

Camp
September 26. □ 2.
Breaking camp at 8 a. m., I marched to Fort Defiance, arriving there at 2 p. m. I endeavored to get information at the Indian Agency about certain springs and creeks, but failed. I was told there that it was impossible, on account of lack of water, to traverse the district assigned to me from east to west as I intended. 17 miles.

Camp
September 27. □ 3.
Broke camp at 6:30 a. m.; reached camp at Chin Lee's store at 6 p. m. 45 miles.

Camp
September 28. □ 3.
Remained in camp.

Camp
September 29. □ 4.
Broke camp at 7 a. m.; marched through Cañon Del Muerto to Tsee-a-lee Creek, arriving there at 3:45 p. m. Throughout Cañon del Muerto water and also grazing. To reach the trail leading to Tsee-a-lee store, one steep trail to ascend. Pack animals have some difficulty at a few bad places to follow the trail. Camp good; water and grazing. Forage can be bought at the store. 31 miles.

Camp
September 30. □ 4.
Detachment remained in camp. Left at 8 a. m. alone to ascertain certain places to be marked on Powell's map. 19 miles.

Camp
October 1. □ 4. 1-2-3-4, 6-7-8-9-10-11.
Detachment remained in camp. Left camp with one Indian trooper at 7 a. m. Followed Tsee-a-lee Creek northeast for about 9 miles. Located four springs on the north bank and five springs on the south bank of Tsee-a-lee Creek. The immediate surroundings being rock formation, these springs can not be used for purposes

of irrigation to advantage. Tsee-a-lee Creek runs in a shallow bed, the bottom partly gravel and partly sand. Indications point to considerable amount of water flowing at certain seasons of the year in this creek. Turning almost north at about 9 miles from the store, I ascended a steep slope on reaching the top of the Tunitcha Mountains. I found plenty of grazing and water. Returned to camp by following western slopes of the above mountains. 36 miles.

Camp
October 2. ▭ 5.
Broke camp at 7 a. m., and marched with detachment, following the western slopes of Tunitcha and Lukachukai mountains. Reached camp at 12:45 p. m. at Charles Mitchell. 21 miles.

Camp
October 3. ▭ 5.
Left camp at 7 a. m. alone. Followed bed of Carrizo Creek. Reached Chee's store at 9 a. m. Found good water at that place and Lieutenant Suplee's party camped there. Concluded to change my camp to Chee's store, where I expected forage. While returning to camp at Charles Mitchell's, I examined the western slopes of Lukachukai Mountains. 16 miles.

Camp
October 4. ▭ 6.
Broke camp at 7:30 a. m. Marched to Chee's store, where I remained that day. Camp good; forage can be bought, water and grazing. 8 miles.

Camp
October 5. ▭ 7. 12—T—13—"A".
Broke camp at 6:30 a. m. Left one noncommissioned officer, two privates, Troop H, and two privates of Troop L, with their horses and five pack mules in camp. The remainder of the detachment, and seven pack mules carrying forage, etc., left with me for the Carrizo Mountains (western slopes). Reached camp at 4:45 p. m. After reaching camp an Indian chief, Blackhorse, and about 25 of his followers came to camp and desired what the object of my appearance was with the soldiers. The only way to communicate with Blackhorse was through an Indian of L Troop, who spoke a little of the English language. Blackhorse delivered a lengthy speech, directed to the Indians who came with him. His manner and gestures seemed to indicate that he was not over friendly toward me and my party. My translator being called upon by me to translate the meaning of the speech of the Indian chief, answered repeatedly, "I do not know." At about 8 o'clock p. m. the interpreter came and stated that the Indian chief would be back that evening to find out who permitted me to pass over Navajo land, and also to get paid for wood, water, and grass used by the men and animals. I then reprimanded my man for not telling me at the time the meaning of Blackhorse's speech, but seemed not to succeed to make him understand. No further trouble occurred. Blackhorse did not return. 38 miles.

Camp
October 6. ▭ 8. 14–15.
Broke camp at 7 a. m, and proceeded to examine the western slopes of the Carrizo Mountains. I tried to make Big Oak Spring as my next camp. I did not succeed and camped at a tank. 38 miles.

Camp
October 7. ▭.
Broke camp at 7 a. m. Marched back to Chee's store. Part of the road heavy sand. 23 miles.

Camp
October 8. ▭ 6. "B"
Left detachment in camp and surveyed Chin Lee Valley, N. Mex., of Chee's store. 32 miles.

Camp
October 9. ▭ 9.
Broke camp at 6:30 a. m., and with detachment marched to San Juan River. I traveled by compass, and 4 p. m. went into camp at the head of Tee-sen-tit Creek. Road very rocky; camp poor; no wood or grass, but plenty of water. 31 miles.

Camp
October 10. ▭ 10.
Broke camp at 7 a. m. Reached the San Juan River, near New Mexico and Arizona Territory boundary line, at 6 p. m. Country very rough, formation almost entirely slate, after reaching the ground north of the Carrizo Mountains. 39 miles.

Camp
October 11. ▭ 11.
Broke camp at 8 a. m., sending pack train on northern bank of San Juan River with instructions to go into camp at Noland's store. About 11 miles I, with one Indian, surveyed grounds on the south side of the San Juan River. 19 miles.

Camp
October 12. ▭ 11.
Remained in camp at Noland's ranch. Sand storm and rain, followed by snow. Rode alone due south of river. 9 miles.

Camp
October 13. ▭ 12.
Left at 7 a. m. to survey ground north of Carrizo Mountains and south of the San Juan River. The pack train traveled on the north side of San Juan River, with orders to go into camp near Gillette's brother's, about 16 miles from previous camp. I reached camp at about 3 a. m. Camp good; forage could be bought at the store. 21 miles.

Camp
October 14. ▭ 13.
Broke camp at 7 a. m. Train ordered to proceed on the north bank of the San Juan. I was compelled at about 10 o'clock to return to the northern bank of the San Juan, there being no trail or way to proceed over south bank or westward. At about 3:30 I went into camp at Bluff City. Camp very good; forage could be bought at reasonable rates. Eight mules and 3 horses were shod at that place. 32 miles.

Camp
October 15. ▭ 15.
Examined ground west. I was convinced that I could not find any more trails leading westwards. Concluded to proceed southwest, carrying grain for six days, to reach Tuba City, whereto I requested rations to be sent to my detachment. 9 miles.

Camp
October 16. ▭ 14.
Broke camp at 6:30 a. m. Found spring and grass about 12 miles from camp. Surveyed vicinity of T-hona-d-le, and was compelled by sandstorm to go into camp at 11:30 a. m. Pack animals refused to advance on account of the storm. 17 miles.

Camp
October 17. ▭ 15. "C" 16.
Broke camp at 7 a. m. Selected camp at a water pool 6 p. m. Pack train did not reach camp until 8:30 p. m. 47 miles.

Camp
October 18. ▭ 16. "C."
Broke camp at 7 a. m. Reached T-hee-an-ta Creek at 11:40 a. m. 19 miles.

Camp
October 19. ▭ 17.
Broke camp at 7 a. m., and through Marsh Pass reached Shan To at 12:45. 34 miles.

Camp
October 20. ▭ 18.
Broke camp at 7 a. m. Marched to Red Lake, arriving there at 3:30 p. m. 33 miles.

Camp
October 21. ▭ 19.
Broke camp at 7 a. m., and reached Tuba City at 1:15 p. m., found rations as expected. 24 miles.

Camp
October 22. ▭ 29.
Remained in camp, bought forage, had animals shod, heavy rain.

Camp
October 23. ▭ 20.
Left camp with part of detachment and pack train, carrying forage for Keam's District. Reached camp at Allen's at 1:30 p. m. After reaching camp, I was annoyed by civilians who desired to make a complaint, and who would not understand that I did not have any authority to investigate into their grievances. 24 miles.

Camp
October 24. ▭ 21 "D."
Broke camp at 7 a. m. Proceeded towards Kai-Peto Springs; reached camp at 4:45 p. m. Best grazing while on march.

Camp
October 25. ▭ 22.
Broke camp at 6:30 a. m., marched towards Navajo Creek; hard trail and slow progress. Reached camp at 4:50 p. m. Pack-train traveled slow, camped in cañon. 31 miles.

Camp
October 26. ▭ 22.
Rain. Left alone at 8 a. m. for Pah-ute Cañon and creek south of it; returned to cañon at 5 p. m. 29 miles.

Camp
October 27. ▭ 23.
Left at camp at 7 a. m., and Shan To, marched towards Tuba City, camped at Pa-Kai-Shee-Bit-To. 23 miles.

Camp
October 28. ▭ 23.
Rain. Left camp alone, surveying towards Kai-Peto Springs, returned at 11 a. m. 15 miles.

October 29. Camp ▭ 18.
Left camp at 7 a. m., marched to Red Lake, where at 6 p. m. I was informed a courier is trying to overtake me. 19 miles.

October 30. Camp ▭ 19.
Broke camp at 7 a. m. and marched to Tuba City. Rain and snow. 24 miles.

October 31. Camp ▭ 19.
Remained in camp. Courier, with pedometer, clinometer, and also hand le reached camp at 11 a. m.

November 1. Camp ▭ 19.
Remained in camp. Rain. An Indian guide and interpreter reported for d hired by the Interior Department.

November 2. Camp ▭ 24.
Broke camp at 6:30 a. m. and marched to Oraibi Village, 41 miles. After arri in camp interpreter informed me of a trouble which occurred in Chee's store.

November 3. Camp ▭ 25.
Broke camp at 6:30 a. m. and marched to Keams Cañon, reaching there at 3 p. one mule sick; 32 miles.

November 4. Camp ▭ 25.
Remained in camp. One horse shod.

November 5. Camp ▭ 26.
Broke camp at 7 a. m.; reached Sheep Springs at noon; 20 miles.

November 6. Camp ▭ 27.
Broke camp at 6:30 a. m. Proceed across the country by compass; found, at 9: a trail and wagon road, indicating a body of cavalry traveling west with pack-tr and army wagons. Reached camp at 1 p. m. It was reported to me by the Ind guide from the agency that the Indian agent had died from wounds received Chee's store. 27 miles.

November 7. Camp ▭ 28.
Left camp at 6:30 a. m., reached camp at Cienega Station at 1:10 p. m. 218 mi

November 8. Camp ▭ 29.
Broke camp at 6:30 a. m., and reached camp at Rock Springs at 11 a. m. U being informed that the Indian agent was at Gallup, I gave instructions to the tachment to follow the next day, and rode to Gallup. 27 miles.

November 9. Camp ▭
Left Gallup after arrival of pack-train; with it, at 9 a. m., reached Fort Wing at 12:30 p. m. 12 miles.
Total distance traveled on horseback, about 1,061 miles.

TUNITCHA MOUNTAINS.

Nine small springs located on Powell's maps, marked and numbered "1 to" These springs at present give from 1 to 3 gallons per minute each. There is arable ground in their vicinity, the ground being rock. They shed into the Ta-A-Lee creek, south of the Tunitcha mountains. Following trail almost due nort which is very rough and steep, one reaches the flat on the top of these mountai I found good grazing; area about six square miles. (Lakes) marked on Powell map are only water holes. Two out of the seven at present are almost dry. I c not account why I found only two sheep herds and about 250 horses on these fla perhaps it is on account of the difficulty to ascend. I do not think it probable th animals can climb the trail on the north side in less time than a day's travel.

There is one spring about halfway down that trail, marked "10," which is trampled into by animals. By digging with branches broken off trees, the flow increased from about 30 quarts per minute to about 16 gallons per minute. This and similar springs ought to be opened up and protected by a covered-up spring-house.

The accompanying map, marked "1," will give an idea of the work recommended to be done. A spring near Kean's Canon, on the Moki reservation, has been similarly protected.

(10) The ground is lime-stone formation and rock. The overflow would quickly be carried into Lukachuki creek as at present.

There is one spring, marked "11," which ought to be protected, and I think that

falling about eight feet deep, with a hand-pump and trough, would be desirable here. Sage bush grows in the vicinity. West Tunitcha creek flows into the Carrizo creek and is well used by farming Navajoes.

Recommend one spring house at "10" and one hand pump and trough at "11." Cost can not be ascertained.

LUKACHUKAI MOUNTAINS.

The western slopes of these mountains are so steep that only the lower portion sheds any water to be considered. The water is carried by various and constantly changing water-courses into the Carrizo Creek. At present there is no water flowing beyond. By digging from 2 to 4 feet in the dry bed of the Carrizo Creek, I found water (plenty) in about ten places. The banks of Tunitcha, Lukachukai, and Carrizo creeks vary from 10 to 50 feet high. Hand pumps and troughs, the pumps to be turned over in working order to the Navajoes, might induce them to cultivate land. I do not think that anything but corn or melons could be raised. It would also increase the number of watering places where sheep could be watered while in transit from one place to another. There are several farms along the banks of the above-named creeks.

Recommend that about 25 hand pumps, in working order, be turned over to Navajoes—they to be their property and troughs also to be furnished; could not ascertain the cost of these pumps.

Water is plenty; no sheep grazing in vicinity, although grazing at some points.

