

MARA I, RG 15, Entry 655, Box 43



ANNUAL REPORT

- 1917 -

H. F. ROBINSON

*Superintendent of Irrigation*

ALBUQUERQUE  
N. M.

Annual Report.  
H. F. Robinson ,  
Superintendent of Irrigation,  
Albuquerque, New Mexico.

FISCAL YEAR 1917.

To  
The Chief Engineer,  
U. S. Indian Service.

Aug. 6 1917

Respectfully forwarded to the Commissioner  
of Indian Affairs, with the recommendation  
~~that it be~~ assurance

*that it is all worth reading,  
but that the portions marked  
with a blue pencil are of special  
interest, and should be read by all  
having to do with the Reservation  
in this district.*

(signed) W. M. Reed,  
Chief Engineer.

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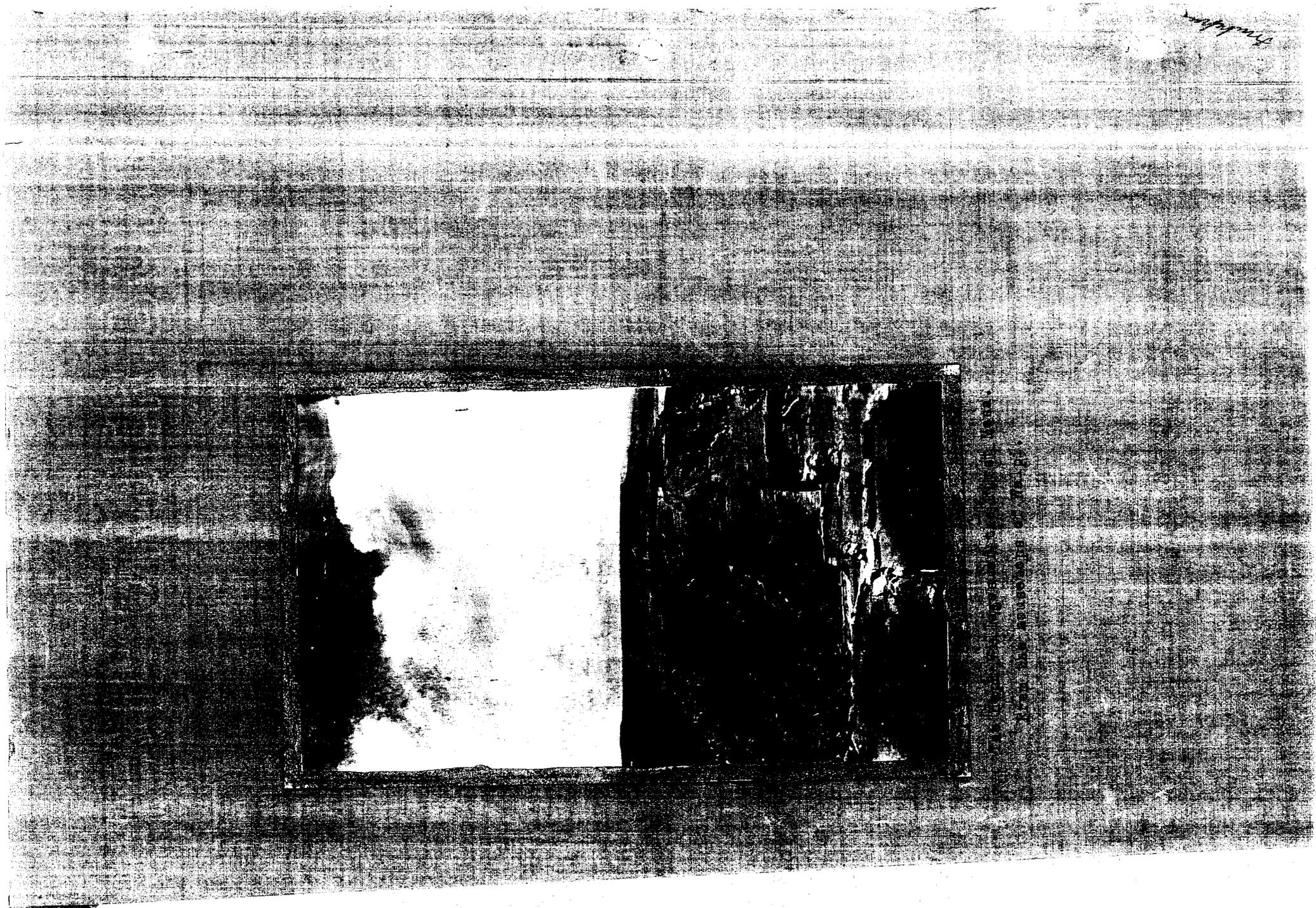
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Annual Report  
Fiscal year, 1917,  
H. F. Robinson,  
Sup't of Irrigation.