"WESTERN SLOPES OF THE CARRIZO MOUNTAINS."

All water shedding from these mountains west and north is utilized until it reaches sandy soil, and then disappears. The spring marked "Hospitito" at present is almost dry. After digging but few seconds two gallons per minute were measured. Another spring located as number "12" on the map, requires a "spring-house," the outflow is suppressed and mired. Sheep and horses trample into the spring the soil, like heavy mud at present. The tank marked on map of Powell's could not be found, but a place marked on map with "T," was found after following a hardly perceptible trail, for over two miles, over rock without any sign of grass or wood. The water accumulates there in a natural basin of rock formation, contents about 1,000 gallons. There was an overflow which disappears full about fifty feet deep, almost perpendicular. Then within about ninety steps the fall is about 100 feet more. Further to follow course is impassable. Upon examining the surroundings of the natural basin, I found two splits in the rocks whence the basin was fed. With a picket pin I enlarged one of these openings, which resulted in an overflow within ten minutes, to 27 quarts per minute, more than one third of increase. I can state but believe, not being an expert upon the subject of water supply.

Based upon: The surrounding circumstances—(elevation)—The outflow of water at about 14 miles west from the "T" marked place and the same temperature of water at both places, I believe that there is no difficulty to find water by boring.

Considering only that portion of area marked "A" which has at present grass not used. At least 25 square miles could be made available for stock. The springs at the place marked "13" number 5. In addition to this there are two natural basins, similar to the one described before. Contents about 1,200 gallons. There is no trail leading to this water. The name as given to me by a few of the Navajoes, is Hohwass-ha-han. The Navajo soldiers did not know of that water. Navajoes who I met later stated repeatedly that there was no water in that direction, except the salt water of no use in Gothic Wash, and Sahotsoidbeazhe. The water referred to as of no use, is salty, and animals refuse to drink it. There is no vegetation in the vicinity. The taste is more salty than the usual alkali water. A whitish deposit, crystallized, indicates more salt than the usual alkali deposit.

Recommend that one "wind-mill pump" be bored in a place somewhere marked "A."

NEAR CHEE'S STORE.

Saeltiso Spring is at present dry. Two Navajoes live near it. The points marked "14 and 15" are worthy or development. The amount of water flowing there into natural basins, rock bottoms, is about 20 gallons at 14 and 30 gallons at 15 per minute. One and one-half miles of travel without trail is required to reach them. The names given by some Navajoes are: 14, Tsa-tsak-sah-hat-a, and 15, Tsa-tsil-T-so; 15 also known as Big Oak Springs. The area marked "B" is only about two contours above the level of these springs. Everything makes me believe that water will be

found when bored for. There is a pool marked on Powell's map, west of "B," which at present is dry. The grazing inclosed in the remarked area amounts to about square miles. Not used at present.

Recommend that at least one "wind-mill pump" be bored within area marked "B."

PART OF SAN JUAN RIVER.

Commencing at a point west of New Mexico, a wagon road leads to Bluff City north of the San Juan River. The banks on the south side are extremely steep vary from 50 to 300 feet.

Arido Creek, Desert Creek, marked on map, also McElmo Creek, Montezuma Creek, Recapture Creek, Cottonwood Wash, Butler Wash, and Comb's Wash are dry at present.

Only one strip (marked by dotted lines) near Bluff City is recommended to be irrigated. The people of Bluff City (Mormons) built about 9 miles of irrigating ditch on the northern side. They raise corn, wheat, oats, alfalfa, and timothy hay. The soil is alike on both banks at that place. About 3 miles of ditches would give sufficient water to irrigate about 260 acres of land; the ditches to be 5 feet wide at top, 3 feet deep, and 3 feet wide at the bottom. An effort was made by the inhabitants, about thirty-five families, to submit an offer by them to do this work for the amount of $650, to proper authorities, in my report. They are interested in the matter. The work would be finished within one month. They would not demand pay until the work was inspected by any competent official. Furthermore, they are willing to teach Navajos. Judging from the success on their side and, as I think the small amount asked for to do this work, I recommend that it be awarded to the people at Bluff City.

The best spring in my district is at the point marked "16," called by Indians T-hon-nad-la; in English, "Always Flowing;" rate of flow being about 182 gallons per minute. Spring marked "17," To-doh-konch.

Recommend one irrigating ditch about 3 miles long, 5 feet wide at top and 3 deep, and 3 feet wide at bottom. Cost, $650.

Area to be irrigated, over 260 acres.

KEAM'S DISTRICT MARKED "D."

The best grazing of the entire district was found by me. At least one artesian well should be bored at space marked "D." On account of a large area one additional windmill pump is desirable. I traveled from about 8 a. m. until about p. m.; good grazing as far as I could see to the right and left (bunch grass about feet high); no animal life observed during the entire time. A number of bleached skeletons indicate that horses and cattle perished for want of water. I am sure that no sheep herd ever was grazing there for years. One spring marked "15" gives at present 1 gallon of water in thirty minutes. As water can be found everywhere south of Cedar Ridge as far as Tuba City and farther by digging from 6 to 8 feet deep, and considering the elevation of Navajo Creek, Pah-Ute Creek, and Colorado Creek, one is justified to believe that an artesian well will give abundant water, and the entire area inclosed will be used by the Navajos when water is furnished.

I was informed that east of Keam's district towards the Colorado River and Navajo Spring there is a valley known as "Horse Valley." I could find no trail leading to it. The grazing there is to be like the one described in Keam's district marked "D." After water is provided for in the area marked "D" this "Horse Valley" might be made arable.

NAVAJO CREEK, PAH-UTE CREEK, AND KAI-PETO SPRINGS.

Upon leaving Kai-Peto Spring there is good grazing north of White Mesa, marked "E." After reaching Navajo Creek the country east becomes extremely rocky, rock formation all through, south of Pah-Ute Cañon, as far as Shan-To Springs, where the water flows into Marsh Pass. This pass is not known as such. West of Shan-To Springs there is fair grazing, unused towards Kai-Peto Springs.

AGA-THLA NEEDLE.

Upon leaving Chin Lee Valley, the general configuration of the ground is very rough, until the portion is reached marked "C." There plenty of grazing exists, but no water at present. The animals of my pack-train had no hay or grass after leaving Bluff City, and considerable of delay was caused by their efforts to graze on the march. Traversing in a direction of a trail southwest, after leaving 14, no water was found until reaching Camp 15. Almost 20 miles march with grazing on both sides until necessity compelled to make camp, by hunting for which was found in a hole marked 15. I recommend that at least one well bored, worked by windmills.

reach the next water, I had to make T-Heen-An-Ta Creek. This creek is the furnishing all the water used by Navajos residing upon and cultivating T-Heen-a-Mesa. I think that all water available there now is used to good advantage.

WORK RECOMMEMDED TO BE DONE.

spring marked "10" to be protected and a spring house to be built. (See 1.)

spring marked "11" to be covered up, hand pump and trough to be put in

spring at Hospitito to be covered up, trough furnished.

spring marked "12" to be protected and spring house built, trough furnished.

" and 13 convince me that water will be found by boring in area "A," windpump and trough required.

and 15 convince me that water will be found in area "B," windmill pump, and gh required.

out 25 hand pumps in working order, with troughs to be turned over to reliable os, in Chin Lee Valley, and on banks of Lukachiuca and Carrizo Creeks.

igating ditch to be built by the inhabitants of Bluff City, three miles long. San Juan inclosure." Cost $650.

least one windmill pump with trough in the area marked "C."

least one artesian well to be bored, in space marked "D," and one additional mill pump with trough. The grazing is the best I found there. I traveled about 8 a. m. until about 8 miles from Kai-Peto. Bunch grass about 2½ feet , and no sign of animal life discovered. Considering the elevation of Navajo k and also of Colorado, as well as the fact that by digging north of Tuba City re reaching the Navajo line, where Cedar ridge commences, I found good and ty of water at about seven different places, 4 to 8 feet deep, I have no doubt that entire area marked " will be used by Navajos when water is furnished. I told that not one herd ever goes near that grazing at present.

i-Peto spring to be protected by spring house and trough furnished.

ring "15" to be opened up, and hand pump with trough needed,

Hon-A-Dle spring and San Juan sheet convinces me that water will be found at Windmill pump and trough needed.

least one windmill pump and trough in area marked "C."

all these mills are furnished about 150 square miles of grazing will become avail- and which now is never used. One well, certainly, should be bored, and the rict marked "D" should be tried. If successful there I have no doubt that all rs will give water. After the water becomes available there will be an excess ater available for irrigation.

espectfully submitted.

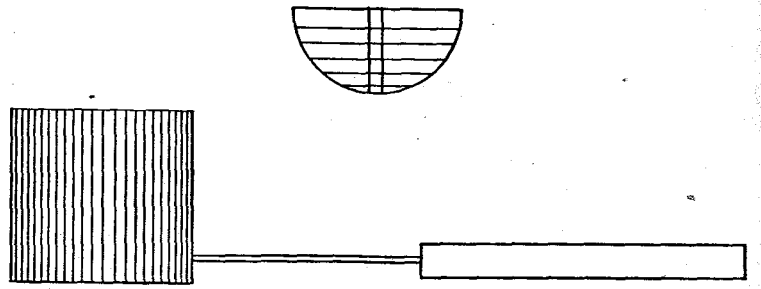
ODON GUROVITS,
Second Lieutenant, Eleventh Infantry.

PORT OF WATER SUPPLY ON A PART OF THE NAVAJO RESERVATION.

n compliance with paragraph 4, Special Orders 115, Headquarters Department of zona, Los Angeles, Cal., I reported to Lieut. W. C. Brown, First Cavalry, at Fort gate, N. Mex., September 24, 1892, and received instructions to investigate and ort upon the water supply of the Chin Lee Valley, and the district south of it to reservation line, or the district included between the southern boundary of the vajo reservation and parallel 36° 30′ and meridian 109° 15′ and 110°. My detachnt, including myself, one sergeant, one packer, four privates, and two Indian uts, with eight horses and ten pack mules, left Fort Wingate at 9 a. m. on the h of September, 1892, and reached camp at Rock Springs at 3.30 p. m. I left next ning at 8 a. m. and reached camp at Fort Defiance at 12.30 p. m.

broke camp at 6.30 the next morning and started towards Chin Lee's store at the th of Cañon De Chelly. At 10 miles northwest of Fort Defiance we watered at

a spring that comes out of a crack in the rocks and falls 3 feet to a flat-topped rock where the Navajos have made a mud wall 6 inches high to catch the drip. There was over forty head of animals watered there at one time, and there was plenty of water left. This spring is on the trail to Chin Lee and to Cañon De Chelly. I would recommend the following work to be done, as this spring is not apparently claimed by any one and there is no water within 3 miles of it. There is plenty of grazing in the vicinity. Sandstone of good quality is to be had on the spot. The Government sawmill is 5 miles distant.



There should be a semicircular wall of stone 4 feet in diameter and 4 feet in height built against the solid rock. It should be covered with a wooden cover. This rock is sandstone, and would have to be squared up by removing a triangular piece from the rock 1 foot wide at the bottom and 4 feet long. The bottom of the spring would rest on stone, and a 1-inch pipe 5 feet long could be placed inside next to trail, and three troughs 1 foot by 1 foot by 12 feet filled. The overflow would, if any, fall directly away from the troughs and cause no trouble. The thickness should be sufficient to stand the pressure of water when full. The trail leads up over the hill, and 15 miles from Defiance is a long valley running north to Monument Cañon. Here is 10 square miles of good grazing, and a hand pump with three troughs should be here. Nothing further being done in this section, I reached Chin Lee store at mouth of Cañon de Chelly at 6:30 p. m.

There I camped the 29th and 30th. Going up Cañon de Chelly, I found many soil banks in corners of the cañon. On a few of these the Navajoes are farming. These banks contain about 2 acres each of rich soil, and the subsoil is so moist that irrigation is not necessary. At 7:20 a. m., October 1, I started down the east side of Chin Lee Valley. There are numerous farms in this valley between the sandy dry creeks, but there are hundreds of acres that can be farmed here without irrigation, if the Indians were compelled to work them. In some places are evidences of small ditches, but the soil rests upon sand through which flows water to the depth of 3 to 5 feet, thus keeping the soil above moist during the entire year. Many farms of 2 acres each are found during the first 10 miles of the march. About noon I came to Sand Cone springs, consisting of three water holes, 5 feet in diameter, 1 foot in depth, in hard sand. They do not overflow and do not go dry, are not muddy, and as there is nothing but poor grazing in the vicinity, I do not think it advisable to expend money there. From this place to within three miles of Chee's store is a stretch of bad land devoid of growth. The last 3 miles is on the top of a mesa on which is grazing. I would state that in all my maps and reports that when I use the word "grazing," I mean an animal by hard work could keep from starving.

There is no grazing like an eastern pasture. We reached Chee's store on Carrizo Creek at 5:30 p. m. and camped in the creek bottom. They have a well there 8 feet deep which supplies about 200 animals per day and never went dry. On referring to the map and sketch it can be seen that the creek narrows and runs through an opening in the mesa. Here a dam could be built on bed rock and the creek would rise to the surface. Although the water thus obtained could not be utilized in irrigation, yet 10,000 animals could water here while grazing on 50 square miles of land. Stone is in abundance on the spot. I did not compute the thickness of the dam, leaving that to experts, but it should be at least one and one-half times the height. An overflow can be dug 200 yards up the creek, 100 yards in length, with a cross section of 2 yards, requiring 200 cubic yards of excavation through loose soil. Navajo labor is 75 cents a day and board. Three miles to the west of Chee's store is Round Rock, marked "Tsen-a-Kahn," on Howell's map, which is by the way slightly in error as to this distance. On the side of the mesa half way up are two mud holes in which animals grazing on the top of the mesa come to water. This can be converted into a well as shown on the drawing. The excava-

tion will be in red clay. A 1-inch pipe to act as a syphon placed under the soil and cut so as to not entirely drain the well. Four troughs 1 foot by 1 foot by 12 feet, and resting on the solid ground. A pipe 4 feet in length should act as a waste pipe. The well to be walled over leaving a manhole in the top for cleaning purposes. Down the creek from Chee's is a side creek where the water rises to the surface for a distance of 200 yards and again sinks. But a dam as recommended would exclude time and money spent on the dry wash. Three miles to the south of Chee's is a similar creek which runs through a mud channel 75 feet wide and 20 feet deep. The Navajo if enterprising could construct here a brushwood dam 2 feet high that would water 2,000 sheep, but they all seem too lazy to think of work.

While working in this vicinity, Lieut. Gurovits camped at Chee's. He informed me that he had covered the western slopes of the Lukachukai and Tunitcha mountains as far as Tse-a-Lee.

I left Chee's store on the 5th of October, keeping well off to the left, but found it very difficult in traveling and of no value as regards water supply. At Tse-a-Lee I remained two days, allowing my animals to rest and eat. From Tse-a-Lee I marched down Cañon del Muerto, camped one night in cañon, finding some soil banks as in Cañon de Chelly, and reached Chin Lee store the 9th. I dug a well 3 feet deep in the dry bed of the creek that comes out of the cañon, and walled it up with stone; this furnished me with all the water for permanent camp. Leaving my party here and taking one man, a packer, and four mules, I would make side trips on the western side of the Chin Lee Valley. (Referring to map No. 1.)

There are three artesian wells and ditches. As my instructions say, it is impossible to compute cost of same, I omit that, and as ditch must depend on flow of water, that is not computed. The land is as level as a floor, and soil easily worked, and the Navajo could dig the ditch without any trouble. As regards the feasibility of the artesian well, I have reason to believe that water can easily be found, as they would be sunk in a basin the sides of which are 3,000 feet high and 40 miles apart. And springs, when found, are coming out of the face of solid rock, as if it were forced from below. Look-as-Sky spring flows about one-half gallon per minute. This spring could be improved by one charge of blasting powder at the crevice from which the water flows. At 3 feet from the opening, by building a masonry wall 2 feet thick 3 feet high and 6 feet long, a basin is formed holding 300 cubic feet of water.

All the approaches to this spring are solid rock. Only one flock waters there at present and they do not get enough to drink. Valley No. 1 contains 12 square miles of grazing land the center of the valley (see sheet of valleys Nos. 1 and 2); would make good farms if water could be obtained. If the wells would not flow, wind pumps could be used, and three families could live in this naturally hemmed-in valley. No one lives in or uses this valley at present. Along the Black Mountains are a few tiny springs, which sheep trample almost out of existence in their haste to quench their thirst. There are five of these springs along valleys No. 1 and 2; a description of one suits all. On leaving the valley you enter the foothills and proceed up between narrow, steep banks of mud and clay for half a mile; then come mud dams 1 foot in height and mud holes that the Navajoes have made in their shiftless way. But the animals do not stop here but crowd on to the very source of the water and get in it and remain there for hours. Four men could clean out one spring in a day, laying 60 feet of 1-inch pipe to 6 troughs down the ravine. Two hundred feet of barbed wire fence stretched from one side of the precipice to the other will effectually keep stock from pipe and spring.

Crossing over a slight ridge to Valley No. 2, an exact counterpart of valley No. 1, except that it is twice as large. A Navajo has a small spring called Maito, or Coyote spring, walled over and 6 feet of 1-inch pipe laid to two troughs in which to water his 30 head of cattle, 300 ponies, and 1,000 sheep.

He has a stone house, windows, and doors. The artesian well, if successful, would irrigate rich black soil and the above Navajo is very desirous to farm in his vicinity. He is the only one living in the valley. It would support several families if water is struck. Passing from Valley No. 2 toward my permanent camp at Chin Lee's store, I ascend a long sloping ridge and then go down into a basin where the water has worn its way into the Chin Lee Valley at Notch No. 1. (See map No. 2 and Notch No. 1.) This notch is an opening in the face of the mesa through which the water rushes in the rainy season as is shown by the arroya. It drains about 12 square miles, and I think it could be dammed at little cost. Rock is to be had on the ground. Although I did not strike rock bottom yet the two sides of the gorge are of shale, clay, and rocks on the bottom. Ditch "B" should be 3 feet deep, 3 feet wide at the bottom, and 5 feet wide at the top. It can be made as long as water will supply, through soil easily worked. A few boulders would have to be rolled away near the head of the ditch. The ditch should be at least 3,000 yards in length, requiring 4,000 cubic yards of excavation. Ditch "A" should be 2 feet wide at the bottom, 4 feet wide at the top, and 3 feet deep, and 1,500 yards in length, requiring 1,500 cubic yards of excavation.

The soil is easily worked and quite level, lying to the left of the Chin Lee Valley, and not requiring much water for irrigation. Valley No. 3 (see map of Valley No. 3) is 8 miles wide and 10 miles long, where I found four springs. Spring No. 1 is of similar formation to those in valleys Nos. 1 and 2.

Spring No. 2 comes out from under the rock and one man can with a stone chisel cut a half-formed basin into a good rock basin in two days, holding 100 gallons. It will run this full every 24 hours.

Spring No. 3 requires a well 3 feet deep and 3 feet in diameter, 10 feet of 1-inch pipe, and two troughs. Plenty of rock on the ground. Spring No. 4 requires a little blasting to give it a natural rock basin. The soil where artesian wells are located is black and rich. In two or three side valleys there are farms without irrigation. West of this valley was very hilly and rough, little or no grazing, and no water, though I think the Navajoes if desiring, could tell where their springs are, and I think that when they see that the Government is improving their springs they will bring in all the information desired. But up to November I every Indian I met asked what I was after, and on hearing my reply, they would tell me I lied.

On asking them for water they would say there was none. It appears that they have been threatened that if they did not send their children to school they would have the soldiers after them. And to every detachment that goes into the field their first question is, are they after our children. This threat with the use of the military to compel separation from their families is the one great question with the Navajo, and although his stock and relations will die this winter of starvation, yet that is a small item compared to the taking of his children. This compulsory attendance of his children will send him on the warpath quicker than anything else. White people would not stand it, and they make a mistake if they think the Navajo has only animal affection for his young.

There are milder ways of educating this tribe.

Valley No. 4 is simply the back or top of a mesa and can not be irrigated. Pragaatzo or Black Lake is simply a depression, and was dry when I rode through it. It has no outlet and consequently holds all the water which flows into it. This valley contains 300 square miles of fair grazing, where farmers in valleys Nos. 3 and 5 could graze their flocks while farming below.

Valley No. 5 (see map No. 2) is the head of Chin Lee Creek. This creek is, of course, dry, as are all my creeks, except Tse-A-Lee and at Gonado. This is a narrow valley 1½ miles wide, shut in by steep mesas. In one or two places where farms are indicated, they have no irrigation. Water can be had by digging 3 feet in the sandy bed of creek. At "A," I found three holes in mud crust containing standing water, no overflow, and I judge from this that most of the valley could be cultivated without irrigation. However, at the two places indicated, 500 acres could be cultivated with small expense of ditching, as ground is quite level.

Spring "B" is in a mud bank, and should be formed into a well the exact dimensions as the spring at Round Rock. (See cut.)

I finished my work in Chin Lee Valley, October 20, and started for Gonado or Cotton's Store. I left at 8 a. m. and reached there at 6 p. m. There it rained two days, after which I went to Eagle Crags, leaving Cotton's at 8 a. m. and arriving at 1 mile north of Eagle Crag at 3 p. m. This valley is occupied by three families, two at the head of the valley and one where I camped. A Navajo there named Hostinez has dug a well 10 feet deep, in which is 2 feet of water. He should be furnished with a pump. He has a stone house with windows and doors.

At the head of the valley is a cañon, up which is a little water for stock, but not enough for irrigating purposes; yet these Navajos raise corn and melons without irrigation. Three miles west of Eagle Crags are Sheep Springs, called Koi-Soi-Te In-Lee Springs. Ten Navajos were busy at work trying to fix it up. This is the largest I found in my whole trip. It flows 5 gallons per minute. All they need is 275 feet of 2-inch pipe to run into a natural basin which they have fixed up and cleaned out. Seventy-five feet below it is another spring, 2 gallons per minute, which flows into a trough 4 feet long. This should be replaced by two troughs 1 foot by 1 foot by 12 feet. Returning to Cotton's and inspecting the Arroya Colorado, which goes dry about a quarter of a mile below his store, I find three miles up stream a natural lake in which water remains the year around, this year being the only exception. Six thousand feet up the stream from the lake (see Gonado map) a brush-wood dam 200 feet long and 20 feet wide, of rough construction, merely to turn the course of the stream, which here flows 100 gallons per minute, into an artificial channel 6 feet wide at the bottom, 8 feet wide at the top, is recommended. The excavation is in easy soil running the stream through a notch to the lake; 200 feet of the excavation will be 6 feet wide at the bottom, 14 feet at the top, and 15 feet deep; the total excavation being 7,121 cubic yards. The lower end of the lake should have an embankment 3,500 feet long, 30 feet thick at the base and 15 feet high, thrown up with scrapers from the bottom and sides, requiring 60,000 cubic yards of earth. The lake itself drains 8 square miles of land, and the freshets and constant running of the stream should give a lake ten feet deep covering 200 acres.

The irrigating ditch should have a race and head gate. The race should be made 2 feet by 2 feet by 200 feet, of boards from Government sawmill 20 miles distaut. It should run from 150 feet inside of embankment to 20 feet outside, where the gate should be made to regulate the flow. The ditch is 5 miles long, 3 feet wide at the bottom, 5 feet wide at the top, and 3 feet deep, and will irrigate 1,000 acres or more, if water is sufficient. The ditch is in firm soil except for 1,000 feet at the head, where loose soil and bowlders occur. It rained six days while I was at Cotton's, and although the lake had been dry, it had 8 inches of water in it after the rain. From this point I returned to Fort Wingate, camping at Defiance and Gallup. I would recommend that all Navajos digging and walling up their wells be furnished with a hand-pump and lumber for troughs. While wind pumps would no doubt give plenty of water, yet they require constant attention, oiling, etc. I therefore recommend the converting of springs into wells and draining them by siphons. In all my recommendations for work, material can be hauled in wagons from the railroad down the entire length of the Chin Lee Valley to every spring mentioned. I have no doubt there are other springs on my part of the reservation, but with the Navajos being unwilling to tell me the whereabouts of water, I had to hunt for it myself with the above results.

Respectfully submitted.

E. M. SUPLEE,
Second Lieutenant, Second Cavalry.

FORT WINGATE, N. MEX., *November 17, 1892.*

Camps are marked down on Powell's map (number in red) ▭. Numbers in parenthesis black indicate water located. Letters inclosed indicate area where good grass is now;—not used on account of lack of water.

Where windmills are recommended there is throughout a gentle slope, and with a little labor irrigation might be taught to Navajos—provided the bore wells are furnishing enough water—which I believe they will.

Memorandum of cost of "bore wells" worked by "windmills" at Gallup, N. Mex.

Cost of boring 300 feet, at $2 per foot	$600
Four casings, 65 cents per foot (300 feet)	195
2-inch pipe, 18 cents per foot	54
100 barrels tank iron	150
Windmill	125
Brass barrel and valve	5
Derrick steel, 35 feet high	100
Sucker rods, 10 cents per foot	30
Total	$1,259

Add one-third for incidentals.

	Days.
Time required to put up derrick	2
bore, 30 days (300 feet)	30
put up windmill	14
Total	46

Information received from C. S. McIntyre, Gallup, N. Mex., who believes that he will strike water at from 200 to 300 feet anywhere on reservation.

Indian names of certain springs and places.

Marked 12, Tsa-yee-hat-chong.
Marked T, Tsa-yee-hoyt-sho.
Creek at Camp ▭ 7, Tut-chin-leen.
Creek at Camp ▭ 9, fluming South: Tees-an-tit.
Spring at 13, Ho-wass-sa-han.
Springs at 14, Tsa-tsa-k-ha-ta.
Springs at 15, Tsa-tsil-tso, also Big Oak Spring.
Nolan's store on San Juan, Ro-ekas-suss-e.
Gilette's store on San Juan, Na-shay.
Store in Bluff City, Kinch-lan-hay.
Camp ▭ 16, Creek Bluff City, Thee-pen-ta.
Spring R, Kas-ka-da.
1 S. Spring, Badger Spring.