5-1143

DEPARTMENT OF THE INTERIOR  
UNITED STATES INDIAN IRRIGATION SERVICE  
SUPERINTENDENT OF IRRIGATION

Albuquerque, N. M., July , 1917.

Mr. W. M. Reed,  
Chief Engineer,  
Washington, D. C.

Sir:

I herewith submit my annual report for the fiscal year 1917, covering the operations in District No. 5.

THE DISTRICT.

This District, as is shown on the accompanying map, comprises the states of Colorado, New Mexico, the northern half of Arizona, and a small part of Utah, and includes the following reservations and pueblos:

Reservations	Pueblos
Navajo	Taos
Hopi	Picuris
Zuni	San Juan
Supai	Santa Clara
Mescalero Apache	San Ildelfonso
Jicarilla Apache	Nambe
Southern Ute (Allotted)	Tesque
Ute Mountain	Cochiti
Allotted Navajo Indians (Pueblo Bonito)	Santo Domingo
Canyoncito Navajo	Santa Felipe
(and several other reservations for which no work has ever been done lying within the bounds of this district)	Sandia
	Santa Ana
	Zia
	Jemez
	Isleta
	Laguna
	Acoma

The combined area of these reservations and grants amounts to 14,166,041 and the population is about 36,000.

NAVAJO-MARSH PASS.

The Marsh pass project is a small one in the Navajo Reservation north of the Black Mountain district. This point is 90 miles north of Tuba or about 180 miles from Flagstaff; 170 miles northwest from Gallup and 130 miles due west from Farmington, New Mexico. The elevation is about 6000 feet and the average annual rainfall is from seven to eight inches.

At this point a small boarding school is located. The surrounding country is well populated by Navajos.

The project is to divert water from Laguna Creek, which has a normal flow of from six to ten second feet and flood flow of considerable magnitude.

The water is to be diverted from this creek by the construction of a rock filled crib dam and the water is carried a couple of miles to an old lake bed, which by the building of a small earthen dam will form a storage and equalization reservoir. The water then drops into a natural channel and is diverted some distance below into a ditch some three miles long, covering approximately 500 acres. If the water supply warrants it, this can be extended at small cost to cover 1000 acres of land.

At the beginning of the present fiscal year the project was nearly completed. The canal was practically all excavated, most of the structures were in, the crib

for the diversion dam had been extended entirely across the stream, and a small amount of the rock filling placed. In July there was a large flood that came down the stream in the night, caused by rainfall in the upper part of the watershed, no sign of which was seen at the project. About one-half of the crib, not being weighted with rock, was carried out and a considerable portion of the material lost although much of it was salvaged after the water went down. Work was continued on the minor structures and on the inlet to the canal during July and August.

Assistant Engineer Donald M. Baker was in charge and had submitted his resignation at an earlier date, requesting to be relieved July first, but stated that he would stay until relieved by the new appointee, if the relief came within a reasonable time. As it seemed impossible for the Civil Service Commission to fill this position, about the 20th of September Mr. Baker left the project, mailing his formal resignation and was out of the state before the resignation was received here.

As the weather conditions are very severe during a part of the winter no effort was made to reopen the work until this spring, expecting that in the meantime an assistant engineer would be appointed to continue the work. There having been no appointment made by the first of May, I hired an engineer by the day and took him up there the 14th.

It was found that when Mr. Baker left he had not stored the tools and supplies before his departure, but had left them scattered up and down the work and a good many of the tools and some material had been stolen or lost during this time.

The man appointed was Mr. G. S. Willhoite. He commenced work by clearing out the wrecked portion of the dam and securing material in the shape of rock and logs for its completion. Owing to the scarcity of labor only a small force could be secured and practically no teams until, almost the end of the fiscal year.

Such material and supplies as are needed to complete the work have been ordered and it is hoped to finish the project during the present summer.

Authority was given for the subdivision of the land under ditch into ten acre tracts and a portion of this work was completed before Mr. Baker left and the balance will be completed and a plat will be filed with the Indian Office by the time the project is completed.

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NA 14070 (9-87)

UNDER GROUND WATER DEVELOPMENT.

The area covered by the Navajo and Hopi Reservations, while not an absolute desert is an arid region, most of the country having a very scanty rainfall, which is very irregularly distributed throughout the year.

The greater part is of a character on which the average white man would be unable to more than exist, although the Indian population from generations of living here, manages not only to make a precarious living, but in many instances what would be considered a competency by the white man.

While the rainfall is very scanty it is still sufficient to bring to maturity grass and other vegetation in most parts of this country, forming good grazing lands at certain times in the year.

Notwithstanding the fact that the feed conditions are fair for grazing, the size of the flocks and herds of the Indians have been limited heretofore from the fact that the water supply has been insufficient and there are great tracts of land where no surface water exists, other than an occasional small spring or seep or in temporary water holes following storms. In other words the limit of the size of the flocks and herds is set by the existence or non-existence of a water supply, not by the feed.

It is because of this that the Indian Service

has been endeavoring for the past six or seven years to increase the water supply of these reservations. Water is desired in this country both for stock raising and irrigation though not much attention is given to developing underground water for the latter purpose.

The proper water supply for a grazing country involves not a few large supplies but many small ones; not an increase in quantity where water now exists, but a moderate supply at various points where at present it is not found, and the points where water is needed is where advantage may be taken of the grazing areas of the reservation.

In considering the development of water in new places it must be borne in mind that too great a quantity of water at any one place when there is a scarcity at others will have a tendency to cause that part of the range to be over stocked and as at no place is the grass and natural feed very luxurious more harm than good may be done, by the overgrazing and the stock trampling out the grass.

Stock raising, especially the raising of sheep, on these reservations has proved the salvation of the Indians. They are natural herdsmen and for a number of years their flocks have increased to about the maximum figure that the natural water would supply, although the limit of grazing has not nearly been reached. The natural increase of the flocks would



The watering hole at the end of the road is the only one available there. The cattle are seen drinking from the tank.

reach a maximum point, then there would be a season of drouth and the mortality would be very great reducing the flocks to that number that could exist on the water supply.

Under Ground Water Development in this District can best be considered by dividing it into five headings:

- (1.) Deep Well Drilling(Exploring for Artesian Water.)
- (2.) Shallow Well Drilling( to 300 ft.) Navajo.
- (3.) Well Maintenance.
- (4.) Spring Development.
- (5.) Shallow Wells, Pueblo.

The Office is familiar with the first efforts in developing artesian water where a well over 1300 feet was drilled at Keams Canyon, in order to determine whether it was possible to secure artesian water at any point south of the Black Mountain country. The trial resulted in failure and on the advice of the geologists the rig was transferred to the Choiska Valley; a well put down at the head of that valley some nine miles east of Tohatchi and about twenty-five miles north of Gallup. Artesian water was found at about 1000 feet and just below 1100 feet the flow was increased to 6500 gallons an hour. This proved conclusively that artesian water could be found in this valley, but the Indian Office decided that the cost of putting down such deep wells would not be justified by the results and I was directed not to go to such depth in the future; but to develop water at the shallower depths, securing



Two pack animals, mules or horses, standing on a bank next to a body of water. The animals are facing right. The photograph is mounted on a textured, dark fabric surface.

artesian water if possible but if flowing wells could not be made to follow the plan of putting in pumps and windmills as is done in other parts of the reservation.

The rig was moved north and east and good artesian flows have been developed at depths varying from 205 to about 500 feet. Other details will be given of these wells at another part of this report.

Two well rigs have been operated throughout the year putting in the shallow wells; one of them has been operating along the north and northeast side of the Black Mountains and in what is known as the Kayenta country; the other one, at the beginning of the year was working in the lower Chin Lee valley in the vicinity of Round Rock, but early in the year was moved to a point just within the border of the Hopi Reservation, but on land entirely occupied by the Navajo, lying south and southwest of the Black Mountains. It has been working west in the valleys coming down from this high ground during the year. An inspection of the map accompanying this will show the location of the various wells put down during the past year as well as those put down in former years.