DEPARTMENT OF THE INTERIOR,
OFFICE OF INDIAN AFFAIRS,
Washington, D. C., February 10, 1893.

SIR: The relations between the Navajo Indians of New Mexico, Arizona, and Utah and their white neighbors have been much strained for some time. The Navajos, on account of a lack of water and grass upon their reservation, located in the Territories named, have been forced to go beyond its boundaries to sustain their flocks and herds.

A few have settled upon the public domain with a view of securing title to their homes under existing public land laws. The whites have sought the use of the public lands in the vicinity of the reservation mainly for grazing purposes and the interests of the two races have thus conflicted. Difficulties have occurred between them, resulting now and then in the loss of life both to Indians and whites.

This office has endeavored to maintain peace and harmony among the Indians and whites and to return the nonreservation Navajos to their reservation; but the want of a water supply and grazing facilities thereon have hindered their return thither; notwithstanding these needs the Navajo Indians are self-supporting.

In a letter dated July 16, 1892, Gen. Alexander McD. McCook, U. S. Army, commanding the department of Arizona, in reference to the condition of affairs on the Navajo reservation, submitted for my consideration certain recommendations based upon what he deemed an immediate necessity with a view to settling the differences between the Navajos and the whites upon the borders of their reservation, with the statement that it was reported by the Navajo agent that 9,000 of these Indians were without the limits of the reservation from necessity; that they had large flocks and herds; that there was no water or grass within the official limits of the reservation to maintain them, and give sufficient water even for limited agricultural purposes to the 18,000 Indians said to constitute the Navajo nation.

Gen. McCook's recommendation for a quick solution of this question was a division of the Navajo Reservation into six or eight districts; the appointment of as many engineering parties to be sent into the reservation, each party being assigned a district to make a survey and a contour map of the district of the country assigned to it, and to submit an early report to this office as to where artesian wells might be located, where bore wells worked by windmills might be placed, or where points in cañons or mountains might be selected with a view of constructing storage reservoirs, with the statement that if the surveying and mapping proposed could not be done otherwise he would, if approved by the War Department, detail young and efficient officers in the Army to take charge of these different surveys, each survey being conducted on the same scale, so that a proper and correct map could be made of the 12,000 square miles constituting the Navajo Reservation.

The general stated in his said letter that it would, in his judgment, be inhuman to drive the Navajo Indians, with their large flocks and herds, back to the reservation as it now is; that, should the results of these surveys warrant the same, with slight expense wells could be bored and water developed to such an extent on the reservation as to justify this Department in requiring the Navajoes living now outside of the public lands to confine themselves and their flocks and herds within the limits of the reservation possessed by them.

In view of the fact that the situation among these Indians was one of great difficulty, perplexity, and possible peril to the public peace,

and one which called for immediate action, I made on July 30, 1892, to the Department the following recommendations pertaining to the Navajo Reservation, and suggested that the President be requested 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 might 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 Navajoes, together with their flocks and herds.

Second. That as many officers of proper rank, the number to be designated by the said 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 could 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 16,000 or 18,000—and that the irrigating ditches, or corrals, dams, laterals, etc., necessary for irrigation purposes, and the lands to 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 cañons or mountains where storage reservoirs may be constructed, or where springs or other sources of water supply may be developed.

Fourth. 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 Navajoes 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.

It was stated in said report that these investigations and estimates were desired by this office in order that the whole Navajo matter, with full information and data, be presented to Congress, with request for the appropriations necessary to put into execution the system of irrigation and water supply indicated, with the remark that if this plan could be carried out, it would, in my opinion, materially aid in the solution of this vexed question.

On August 1, 1892, the Department addressed a letter to the President requesting, upon the recommendation of this office, as above indicated, that instructions might be given to the War Department to cause a survey to be made of the Navajo Indian Reservation, in accordance with the plans suggested to me by the commanding general of the department of Arizona.

The instructions requested were given by the President, and I am now in receipt, by Department reference for report, of a communication, dated December 20, 1892, from the honorable L. A. Grant, Assistant Secretary of War, stating that the survey has been made, and transmitting therewith the original reports of Lieut. W. C. Brown, First Cavalry, Lieut. Odon Gurovits, Eleventh Infantry, and Lieut. E. M. Suplee, Second Cavalry, the officers charged with the duty, which reports are accompanied by notes and explanatory maps under separate cover.

The Assistant Secretary of War observes that it will be seen from the indorsement of the commanding general of the department of Arizona on an inclosed copy of the letter from the President to the Secretary of War, dated August 2, 1892, directing this survey, that the reports of the officers above mentioned have been carefully scrutinized by him personally and have received his approval in every particular; and requests that should these reports and maps at any time be printed under the direction of this Department, to be furnished with a few copies of the same for the files of the War Department.

The reservation was divided into three districts and the survey made under the supervision of Lieut. W. C. Brown, First Cavalry, as per paragraph 4, Special Orders No. 115, dated headquarters department of Arizona, September 13, 1892.

Lieut. Brown took that portion of the reservation east of the mountains and north and east of Cañons del Muerto and De Chelly on the south. To Lieuts. Suplee and Gurovits were assigned the southwestern and northwestern parts of the reservation respectively.

Lieut. Brown states, in his report dated November 29, 1893, that he accompanied the Indian agent of the Navajo Agency to the camp of Manuelito, chief of the Navajoes, on September 28 last, and found there the largest collection of Indian farms seen on the trip, the camp and farms extending over an area about a mile long and near one-fourth of a mile wide, with from 10 to 40 families according to season; that the water for domestic purposes was obtained from holes 3 to 4 feet deep in the sandy bed of a "wash;" that at this depth there is a stiff clay subsoil perfectly impervious to water; that the method of irrigation here, as in many parts of the reservation, he found to be to flood the surface during the season when the snows are melting on the mountains and water in streams and "washes" is plenty, holding it on the surface by means of small dams about 12 inches high, at a distance apart from 15 to 50 yards, depending upon the natural slope of the ground; that the water soaks through only as far as the clay subsoil, one irrigation being found sufficient to raise a crop of corn, and that this camp is a place of importance—one where an artesian or bore well should be located. (See map of Geological Survey, by Powell, transmitted herewith.)

Lieut. Brown states that he informed Manuelito of the object of his visit, and with him visited Heavyman's Springs, some 5 miles to the west, where herds were watered; that here was found an excellent opportunity to instruct the chief, and through him the Indians of his camp, in the proper method of developing these springs and storing the water from them; that by a few minutes' work with the shovel the flow of two springs was materially increased under his own eyes, and that he was shown how, by the labor of ten men for a day, a dam could be constructed which would hold a large volume of water and give the herds watering there comparatively pure water instead of the muddy polluted stuff which the large number of sheep, goats, and ponies watering there were drinking; that the condition of these springs is similar to that of many others, neglected partly because the Indians do not know how to develop them, but chiefly because they are too indolent and shiftless to care for them; that these springs lie in the bed of an extensive "wash," and as any improvements made would naturally be washed away by the floods, no work is recommended other than to thoroughly dig out some half dozen springs found there and to put in a small dam for the purpose of holding the water for stock, which would require about fifteen days' labor each season, for reasons as stated.

The lieutenant next visited Manuelito's springs at his permanent home (Powell's map, southeast portion), and found there a series of seven mud springs, which he states are evidently very old and permanent springs. He recommends that these springs be cleaned out and protected by a low stone wall and the water piped into a trough; labor required, six days; material, wooden trough and 20 feet of inch pipe; and states that if this is done it is possible that during the irrigation season there would be enough surplus water to irrigate a garden of about an acre of ground.

The lieutenant further states that 700 yards south of east of Manuelito's house there was found a water hole (slightly alkaline) in a shallow gully; that it would require but a few hours' work with a shovel to clean this out and thus furnish an additional watering place for stock in that vicinity; that to the southeast of this point is a low sandstone ridge sloping to the north, from which a number of cañons issue, in each of which more or less water may be found; and that in their order from west to east these springs are numbered on the general map referred to as follows: 4, 5, 6, 7, 8, and 9.

He states that, at No. 4, there is a small fresh-water spring near Tom Terlino's place, who is a Carlisle graduate and will act as interpreter and guide for any one working in that vicinity; that, at No. 5, there is quite a strong flow of water, but no work is recommended; that at No. 6, the water is fresh and cold with a slight taste of iron; that during the dry season the flow is small, but the indications are that it could be considerably increased, and recommends that the spring be thoroughly cleaned out and a wall be built across the cañon to keep out stock; labor required, two days' work; material, 20 yards of inch pipe and wooden trough; that, at No. 7, there is an alkali creek, where no work is recommended; that, at No. 8, there is a small, running fresh-water spring, which would require one day's work to clean out and put in order, and one water trough; and that, at No. 9, there is also an alkali creek with large flow of water, where no work is recommended, adding that in this vicinity in a tributary cañon there is a water hole, which by a few hours' labor might be developed into a small spring.

Togkay Springs, marked on the map No. 10, are a collection of mud springs located in the southeastern portion of the reservation, covering about an acre of ground and being quite alkaline, and, as this is a place of some importance, Lieutenant Brown recommends that a bore well be established here deep enough to strike fresh water. He also recommends that another well be bored at No. 11, some 10 miles to the northeast of the springs last referred to, for the reason that there is no water between that point and the eastern boundary of the reservation, and also recommends bore wells, or, better, artesian wells, at Nos. 13 and 14, the former being located some 6 or 8 miles west of Manuelito's springs, and the latter some 10 miles north thereof.

Lieut. Brown states further that, at several points on the main road leading north from Manuelito's springs, fields of green sage exist extending east and west; that at these places water is doubtless near the surface, and at one of these points at least, near No. 15 (Powell's map), a bore or artesian well should be located; that, at some 10 or 15 miles to the northwest thereof, his camp, on October 2 last, obtained water from two large water holes about 10 feet in diameter and 4 feet deep, dug by the Navajos in the dry creek bed, for use of their stock; that a well walled with rock was also found there, sand, however, having drifted in, partly filling the same; that no work is recommended at that point, but that a bore or artesian well might to advantage be placed a mile or two below, where the Indian farms are located; and that at this point much assistance might be given the Indians in the way of farming, by cutting a good irrigating ditch, to make use of the water coming from the mountains in the spring and early summer.

He indicates that at Nos. 16, 17 and 18 (see map), bearing to the northwest from the points last referred to, will be found alkaline springs, which will furnish a supply of water for stock as well as for domestic purposes, and states that at No. 16 there is a good adobe Navajo house, some 500 yards above which and a little removed from

the "wash" of the creek are two water holes, which one man can clean out thoroughly in one day; that a water trough should be provided for the use of stock at that point; that good corn is produced about two miles below this place on this creek or "wash," and that here again facilities are offered for irrigation; that at No. 17 is a very small alkali creek, on the south bank of which and one-third of a mile up the cañon is a small, somewhat alkaline spring; that a day's labor will be sufficient to dig this out, which will probably increase the flow sufficiently to water 500 head of sheep, the water in the creek being muddy; and that about half a mile still farther north on the north side of a hill is another spring very alkaline, which should also be cleaned out and rendered suitable for stock-watering purposes.

Sheep Spring, still farther to the north, is defined as a well-known spring and camping place, where the Navajos have built several stone and adobe houses and constructed two small reservoirs for the purpose of holding water, which can be deepened and improved by constructing a low wall of rock and mud on the lower side of the same, making a reservoir large enough for all probable needs; labor required, one man four days.

Sulphur Spring is located almost due north of Sheep Spring, and between these two points Lieut. Brown states that two bore or artesian wells should be established at the places marked on the map referred to; that the former is a well-known camping place and was once the location of the Chaco Indian trading store, the building of which still stands; that the spring, quite strongly impregnated with sulphur, flows at the rate of about 5 ounces per second; that it would be well to build a 2-foot wall there, which would require the labor of one man for three days; that, if the wall is well built and proper means taken for carrying away the sulphur water, a trough will not be needed; that there is sufficient water at that point to irrigate several acres of ground in the valley below, but that for some reason it has not been utilized in this manner, probably because there is no wood to be had nearer than the mountains; that about a mile northwest of Sulphur Spring are two other fine sulphur springs, indicated on Powell's map; that a few hours' work would be sufficient to clean out the one to the west and make it a suitable drinking place for stock; that the other spring or springs—there being several of them—have a much greater flow, enough to irrigate several acres of ground were the Indians disposed to take advantage of the same, scarcity of wood being probably the reason why they do not do so.

The lieutenant states that Chaco River was found to be dry, but that there is plenty of water in its bed at a depth of from three to five feet, which occasionally appears at the surface; that the river bed is from 20 to 200 yards wide, while the valley itself is in places a mile wide; that the latter contains so much fertile land that it is thought that soundings might to advantage be made to determine the practicability of irrigation there by means of submerged dams; that at No. 20 (Powell's map), along the east side of the Hog Back, is another very fair sulphur spring, which however needs no attention, as the Navajos have themselves constructed the necessary reservoirs; that Powell's map here is in error, as the Chaco River is not more than 500 yards from the spring, and not several miles, as the said map indicates; that search was made for the water holes in the Bad Lands near No. 19, but that they could not be found, finding instead thereon several fine veins of coal in that locality; that, while he did not visit the extreme eastern portion of the reservation, inquiry developed the fact that the region

is without water, and that if a boring apparatus is sent anywhere near that section of the country it would seem advisable to bore wells at or near the points marked Nos. 21 and 22 on the general map referred to.