The Indians are very anxious to have the well work extended as fast as possible, and in most sections they are cooperating with this service in every way



An artesian well in the desert.  
A well on the Navajo reservation.

possible; are furnishing teams to help in moving the rig, hauling wood and water and doing other work of a like nature without charge as they feel that they will be benefited to such an extent that they are willing to donate time and labor in helping the work along.

Well maintenance is under the charge of Foreman Womack and the actual work and inspection is done by men under him.

A camp is maintained at Chin Lee and from this all the wells in the Navajo country are visited at frequent intervals in order to oil these windmills and attend to all minor repairs, that may be necessary to windmills, pumps, troughs and tanks. Polacca is the headquarters for the Hopi inspection and maintenance.

This maintenance work is absolutely necessary for any country and doubly so where the wind carries a great deal of sand and dust and the atmosphere is so extremely dry. Unless the windmills are regularly oiled the bearings soon cut out. Owing to this necessity for frequent oiling we have been installing a new type of mill, which is known as the auto oiled mill, in which all of the gearing and working parts of the mill are inclosed in one dust proof case, which contains a reservoir filled with oil and all of the working parts are automatically lubricated in a manner similar to the oil distribution in an automobile. It is only necessary

to fill this oil reservoir once or twice a year. While the cost of this mill is somewhat greater than that of the open type the difference in the cost will more than be offset in one year's operation and maintenance.

The oiling of the mills is only a small part of the care, however. With a well developed in the fine material encountered in this country the pump leather and valve last but a short time, in some wells only a few weeks. Then the pump rod must be pulled and a new leather inserted, at other times wells that are pumping considerable sand are frequently badly damaged during periods of calm when the windmills do not run and sand settles on top of the valve in sufficient quantities to weigh it down or even to fill the cylinder and when the windmill again begins to turn the valve is immovable resulting in the breaking of the pump rod or the wrecking of the cylinder connection. A report is sent in for each well visited with a memorandum of the work done, from which we keep track of the work and the costs.

In the well drilling we have had much trouble in developing a sufficient quantity of water at many points when it is found in sandstone owing to the fine nature of the sandstone and the slow movement of the water.

Experiments have been made during the past year in shooting the wells with very gratifying results. In drilling one of the wells with Rig No. 4 a fairly good

strata of water bearing sandstone was encountered but the water came in so slowly that with the sand bailer at work the entire amount of the flow would be bailed out by lowering the bucket twice. This well we shot with a small charge of ordinary 40 per cent dynamite and after cleaning it out the flow had increased to such an extent that it was impossible to pump it dry with a pump and it is proposed hereafter to shoot all the wells developed in sandstone, that are of this character.

The wells with the artesian flow are also developed in rather fine rock and we are going to try the experiment of shooting the last one put down, believing that the flow can be materially increased in that manner.

In the report of Foreman Womack for the month of June just received he makes some general statements which cover conditions very clearly and I will quote him to some extent that you may get the viewpoint of the man in the field.

"The work in the Moqui Reservation is confined to the development of water for domestic and stock use, by developing springs, making surface water reservoirs, drilling wells (50 to 300 feet deep) erecting windmills, tanks, troughs, etc.

Owing to the fact that we have increased the water supply the Moki Indians have increased the sheep and cattle to such an extent that we cannot keep pace with the demand for more watered range, notwithstanding they have three or four times as much range as they had five years ago. The Indians have become interested in the cattle and sheep business and are amking use of all the water that has been developed. Many of them have in-

creased their herds three, and in some cases, four hundred per cent in the last five years. This progress may be expected to continue if water can be developed in more of the outlying country. In years past the Indian did not care to have many sheep as he was forced to lose them the first dry year as there were no wells or permanent water, and naturally the sheep would die off to a number that could live on the amount of water remaining. But now, with wells, we have developed water that is not affected by the drouth and they can see where it is possible to raise large numbers. Also we have confined the water in troughs where it can be clean and not so many die from drinking stale water. Many of the Moki Indians are abandoning the village and moving out to the windmills where there is an abundance of water, living there with their stock instead of driving them into the village at night.

We have drilled many wells in the part of the Moki Reservation inhabited by the Navajos and developed six good wells which has developed a large area of excellent grazing country. This will add to the available grazing about 30 per cent and will take care of thousands of sheep and cattle. The above country was almost without water. If we get a good flow of water in the Cedar Ridge Country, which is the next move with Well Rig No. 4, we will add a large country to the west side of the Moki Reservation and the east part of the Western Navajo Reservation.