On arriving at the San Juan River, where there is an abundance of water for stock, the lieutenant's attention was directed to the matter of irrigation, the advantages of ditches along the river being, as he states, (1) a permanent and abundant water supply, and (2) the example of fine farms and orchards owned by whites across the river—beyond the reservation line—with whom the Indians are on quite amicable terms, and whose thrifty agricultural pursuits afford a valuable lesson to the Indians.

At this point the lieutenant secured the services of Mr. F. J. Coolidge, civil engineer, of Olio, N. Mex., one of the owners of the Coolidge Ditch, constructed on the opposite side of the river at a cost of $75,000, from whom he learned that before that section of the country was added to the Navajo Reservation, the white settlers had constructed what is known as the old Virdin Ditch; and who, locating a good heading about half a mile below the mouth of the Animas River, ran the levels for him for a ditch, which was designated as the Francis Ditch, which in its upper part coincides very nearly with the course of the Virdin Ditch, being, however, much longer and covering a greater area.

Lieut. Brown states that the Francis Ditch was surveyed under his direction by Mr. Coolidge; that as he had at hand a complete plant for constructing ditches, he requested him to make notes as they proceeded with the survey, in order to be able to make a proposal for the construction of the ditch; that the length of this ditch is 56,628 feet, the grade assumed being 4 feet to the mile; that it will irrigate an area of 2,317 acres; that a cross section of this ditch should be 12 feet at the top, 8 feet at the bottom, and 2 feet in depth, the ditch requiring—

Excavation of 44,105 cubic yards of earth, at a cost of 10 cents per cubic yard	$4,410.50
Bowlder work, 4,800 cubic yards, at 50 cents per cubic yard	2,400.00
Gravel work, 1,120 cubic yards, at 50 cents per cubic yard	560.00
Flumes, headgate, etc.	730.00
Total	8,100.50

He adds that the grade of this ditch will keep it well up on the side-hills along the lower part; that it may be found best to extend the ditch about a mile further, at a cost of $2,000, which extension would irrigate about 680 acres of fine mesa land just below Fruitland post-office (Burnham), on the south bank of the San Juan River; that in order to obtain water from that river and trough the same to the land where needed, it will be found necessary to go about 3¼ miles above (east) the reservation line; that if the ditch is constructed it will be necessary for the Government to either condemn so much land as may be needed to run the ditch as indicated, or add to the reservation a triangular piece of land bounded on the south by an east-and-west line from the mouth of the Animas River west to the present eastern boundary thereof, including all land between this line and the San Juan River, within which territory there are no improvements except two small ranches.

Sandival's farm, on the San Juan, was next visited, where the lieutenant found that certain ditches had been dug and fences built, which show that the Navajo Indians are making earnest efforts to become successful farmers, and that they certainly deserve encouragement in that direction. He states, however, that the Indians almost invariably

construct a poor ditch heading, on which the efficiency and permanency of a ditch largely depends; that in order to handle only a minimum amount of earth, the cross section of the Indian ditch is usually shaped in the form of a square, in consequence of which the ditch is constantly caving in and annually requires a much greater expenditure of time and labor to put it in order than if the cross section were originally of the approved form; that this ditch (Sandival) will irrigate 760 acres of the south bank of the San Juan River; that from the lower end of the same a line was surveyed directly across the river and valley, a distance of 1 mile, with a view to carrying the surplus water by means of an inverted syphon (6-inch pipe) and irrigating about 640 acres of land on the north bank thereof; that in the survey of these ditches (Francis and Sandival) the construction of which is recommended, he is under many obligations to the said engineer and J. E. Francis, the farmer employed there by this Department, who was most active and earnest in his efforts to assist the Indians in farming, adding that Mr. Coolidge stands ready to construct the Francis Ditch for the amount named, $8,100, and to complete the work, if desired, within sixty days from the time the contract is awarded. He is represented as a large property owner in that immediate vicinity, and the lieutenant states that he has every reason to believe that he would put in only good work and earnestly recommends him as a suitable man for that purpose, if contracts should be awarded.

On leaving the San Juan for the mountains, Lieut. Brown found at the point marked 23 on the general map—4½ miles northeast of the "Needle"—a mud spring, which from its location in the center of good grazing land should be improved by cleaning out the same and building a wall about 18 inches high, on top of which should be placed a wire fence to keep out the stock; work required, twelve days; material, two water troughs.

On October 14, 1892, the lieutenant camped 2½ miles west of the "Needle," where he found a small mud spring, which he recommends should be cleaned out, walled up, and water piped a distance of about 50 feet to a water trough, which will require some six days' labor.

A mile north of this spring, at the extreme western point of a rocky ledge running west of the "Needle," is another small mud spring, which, he states, two days' labor would put in proper condition by cleaning out, walling up, and digging a small reservoir or putting in a small trough, covering the spring with large flat rocks or logs.

Another small spring of good water was found in a little cañon near No. 24 (see map), from which the water seeps through the sandy rock, and which, he states, will require two days' labor to excavate a couple of small reservoirs for domestic use, the overflow to be caught in water troughs placed below.

The lieutenant reports further that a careful search will probably result in the discovery of other small springs in that vicinity in the low sandstone ridge which trends north and south; that a few miles west, at No. 25 on map, a water hole was found in the dry bed of a spring; that drive wells could be located to advantage anywhere in that section of the country; that springs were also found to the southwest at the base of a landmark which he called "Mitten Rock," No. 26 on map, from its resemblance to that article; that at his camp on October 15, indicated on map, water was obtained from a natural tank or basin contained in sand rock; that there is no spring at that place, the water simply being caught from the rains in a basin in a "wash;" and that the basin could easily be enlarged to hold double the quantity

which it now does by building a little rock and cement dam 3 feet long by 18 inches high.

At No. 27, a few miles east of the place last referred to, there exists a mud spring, which, it is reported, will require one day's labor only to put it in condition for a small watering place, while a bore or artesian well might to advantage be located at No. 28, on map some 20 miles west of No. 27.

Lieut. Brown further reports that from this time on springs were found in abundance; that no special work is recommended other than that which may be done under the supervision of the farmers employed by this Department to assist the Indians in farming; that east of the Lukachukai Mountains, in Black Horse's district, was found a running stream along which were a number of Indian farms; that their ditch headings were very poor ones; that the indications are that there is usually an abundance of water during the irrigation season; that the Indian name of this stream and valley signifies "Standing Red Rock" from a red sandstone butte in the middle of the valley, surmounted by a rock which in appearance resembles a kettle; that about half a mile east of the rock described there is a 20-foot fall in the stream, 20 yards above which is an excellent place for cutting a heading for a ditch, which he named "Standing Red Rock Ditch," and which will irrigate about 2,645 acres of good land.

This ditch is represented upon the accompanying drawing, marked "A," executed by Lieut. Brown. He states that the heading of same should be cut out of solid red sandstone rock; that a cement dam less than 2 feet high and about 25 feet in length will turn all the water of the creek, or so much thereof as may be necessary, into the ditch, the surplus going over the top of the dam; that for the first thousand feet any grade may be given, from the ordinary grade of 0.15 of a foot to 200 feet up to 5 feet per thousand feet; that in case the easier grade is assumed, a great part of the ditch will run through the sand overlying the rock, which, however, is not recommended; that to avoid danger from "washouts" and to secure permanency the first thousand feet should be cut in the red sandstone rock, giving considerable fall (say, four feet) to the ditch in that distance; that the rock is soft enough to be worked with the pick, but that blasting would be the more expeditious method; that he marked the heading of the ditch by lines cut in the red sandstone rock; that he drove stakes into the surface from zero to 35 every 200 feet, as indicated on the drawing referred to; that beyond No. 35 thereon the distance was obtained by pacing; that the profile on the same sheet as the map of the ditch gives the amount of rock cutting that must be done even if only a grade of 0.15 of a foot to 200 feet is given to the ditch, and that a steeper grade would necessitate correspondingly more rock work. He remarks that the dam, though a small one, should be built and run back into the sage-brush bank, which end should also be protected by rock and brush to prevent the possibility of the water washing round the west end of the same, and that the flume required is one of 25 feet, as represented on the drawing.

In connection with the construction of ditches, Lieut. Brown suggests that a New Era grader and ditcher be purchased for use of the Navajo reservation, as the conditions there are particularly favorable for the use of an earth-moving machine of this kind; that with the exception of the ditches on the San Juan River and that at the agency they are mostly surface ditches almost from their very heading; that in making this suggestion regard is had not only to the construction of the ditches

already located, but also to the opportunity for constructing from the many little streams and "washes" issuing from the mountains additional ditches to irrigate tracts from 20 to 500 acres of land each; that as the Navajoes depend so largely for support on their herds, which require large tracts of grazing land, it will be seen that 1,000 acres under irrigation, in, say, ten different tracts, will be of far more use to them than where it happens to be in one solid body, for which reason the advantage to be derived from small ditches should not be overlooked; that the manufacturers of the machine referred to advertised that it will cut a ditch 8 feet wide at the top and 2 feet wide at the bottom, and from 24 to 28 inches deep, at the rate of three-quarters of a mile per day; that this is approximately the size of most of the ditches surveyed, and as the force required to run the ditcher is 3 men and 12 horses, it will be seen that the machine would more than pay for itself in the construction of ditches regularly located, not to mention the cutting of laterals and many smaller ones.

An area of nearly two square miles was found north of Luk-a-chukai Mountains, and another of about 1,000 acres east of that mountain, each of which the lieutenant thinks could doubtless be irrigated without great difficulty, the greater part of the expense being for flumes across the numerous arroyos.

He states that besides these there are numerous limited areas on which the Navajoes have already started farms, which by the use of small ditches can be made quite productive; that this valley (Standing Red Rock) is the district which Black Horse controls, and is one of the finest seen on his entire trip, but remarks that not a wagon or a plow was seen in the whole valley; that there is but little encouragement for the Indians to engage in agricultural pursuits, for all material must be packed on the backs of ponies, and "all the plowing must be done with the hoe" and ditches constructed solely with the spade and shovel.

Lieut. Brown next visited the section of country lying east of Beautiful Mountain, where a survey of a ditch was made which he designates Tsa-a-no-sti ditch. He states that this is a type of a number of inexpensive ditches, which it is believed can be dug in the valleys adjoining streams or "washes" which issue from the mountain ranges; that the heading of this ditch is almost identical with that of an old one dug many years ago by the Indians, but now abandoned, evidently on account of a large arroyo which some cloudburst had caused; that this can be easily flumed and those below filled and the ditch embankment on the lower side at these places made considerably higher and thicker, so that during heavy rains the water in the arroyo would be run into the ditch. He adds that this ditch may be found at the entrance to the cañon where the stream issues from the mountains, and that on the north bank of the creek, about 20 feet from the top head, the tip of Mount Bennet can just be seen above the hills, magnetic bearing 5 degrees south of east.

Lieut. Brown submits a drawing of this ditch, transmitted herewith, marked "B," and states that beyond station numbered 30 thereon, the line, if kept at its ordinary grade, 0.15 of a foot to 200 feet, would run up and along some low hills; that to avoid the expense of hillside work, the ditch should be run along their base; that it is quite possible that the natural fall of the ground from No. 30 to "A" may be found so great that an arroyo would be created by the run of water through the ditch; that this, however, may be obviated by running the ditch in a zigzag manner between these two points, thereby making the distance greater, and the grade correspondingly less, and that beyond the point marked "A" the ditch might be continued indefinitely as long as the supply of water will hold out.

He further states that on the south side of this stream a smaller ditch may be constructed to irrigate about 600 acres of land; that the heading of the same should be just above an old Aztec ruin, and about a mile below that of the Tsa-a-no-sti ditch; that its construction would be somewhat more expensive than the latter, the deepest cut, 13 feet and 3 inches, being near the bank of the creek and sloping to grade at a distance of about 2,000 feet; that some 3 or 4 miles south of Tsa-a-no-sti Creek is another one parallel to it, and on which are a number of Indian farms, and that an inspection of the ground showed that while ditches could doubtless be constructed there to advantage, the cost per acre would be greater than that at Tsa-a-no-sti.

The territory in the vicinity of the Indian store at Tse-a-lee was next examined and found to embrace open timber lands, with an abundance of water and a number of tracts of from 5 to 20 acres, which, with a little labor in the way of ditching, the lieutenant thinks could be transformed into excellent farms. He reports that the principal body of farming land lies immediately northwest of this store, and would be irrigated by the construction of the Tse-a-lee ditch—350 acres—which would require two dams at the heading. First, a low dam of earth and logs, there being plenty of timber in the vicinity; and, second, a masonry dam 14 feet high, the site of which is shown on drawing herewith transmitted, marked "C," and in the photograph thereto attached.

He states that about all the work done here was to demonstrate the practicability of taking water from the creek by means of the dams referred to, and to accurately measure the length of the ditch and the area irrigated; that two lines of levels were run and the natural fall of the creek was found to be about 1 foot in 65; that the fall of the land adjoining was nearly as great; that before the ditch is actually constructed a resurvey of the same should be made, with a view of obtaining an easier grade to the ditch and permitting lower dams to be built; that the heading of the ditch can easily be found about 1 mile above the said store, and that, as will be seen on an examination of the photograph referred to, the creek bends suddenly to the south and runs through a rocky gorge.

Lieut. Brown submits next a drawing of a ditch to be known as Wheatfield (Creek) Ditch, which is also herewith transmitted, marked "D." He states that the heading and first 1,500 feet of this ditch are identical with the old ditch above referred to; that there is no difficult work whatever on the same; that all but the first 1,000 yards can be made with the ditcher; that the creek at this point is a permanent stream and flows even late in the autumn of dry seasons at the rate of 2 to 3 cubic feet to the second; that the indications are that during the irrigating season there would be sufficient water for the entire area of 822 acres; that if not, there is a basin about a mile to the east which could be turned into a reservoir by constructing a dam of earth and logs some 300 feet long and 20 feet high, which would hold 10,000,000 cubic feet of water; that it is not deemed worth while, however, to consider this project until it is demonstrated that the water in the creek is insufficient for the purposes of irrigating the whole area mentioned, or so much thereof as may be put under cultivation; that both the Wheatfield and Tse-a-lee areas are in a country timbered to a greater or less extent; that at the heading of this ditch, the sandy rock bed is about 300 feet in width; that a dam 2 feet high, of earth and logs,

should be constructed, which can easily be done, as there is an abundance of timber in that vicinity.

He adds in this connection that south of Wheatfield Creek is Whiskey Creek, along which the Indians have a number of small farms, and that a ditch here would irrigate possibly 300 acres, as there is an abundance of water available; that just south of Washington Pass, in that vicinity, an educated and enterprising Indian named Chee has fenced in about 100 acres of land which he proposes to irrigate from a mountain stream; that he has not, however, inclosed all lands suitable for farming purposes at that place, and that probably during the months of May and June sufficient water may be had to irrigate the same.

Black Creek Ditch is also represented upon map "D" above referred to. The lieutenant thinks that this ditch would be supplied from Black Creek which issues from the mountains northeast of Baigaichi Mount; that the same will irrigate an area of 348 acres; that water can be taken out of and carried away from this stream more easily than from any other creeks named; that after irrigating this tract of land the surplus water should be returned to the main spring as the cañon below renders it impracticable to continue the ditch further; and that the water should be taken out again below the cañon for the purpose of irrigating as much of the several thousand acres available as the supply would warrant.

Lieut. Brown reports that the volume of water in Bonita Creek at the Navajo Agency was found to be 6½ gallons per second; that he was informed that during the irrigation season there is about double this quantity of water; that the supply is permanent and important by reason of its location at the agency, where all water not needed for domestic purposes and stock uses should be consumed in irrigation; that he was also informed that one or two dams had been constructed above the agency on this creek and had washed away; that a dam, however, except a very low one, is not regarded as necessary, and water can quite as well be taken out by flume at and a little above the bed of the creek; that the flume as at present constructed there, being built entirely of too light material, is broken down in places and has never been surveyed; that it is possible, however, to repair this flume and make it carry quite an amount of water, but that it would be better to construct a more substantial flume from lumber, which can be obtained at the Government sawmill not far distant at $15 per thousand feet.

He states that there are a few acres of excellent land just above the agency buildings, which would make a fine garden; that the water from that point should be carried half a mile or more below the agency and used for irrigation as long as its supply will hold out, there being more land available for that purpose than water to supply the same; that just over the ridge east of the agency a reservoir can be constructed to hold about 16,500,000 cubic feet of water by building a dam 300 feet long by 300 feet high; and that the reservoir can be filled by a flume 3,000 feet in length, running along the "sidehill" above the agency, as shown by the accompanying plans marked "E" prepared by Lieut. Brown.

He remarks that it must be admitted, however, that there is some doubt as to whether the soil will hold water sufficiently well to fill the reservoir from the supply in the creek; that before expenses are incurred in building so long a flume and in the construction of a dam, it would be well to have the ground examined by an expert; that he simply ran the line of levels to determine the practicability of carrying

water to the proposed reservation, and to estimate, approximately, its capacity; and that during the irrigation season he believes the creek will afford sufficient water to irrigate about 173 acres.

The lieutenant says that some 3 miles south of Fort Defiance at Black Moustache's Cabin is a fine spring located in a cañon difficult of access by stock; that it would be well to build a 2-foot dam from just below a natural rock bridge and by means of about 150 feet of 2-inch pipe carry the water out into a ditch where the soil is not so porous; that the water would then be convenient for stock and the surplus could be used for the purposes of irrigation; that two days' labor would be required at that place to perform the work indicated, and that 4 miles southeast of the same is another small spring, almost choked up by the drifted sand, which could be obviated by expending one day's labor in cleaning out the spring and by the use of a water trough.

In Gaudys Valley, near the southern boundary of the reservation, there are several houses and a number of farms, which the Indians for lack of water are unable to occupy in the dry season, where the lieutenant says there is much needed a bore or artesian well.

He states that the mountain range extending some 70 miles north and south through the reservation constitutes in itself a vast reservoir, as the winter's snows melt and run down the numerous cañons and "washes" at almost the very time when water is most needed for the purpose of irrigation; that if the whites were in possession of that country the greater portion of this water would be utilized; that as it now is, however, the water runs from the mountains into the San Juan River, and from it to the sea, without benefit to anyone, while by a little expenditure of money and labor it might be diverted to the soil; that ditches, if constructed, would be quite inexpensive, at least most of them, and would almost pay for themselves, even if the water should be used only to improve grazing lands; that their cross sections, if built, should be sufficiently large to carry an abundance of water during the time of freshets; that if the soil received even one thorough soaking during the month of May, it is a great help, and in some soils sufficient to produce a crop; that although the land in that section is generally sandy, it is as far as could be ascertained, quite fertile, being along the San Juan River well adapted to fruit-growing.

The lieutenant expresses the opinion, however, that it would be throwing money away to construct these ditches unless the necessary wagons, plows, and other agricultural implements should be furnished, together with a sufficient number of active, practical farmers familiar with irrigation to assist and instruct the Navajoes in correct methods of farming; and that if the ditches, as located, should be constructed, not less than five good farmers would be required in that portion of the reservation examined by himself, who should be assigned as follows:

Two along the San Juan River, one above and below the Hog Back; one to Standing Red Rock Valley; one to the vicinity of the Tsa-a-nosti Ditch to take charge of all farms to the south on the eastern slope of the mountains; and one to Tse-a-lee and Wheatfield sections, and all the territory on the western slope of the mountains down to the immediate vicinity of the Navajo Agency.

He remarks, in connection with this matter, that the farmers, in addition to their other duties, should have charge in general of the springs and wells in or adjacent to their respective districts, all to be under the supervision of the head farmer at the agency.

He states that a few drive wells and hand pumps could be used to advantage along the Chaco River, where water is obtainable at only a few feet below the surface; that under the conditions, as he found them there, no wells except artesian wells can be expected to give entire satisfaction; that the country should be examined by an expert with a view to locating artesian wells where the indications are that flowing water can be obtained at no great depth; otherwise, bore wells with windmills to pump the water should be substituted.

He adds that at least ten wells are needed in the district of country examined by himself; that these should be artesian wells as far as practicable, and that where artesian wells can not be established bore wells with windmills might be sufficient. He estimates the cost of a bore well from information and data furnished him by Mr. C. S. McIntyre, of Gallup, N. Mex., a man said to have had much experience in such work, to be about as follows for a 300-foot well:

Boring 300 feet, at $2 per foot	$600
300 feet 4-inch casing, at 65 cents per foot	195
300 feet 2-inch pipe, at 18 cents per foot	54
100 barrel iron tank	150
Windmill	125
Brass barrel or valve	5
Steel derrick, 35 feet high	100
Sucker rods, 10 cents per foot	30
Total	1,259

Time required for boring, thirty days. Time required for putting up windmill, etc., two weeks, to which should be added the cost of transportation and other incidental expenses.

The lieutenant thinks that 300 feet is greater rather than less the average depth of a bore well; that an aggregate of about sixty days' labor will be required on the springs referred to, and that Indian labor can be obtained at from $1 to $1.50 per day, the Indians boarding themselves. In making all estimates the lieutenant notes that the distances from the railroad should be taken into account, and that it should be remembered that all supplies and forage must be hauled from thence in wagons.

Lieut. Brown states that with a view to verifying the levels of the ditches, if constructed as proposed, a level and leveling rod should be supplied at the agency to be sent for use wherever needed; that a Gurley farmer's or drainage level, with tripod and leveling screws (price, $25), and a New York rod, consisting of four parts (price, $20), would fulfill all requirements, and that a couple of hand levels, which cost about $8 each, would also be found most useful in making examination of ground, with a view to locating small ditches and laterals.

He concludes his report by acknowledging the efficient work rendered by his assistants, Lieuts. Suplee, Second Cavalry, and Gurovits, Eleventh Infantry.

I transmit herewith a drawing of the Sandival ditch, a plan of a proposed dam at Rocky Bridge, one-half mile east of Fort Defiance, and also a card to which there are attached photographs showing the character of the country in certain sections of the reservation, marked respectively F, G, H, to which it does not appear that Lieut. Brown invited special attention in his report.

I attach hereto tabular statement of irrigating ditches located on the Navajo Indian Reservatien as proposed by Lieut. Brown, which may throw further light upon the matter of irrigation in that portion of the reservation examined by himself.

Tabular Statement of Irrigating Ditches located on Navajo Indian Reservation, by Lieut. W. C. Brown, First Cavalry.

Name.	Length.	Grade per mile.	Area irrigated.	Size of ditch, dimensions in feet. Top.	Bottom.	Depth.	Location of head.
	Feet.		*Acres.*				
Francis	56,628	4 feet the mile.	2,317	8	6	2	Near head of Old Virdin ditch, and ½ mile below mouth of Animus River.
Sandival	31,218	3.2 feet to mile	*962 †640	8	6	2	About 1⅞ miles above heading Sandival's Indian ditch.
Standing Red Rock.	9,713	1 feet in 1,000 feet.	2,645	†3 §8	3 5	1½ 2	About 20 yards above falls which are 20 feet high, 4½ miles east of pot-shaped rock on red sandstone butte in center of valley.
Tsa-a-no-sti	20,583	15 feet to 200 feet, or 47.52 inches per mile.	1,100	8	5	2	Four miles above village, nearly identical with old Indian ditch on north bank; 300 yards above old cottonwood tree on bank; 20 feet above head; the top of Bennett appears just over grass covered slopes; entrance to cañon.
Tse-a-lee	16,500	About 15 feet to the mile.	350	6	3	1½	One mile above old store where creek turns south and runs through narrow rocky gorge (see photo).
Wheat fields Creek.	13,047	.15 feet to 200 feet.	822	7	4	2	Identical with old Government ditch.
Black Creek	7,000	.15 feet to 200 feet.	348	6	3	1½	On north side and between new log house and tall finger of red sandstone detached from mesa.
Agency	10,000	.15 feet to 200 feet, or 47.52 inches per mile.	‖173	¶1 §3	1 2	1 1	Identical with present ditch of flume.

* South bank. † North bank. ‡ In rock. § In soil.
‖ Without the reservoir. With reservoir, 811. ¶ Flume.

LIEUTENANT SUPLEE'S REPORT.

In his report dated November 17, 1892, Lieut. Suplee states that in compliance with Orders No. 115, headquarters department of Arizona, hereinbefore mentioned, he reported to Lieut. Brown at Fort Wingate, N. Mex., September 24, 1892, and received instructions to investigate and report upon the water supply of Chin Lee Valley and the district south thereof to the reservation line, or the district included within the southern boundary of the reservation and parallel 36° 30′ and meridians 109° 15′ and 110°; that at 10 miles northwest of Fort Defiance his detachment watered at a spring which issues from a creek in the rocks and falls 3 feet to a flat-topped rock where the Navajoes have built a mud wall 6 feet high to catch the drip; that more than 40 head of animals watered there at one time, there being plenty of water left; that this spring is on the trail to Chin Lee and to Canon De Chelly; that there is an abundance of grazing in the vicinity thereof; that sandstone of good quality can be had on the spot; that the Government sawmill is 5 miles distant therefrom; that there should be a semicircular wall of stone, 4 feet in diameter and 4 feet in height, built against solid rock, which should be covered with a wooden cover; that the bottom of the spring, by removing a triangular piece from the rock 1 foot wide at the bottom and four feet long, would rest on stone; that a 1-inch pipe 5 feet long should be placed inside next to trail, by means of which 3 troughs, 1 foot by 1 foot by 12 feet, would be

filled, adding that the overflow, if any, would fall directly away from the troughs without causing trouble, and that the thickness of the wall should be sufficient to stand the pressure of water when full.

Fifteen miles from Fort Defiance there is a long valley running north to Monument Cañon, where the lieutenant found ten square miles of good grazing land, and in each valley he recommends that a hand pump with three troughs be placed for stock water purposes.

In going up Cañon De Chelly he reports that he found many soil banks in corners of the cañon; that on a few of these the Navajos are farming; that these banks contain about two acres each of rich soil, the subsoil of which is so moist that irrigation is not necessary there; and in going down the east side of Chin Lee Valley he discovered numerous farms therein between the sandy dry creeks where hundreds of acres could be farmed also without irrigation, if the Indians were compelled to do so; that in some places there were evidences of small ditches; that the soil rests upon sand through which the water flows to the depth of from three to five feet, thus keeping the soil above moist during the entire year; that at noon of October 1 last he reached Sand Cone Springs, consisting of three water holes five feet in diameter, one foot in depth, and located in hard sand; that they neither overflow nor go dry; that, as the water is clear and as there is nothing but poor grazing in that vicinity, he thinks it is not advisable to expend any money there; that from that place to within three miles of Chee's store is a stretch of bad land devoid of growth, the last three miles being on top of a mesa on which there is grazing. (See Powell's map).

At Chee's store on Carrizo Creek the lieutenant found a well 8 feet deep which supplies 200 animals per day and never goes dry, and states that on referring to the map and sketch herewith transmitted, marked "I," it may be seen that the creek narrows and runs through an opening into the mesa; that a dam could be built there on bed-rock where the creek would rise to the surface; that, although the water thus obtained could not be utilized for irrigation, yet 10,000 animals could water there while grazing on 50 square miles of land in that vicinity; that stone is in abundance on the spot; that he did not compute the thickness of the dam, leaving such calculations to experts, but that it should be at least one and a half times the height; that an overflow could be dug 200 yards up the creek, 100 yards in length, with a cross-section of two yards, requiring 200 cubic yards of excavation through loose soil, and that Navajo labor can be had there at 75 cents per day and board.

Three miles to the west of Chee's store is Round Rock marked "Tsen-a-kahn" on Powell's map, which Lieut. Suplee alleges is slightly erroneous as to distance. He states that on the east side of the mesa half way up he discovered two mud holes, to which animals grazing on the top of the mesa come to water; that these can be converted into a well as shown on the drawing last referred to; that the excavation for this purpose would be a red clay; that a one-inch pipe to act as a syphon should be placed under the soil and cut so as not to entirely drain the soil; that four troughs 1 foot by 1 foot and 12 feet long should be used, resting on the solid ground; that a pipe four feet in length should be used for waste purposes; that the well should be walled over leaving a manhole in the top for cleaning purposes; that down the creek from Chee's store there exists a side creek where the water rises to the surface for a distance of 200 yards and again sinks, but that a dam as recommended would exclude time and money which might be spent on this dry "wash."

Three miles to the south of Chee's store a similar creek was found which runs through a mud channel 75 feet wide and 20 feet deep, where the lieutenant thinks the Navajos, if enterprising, could construct a brush-wood dam two feet high which would water 2,000 sheep.

From Chee's store the lieutenant and detachment marched down Cañon Del Muerto, discovering on the way some soil banks similar to those in Cañon De Chelly, and reached Chin Lee's store on October 9 last, where a well 3 feet in depth was dug which furnished an abundance of water, and from which point he made side trips on the western slope of the Chin Lee Valley. He states that in this locality there should be bored three artesian wells, from each of which should be constructed a ditch as represented on map marked "J," herewith transmitted; that he omits to submit an estimate of the cost of boring an artesian well, for the reason that his instructions say it is impossible to compute the cost of the same; that, as the ditch must depend on the flow of water, the cost of that also is not computed; that the land is however as level as a floor and the soil easily worked, and that the Navajos could dig the ditches without any trouble. As regards the feasibility of artesian wells, he adds that he has reason to believe that water can easily be found, as they would be sunk in a basin, the sides of which are 3,000 feet high and 40 miles apart; and that springs when found issue from the face of solid rock as if the water were forced from below.

He states that Look-as-Ski spring flows about half a gallon of water per minute; that it could be improved by one charge of blasting powder at the crevice from which the water flows; that, by building 3 feet from the opening, a masonry wall 2 feet thick, 3 feet high, and 6 feet long, a basin would be formed with a capacity 300 cubic feet of water; that all the approaches to this spring are solid rock; that now only one flock waters there and for which there is not sufficient water; that Valley No. 1 (see Powell's map) contains 12 square miles of grazing land; that the center of that valley and also of valley No. 2 would make good farms if they could be obtained for irrigation; that if wells would not flow wind pumps should be used; and that no one lives in or uses this valley at present, because of a lack of water.

The lieutenant reports that there are a few small springs along the Black Mountains which sheep trample almost out of existence in their haste to quench their thirst; that there are five or six springs along valleys Nos. 1 and 2; that on leaving the valley he entered the foot hills and proceeded up between narrow steep banks of mud and clay for half a mile, where he found mud dams one foot in height, and mud holes which the Navajos had constructed in their shiftless way; that four men could clean out one spring in a day, laying 60 feet of 1-inch pipe to six troughs placed down the ravine, and that 200 feet of barbed-wire fence stretched from one side of the precipice to the other would effectually keep stock from pipe and spring to which they now crowd to its very source.

On crossing over a slight ridge to valley No. 2, described to be an exact counterpart of valley No. 1, except it is twice as large, he found a small spring called Maito or Coyote owned by a Navajo Indian, which was walled over and six feet of one inch pipe laid to two troughs, from which 30 head of cattle, 300 ponies, and 1,000 sheep water. This Indian has built for himself a stone house with windows and doors, and is very anxious to engage in farming in that vicinity, if water can be had.

The lieutenant thinks that an artesian well, if successful, would irrigate quite an extent of rich soil in that vicinity which would support

several Indian families. Passing from valley No. 2 towards Chin Lee's store, the lieutenant ascended a long sloping ridge and then went down into a basin where the water, he states, has worn its way into the Chin Lee Valley at notch No. 1, indicated on maps herewith transmitted, marked "K" and "L".

He adds that this notch is an opening into the face of the mesa through which the water rushes in the rainy season, as shown by the arroyo; that it drains about 12 square miles; that it could be dammed at little cost, as rock can be had on the ground; that ditch "B" represented on the said map "L" should be 3 feet deep, 3 feet wide at the bottom and 5 feet wide at the top; that it should be continued so long as the water supply would hold out, through soil easily worked, extending at least 3,000 yards, and requiring 4,000 cubic yards of excavation; that ditch "A" represented thereon should be 2 feet wide at the bottom, 4 feet wide at the top, and 3 feet deep, and 1,500 yards long, which would require an excavation of 1,500 cubic yards of earth, remarking that the soil in that vicinity is easily worked and quite level, not requiring much water for irrigation.

In valley No. 3, which is 8 miles wide and 10 miles long, Lieut. Suplee states that he found four springs, the location of which he represents on map transmitted herewith marked "M;" that spring No. 1 is of similar formation to those found in valleys Nos. 1 and 2, map of which is also transmitted herewith marked "N;" that spring No. 2 issues from under the rock, and that one man could in two days and a half form a basin into a good rock, the basin holding 100 gallons of water; that this spring would fill the reservoir thus constructed every twenty-four hours; that spring No. 3 would require a well 3 feet deep and 3 feet in diameter, 10 feet of 1-inch pipe and two troughs; that spring No. 4 would also require a little blasting to give it a natural rock basin; that the soil where artesian wells are located is black and rich; that in two or three side valleys there are farms which may be worked without irrigation, and that west of these valleys he found the country to be hilly and rough, with but little or no grazing and no water, though he thinks the Navajoes, if they desired, could give the location of springs, and that when they see that the Government is improving their springs, they will furnish all the information in their possession respecting the water facilities.

He further states that valley No. 4 is simply the back or top of a mesa, and can not be irrigated; that Pregaatzo or Black Lake is simply a depression, and was found to be dry when he rode through it; that it has no outlet and consequently holds all the water which flows into it; and that this valley contains 300 square miles of fair grazing lands where farmers in valleys Nos. 3 and 5 graze their flocks while farming the lands below.

Valley No. 5, represented on map K above referred to, is the head of Chin Lee Creek. The lieutenant states that this creek is dry, as are all other creeks in that section of the country, except Tee-a-lee and Gonando; that this valley is narrow, being about 1½ miles wide, shut in by steep mesas; that in one or two places where farms are indicated they have no irrigation; that water can be had by digging 3 feet into the sandy bed of the creek; that at spring marked "A" he found three holes in mud crust containing standing water without overflow, from which he judges that most of this valley could be cultivated without irrigation; that in this vicinity 500 acres could be cultivated with small expense of ditching, as the ground is quite level; that spring "B," indicated also on the map last mentioned, is in a mud bank, and should be formed

into a well which should have the exact dimensions as the spring at Round Rock already referred to; that the valley 1 mile north of Eagle Craig is occupied by three families; that a Navajo named Hostinez has dug a well 10 feet deep in that valley in which he found 2 feet of water; that this Indian should be furnished with a pump, as he has built for himself a modern house of stone and his settlement is of a permanent character; that at the head of the valley is a cañon, up which was found a little water for stock, but not enough for irrigation purposes, yet the Navajoes produce corn and melons without irrigation.

Three miles west of Eagle Craig the lieutenant found springs, called by the Indians "Sheep Springs," or "Koi Soi-Tes-In-Lee Springs," where 10 Navajoes were busy trying to put it in order. He adds that this is the largest spring found upon his whole trip; that it flows 5 gallons per minute; that all that is needed there is 275 feet of 2-inch pipe to conduct the water into a natural basin which the Indians have constructed and cleaned out; that 75 feet below that spring is another with a flow of 2 gallons per minute, the water being conducted into a trough 4 feet long; that this trough should be replaced by two others 1 foot by 1 foot and 12 feet in length.

Upon returning, by way of Eagle Craig, to the Gonando in the vicinity of Cotton's store, the lieutenant inspected the arroyo Colorado, which he found goes dry about a quarter of a mile below the store referred to. He found, however, that 3 miles upstream a natural lake exists in which water remains the year round, and states that 6,000 feet up the stream from this lake (see map marked "O") a brushwood dam 200 feet long and 20 feet wide should be constructed for the purpose of turning the course of the stream, which at that point flows 100 gallons per minute, into an artificial channel 6 feet wide at the bottom, 8 feet wide at the top; that the excavation is an easy soil and would run the stream through a notch to the lake, 200 feet thereof to be 6 feet wide at the bottom, 14 feet at the top, and 15 feet deep, aggregating a total of 7,121 cubic yards; that the lower end of the lake should have an embankment 3,500 feet long and 30 feet thick at the base, and 15 feet high, requiring 60,000 cubic yards of excavation; that the lake itself drains 8 square miles of land; that the freshets and the constant running of the stream would form a lake 10 feet deep covering over 200 acres of gound; that the irrigating ditch should have a race and head gate, the race to be constructed 2 feet by 2 feet and 200 feet long, of boards obtainable at the government sawmill, 20 miles distant; that the same should run from 150 feet inside of embankment to 20 feet outside, where the gate should be made to regulate the flow; that the ditch should be 5 miles long, 3 feet wide at the bottom, 5 feet at the top, and 3 feet deep; that if the ditch should be constructed in this manner it would irrigate 1,000 acres or more; and that the soil is firm except for 1,000 feet at the head of the ditch, where loose soil and bowlders occur.

He recommends that all Navajoes engaged in digging and walling up their wells should be furnished with hand pumps and lumber for troughs; that springs be converted into wells to be drained by means of siphons; and thinks in all his recommendations for work, material can be hauled in wagons from the railroad down the entire length of the Chin Lee Valley to every stream mentioned by him; that while wind pumps no doubt afford plenty of water, yet their use among the Indians he regards as questionable, because they require constant attention. The lieutenant expresses the opinion that there are other springs on that portion of the reservation investigated by himself, but

as the Navajos were unwilling to furnish him information as to the whereabouts of water he was unable to find them.

From an examination of the maps transmitted by Lieut Suplee, it is observed that he has indicated the places where artesian wells might be bored and the direction from which ditches should be constructed for the purposes of irrigation. These wells are indicated by means of blue pencil circle, and the ditch by a blue line leading therefrom bordered by ink dottings, accompanied in most instances with the words, "artesian well and ditch;" but it does not appear in his report that he recommends the construction of the same. In fact he remarks in the beginning of his report that as his instructions say it is impossible to compute the cost of artesian wells he omits estimate for that purpose, and as the ditch must depend on the flow of water from the well, the estimated cost of that also is not computed.

REPORT OF LIEUT. GUROVITS.

Lieut. Gurovits refers in his report to Powell's Geological Map above mentioned, and states the points at which he camped on his tour of investigation are indicated thereon by a square in black and numbered in red; that the numbers in black represent the places where water is located; that the letters A, B, C, etc., inclosed on map by dotted lines, show a tract of country where good grass now grows, but it is not, on account of lack of water, used; and that where windmills are recommended by himself there are favorable conditions for irrigation. He submits an estimate of the cost of a bore well, which, in detail and amount, is similar to that framed by Lieut. Brown given in full above.

He began his investigation south of the Tunitcha Mountains near the center of the reservation, and located there nine springs, numbered on Powell's map from 1 to 9. These springs he represents as flowing from 1 to 3 gallons each per minute, in the vicinity of which there appears to be no arable land. They shed into the Tse-a-lee Creek south of the mountains referred to. Following the trail from this point almost due north, which is represented as being very rough and steep, he reached the flat on top of the mountains, where he found an area of 6 square miles of good grazing lands. He states that the several lakes in that vicinity marked on Powell's map are mere water holes; that the only stock observed on the plat referred to consisted of two sheep herds and about 250 horses, the reason being, perhaps, on account of the difficulty of ascending the mountain; that about halfway up that trail he found one spring marked "10" on map, the flow of which was increased with a little labor from 40 quarts per minute to 16 gallons per minute, and that this and similar springs should be opened up and protected by a "covered-up spring house." He accompanies his report with a map marked "1," herewith transmitted, which represents and explains the work necessary to be done on the spring, with the remark that the ground in that vicinity is limestone formation and rock, and that the overflow from the spring would quickly be carried into Lukachuke Creek, as it is at present.

At the point marked "11" on Powell's map, another spring was located, which he thinks should be protected by a wall about 8 feet high, adding that a pump and trough would be desirable there.

The lieutenant states that the west slopes of the Lukachuke Mountains are so steep that only the lower portion sheds any water worth consideration; that the water is carried by various and constantly changing courses into the Carrizo Creek; that by digging from 2 to 4 feet in the dry bed of this creek, water in plenty was found in ten different places; that the banks of the creeks in that locality vary from 10 to 50 feet in height; that there are several farms along the creeks referred to, which produce corn and melons, and which the Navajoes might be induced to cultivate should they be furnished with pumps and troughs for stock-water purposes.

Lieut. Gurovits next examined the country lying to the west and north of the Carrizo Mountains, and states that all the water shedding from these mountains on the west and north sides thereof is utilized until it reaches sandy soil, when it disappears; that the spring marked "Hospitito" was found to be dry, but that after digging to a slight depth, 2 gallons of water per minute were measured; that another spring located as No. 12 on the map requires a spring house, the overflow being suppressed and mired; that the tank indicated on Powell's map could not be found, but that a place marked "T" thereon was found after following a hardly perceptible trail for more than 2 miles over rocks without any sign of grass or wood; that the water accumulates there in a natural basin of rock formation, the contents being about 1,000 gallons; that there is an overflow which disappears over a fall 50 feet high, almost perpendicular; that upon examining the surroundings of the natural basin he found two splits in the rocks from which the basin is fed; that with a "picket pin" he enlarged one of those openings, which resulted in an overflow in ten minutes to 27 quarts per minute, more than one-third of the increase; and that he believes that water could easily be found in that vicinity by boring therefor.

The section of country represented on Powell's map within the inclosure marked "A," is said to produce corn, and it is believed by the lieutenant that at least 25 square miles of grazing country could be made available for stock by means of developing the springs at the place marked No. 13 thereon. He states that in addition to the springs at No. 13, there are two natural basins similar to the one above described, having a capacity of about 1,200 gallons each; that there is no trail leading to this water, the place being known by a few Navajoes as Hoh-wass-ha-han.

He states that the water found in Gothic Wash and Sahotsoidbeazhe Cañon is of no use, being salty; that the animals refuse to drink it; that there is no vegetation in the vicinity thereof; that the taste of the water is more salty than the usual alkali water; that a whitish crystallized deposit indicates more salt than the usual alkali deposit.

He recommends that at least one bore well with windmill be placed in the country marked "A," above described.

He observes that the points marked 14 and 15 on Powell's map are worthy of development; that the quantity of water flowing from 14 is about 20 gallons per minute, and that from 15, 30 gallons per minute, the same being conducted into natural basins with rock bottoms; that they may be reached by diverging from the main trail about 1½ miles; that they are called respectively by the Indians Tsa-Tsak-Sah-Hat-A and Tsa-Tsil-Tso, the latter being known also as Big Oak Spring.

The lieutenant thinks that the area marked "B" is only about two "contours" above the level of these springs; that everything leads him to believe that water would be found if bored for; that the pool marked on Powell's map west of the tract inclosed within "B" was found to be dry, and that the area therein embraced is about 20 square miles. He recommends that at least one bore well with windmill be located in this section of the country.

He reports that Arido Creek, Desert Creek, Montezuma Creek Recapture Creek, Cottonwood Wash, Butler Wash and Comb's Wash,

the five last named being on the north side of the San Juan River were found to be dry; that only one strip, marked by dotted lines near Bluff City, is recommended for irrigation; that the people of that place have built about 9 miles of irrigating ditches on the north side of the river; that they produce corn, wheat and oats, alfalfa and timothy; that the soil is alike on both banks of the San Juan at that place; that 3 miles of ditches would afford sufficient water to irrigate some 260 acres of land; that the ditches, if constructed, should be 5 feet wide at the top, 3 feet at the bottom, and 3 feet deep; that the inhabitants in that vicinity, some 35 families in all, offered to perform the work indicated for the sum of $650; that they are interested in the matter; that they could complete the work within one month should a contract be made with them; that they would not demand pay until the work could be inspected by some competent official; that they expressed a willingness to teach the Navajoes the principles of irrigation, and that, judging from the success of irrigation on their side of the river, he is of the opinion that the amount named is small enough for the work proposed. He recommends that the ditch as described be constructed, and that the contract therefor be awarded to the people of Bluff City.

He states that the best spring found in the district of country investigated by him is at the point marked "16" on the map, called by the Indians Thon-nadle, known in English as Always Flowing, the flow thereof being 182 gallons per minute; and that there is another spring at the point marked "17," known as To-doh-konch.

He also reports that the best grazing land in the entire section of country examined by him was found in the Keam's District marked "D" on Powell's map; that at least one artesian well should be bored within that space; that on account of the large area, one additional windmill is desirable; that in traveling from 8 a. m. until about 2 p. m. he found good grazing as far as could be seen to the right and left, the bunch grass being 2½ feet high; that no animal life was observed during the entire trip; that a number of bleached skeletons indicate that horses and cattle perished there for want of water; that he was informed that no sheep herd had grazed there for years; that one spring, marked "15," furnished them 1 gallon of water in thirty minutes; that as water can be found anywhere south of Cedar Ridge as far as Tuba City and further by digging from 4 to 8 feet, and considering the elevation of Navajo, Pah-Ute, and Colorado creeks, one is justified in the belief that an artesian well would furnish an ample supply of water, and that the entire area inclosed marked "D" would be used by the Navajoes upon development of water therein.

The lieutenant further reports that he was also informed that east of Keam's district, towards the Colorado River, near Navajo Spring, there is a valley known as "Horse Valley;" that he was unable, however, to find any trail leading to it, and that, if grazing facilities exist there as found within the Keam's district mentioned, that valley could be made available by the development of a water supply.

He visited the point known as "Kai-peto" Spring, and northeast thereof, upon the White Mesa, marked "E" on map, he found good grazing, and reports that after reaching Navajo Creek the country east of the same becomes extremely rough, showing a rock formation throughout, and so south of Pah-Ute Cañon as far as Shan-to Spring, where the water flows into Marsh Pass, and that west of the spring last named the grazing was ascertained to be fair, but unused.

He states that upon leaving Chin Lee Valley the general configuration of the country was ascertained to be very rough until that portion

thereof marked "C," near Aga-Thla Needle, was reached; that there plenty of grazing exists, but no water was found; that in traversing the country from Bluff City in the direction of a trail southwest, after leaving Camp 14, no water was found until No. 15 was reached; that he marched some 20 miles with good grazing on both sides until necessity compelled him to make camp by hunting for water, which was found in a hole at the point marked "15." Here he recommends that at least one bore well, worked by windmill, be established. He states that in order to reach the next water he had to make Te-en-ta Creek; that this creek is one furnishing all the water used by the Navajos residing upon and cultivating Te-en-ta Mesa; and that he thinks that all water available there is now used to good advantage by the Indians.

The lieutenant recapitulates the work which he recommends to be done as follows:

The spring marked 10 to be protected and a spring house to be built. (See map 1.)
The spring marked 11 to be covered up, hand pump and trough to be put in place. (See Powell's map.)
The spring at Hospitito to be covered up, trough furnished.
The spring marked 12 to be protected and spring house built; trough furnished.
T and 13 convince me that water will be found by boring in area A; windmill pump and trough required.
Fourteen and 15 convince me that water will be found in area B; windmill pump and trough required.
About 25 hand pumps, in working order, with troughs, to be turned over to reliable Navajos in Chin Lee Valley and on banks of Lukachiuca and Carrizo creeks.
Irrigating ditch to be built by the inhabitants of Bluff City, 3 miles long. (See San Juan inclosure.) Cost, $650.
At least one windmill-pump with trough in the area marked C.
At least one artesian well to be bored in space marked D and one additional windmill pump with trough. The grazing is the best I found there. I traveled from about 8 a. m. until about 8 miles from Kai-Peto. Bunch grass about 2½ feet high and no sign of animal life discovered. Considering the elevation of Navajo Creek and also of Colorado, as well as the fact that by digging north of Tuba City before reaching the Navajo line, where Cedar Ridge commences, I found good and plenty of water at about seven different places, 4 to 8 feet deep. I have no doubt that the entire area marked on the maps will be used by Navajos when water is furnished. I am told that not one herd ever goes near that grazing at present.
Kai-Peto Spring to be protected by spring house and trough furnished.
Spring 15 to be opened up and hand-pump with trough needed.
T-Hon-A-Dle Spring and San Juan Sheet convince me that water will be found at E. Windmill pump and trough needed.
At least one windmill pump and trough in area marked C.
If all these mills are furnished, about 150 square miles of grazing will become available which is now never used.
One well certainly should be bored and the district marked D should be tried. If successful there, I have no doubt that all others will give water. After the water becomes available there will be an excess of water available for irrigation.

It does not appear that the reports mentioned contain an estimate in every instance of the amount necessary to be expended in executing the plans as proposed in detail therein. I have therefore caused a rough estimate to be made of the cost of the improvements recommended by Lieuts. Brown, Suplee, and Gurovits, respectively, and it is ascertained that the amount necessary to be expended to clean out, wall up, and otherwise improve the wells and springs, to sink the bore wells, and to construct the irrigation ditches, flumes, dams, laterals, etc., in accordance with and as specially recommended by these officers, aggregates $84,500.

There is now available on the books of this office about $20,000 for irrigation and water supply on the Navajo Reservation, appropriated at various times by Congress.

In view of all the facts in the case, I have the honor to recommend that this report, together with the accompanying documents and maps,

be transmitted to Congress, and that an appropriation of an additional sum, viz, $64,000, be asked for, the same to be used for the purpose of developing a water supply and a system of irrigation sufficient to meet the actual and immediate needs and wants of the Navajo Indians, upon the general plan submitted by the military officers (draft of an item herewith).

It may be proper to add that these officers in their respective reports speak of the desirability of boring artesian wells at various points on the reservation in order to afford a still more abundant supply of water for stock and to further extend and improve the irrigation system planned; but as they in no case state the probable cost of the same I make no estimate therefor, and no appropriation is asked for, at this time, for that purpose.

It is remarked that the serious situation now existing among the Navajos led me, after mature deliberation, to recommend that the President be requested to give the necessary instructions to cause an examination and survey of the Navajo Reservation to be made, maps, etc., prepared, and report submitted, with a view of showing the best plan of opening up a water supply and establishing an irrigation system thereon. The work has been done and the plan submitted under the direction of the War Department, and the reports of the officers above mentioned have been carefully scrutinized by the commanding general of the Department of Arizona and have received his approval in every particular. The War Department requests, should these reports and maps at any time be printed under the direction of this Department, to be furhished with copies of the same for the files thereof.

In view of all these facts and the further fact that the plans proposed appear to be the only proper solution of the vexed Navajo question, it is hoped that Congress will see fit to make the appropriation asked for. Should the appropriation be made and the water developed and irrigation established as proposed, it is believed that the roving, nonreservation Navajos could be returned to the reservation and induced to remain thereon, and that the reservation Indians themselves could be restrained from going beyond the official limits of their reservation for the purpose of securing water and grass for their flocks and herds.

Lives, both Indian and white, have already been lost by reason of conflicts between the two races, and, should Congress fail to grant the relief asked for, the situation among those Indians will become more and more serious, and I apprehend that other lives will be sacrificed in other conflicts which will surely follow.

All the papers in the case are herewith returned and copy of this report submitted, together with tracings of the maps transmitted with the reports of the military officers, the same having been prepared for the use of Congress.

Very respectfully, your obedient servant,

T. J. MORGAN,
Commissioner.

The SECRETARY OF THE INTERIOR.

DRAFT OF AN ITEM FOR INSERTION IN THE PENDING INDIAN APPROPRIATION BILL.

For the construction of irrigating ditches and the development of a water supply for agricultural, stock, and domestic purposes on the Navajo Indian reservation, sixty-four thousand dollars, to be expended in the discretion of the Secretary of the Interior.

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