#### Navajo Reservation.

We have kept in a repair all the wells on the Navajo Reservation and maintained a good supply of water. One string of wells on this reservation is 150 miles long and other strings leading off from this string make a distance to travel to take care of them about 350 miles and this is covered once a month for the reason that if one of the wells fails it is necessary to move all the stock to another well as the herds are in the most cases so large that they cannot find sufficient amount of water at the springs.

The Indians realize that they have a permanent supply of water and are giving their attention to the stock business and are increasing the number in great proportions and are willing to help in any way that they can to get more water.

Many of the Indians are building houses at or near the wells and establishing homes as they

can depend on the water supply and do not have to move the herds as they did in the past when they were compelled to go great distances to permanent water.

When you realize that one of the wells drilled by Rig No. 4 will flow twice as much water as the combined flow of all the springs in the Navajo and Moki Reservations you can appreciate what the wells have done to water the reservation and how little permanent water there was on the reservation."

\* \* \* \* \*



An area of 40 square miles is often tributary to one of the wells dug in the Navajo land.

SPRING DEVELOPMENT.

During the year the work of developing springs

on the Hopi reservation has continued, although not as

rapidly as desired. The reason? Lack of money.

We have been doing the spring development work on this

reservation from the fund "Support of Indians in Arizona

and New Mexico" and the amount available has been in-

sufficient for the work we are doing. It has been divided

between the well drilling for the Pueblos and the Hopi

Spring work. I cannot put the situation better than to

quote from the April report from the foreman in charge.

He says:

"The main drawback is the lack of money to carry on

the work on a larger scale; for instance the country is

so large that it is impossible for me to personally

supervise work in the remote sections as we do not have

enough money to hire men to look after cementing up the

springs and fitting in the pipe etc., it is a waste of

material to go and lay out a plan of development of a

spring and have to leave before it is completed as to leave

much work as placing a filter, laying pipe, or cementing

up the springs in the lands of the Indians, and for that

reason the spring work does not go fast as it should.

The Indians are increasing the herds so fast that we

cannot keep up with them with the water development.

What we should have, in my opinion, is a mason that can

carry out a plan of development and have him help me do

this kind of work that the Indians do not understand.

I can get plenty of labor donated if I had time to go

to those far away places and stay until a place was

finished.

The Indians have seen the benefit of more water

and are much encouraged and are making good use of the

water, many of the progressive ones are willing to donate

money or labor to help the work along. If we can keep

up with the present increase of stock, with the water

the Indians will make more progress in the stock business

the next five years than they have done in the past fifty.

As the stock in this country has always been limited to



The large rock formation from the  
eruption of 1903, was again  
involved and was covered and is now  
containing a good supply of water.

the amount of permanent water, in the past when a drouth would come and the springs dry up the stock was forced to die off to the number that could live on that amount of water.

While the springs are becoming of less importance as compared with the wells, they will furnish a small permanent supply of water and do not require expensive labor. Also people looking at the map would get an idea that if the springs were developed that there would be all the water that the range required. This is in no way true, as many of the springs that are marked on the map are mere seeps and do not flow one gallon per hour, and there are others that if developed and conserved will water all the stock that will be able to travel to it.

Also many of the springs are in sandhills and as soon as they flow out of the close or impervious formation they are at once lost by seepage. In some cases the seepage is equal to the flow of the spring and a good spring will only be indicated by a moist place on the sand, and can be developed by excavating back to solid formation and all seepage cut off and piped to a concrete reservoir where there is only the evaporation and no seepage."

To further show the interest of the Indian in this work I will quote a letter from one of the Indians working for the Service on the Spring and Well Development. When it is remembered that when this work commenced several years ago the Indians as a whole opposed it, thought we would do something that would deprive them of the little water they had and were almost at the point of resisting by force any tampering with the spring, the change wrought by careful handling of them and the situation is little short of marvelous, and the improvement in the condition of the Indian, the increased flocks, the moving down from the mesa of many is almost if not as great. The letter is as follows:

Polacca, Arizona, Feb. 22, 1917.

Mr. H. R. Robinson.

Dear Sir:

I am here dropping you these few lines to notify you of what the Indians think of the wells and the fixing of springs. I have talked with the Indians about it and they are all interested in it and have promised to help along with the work. The second mesa men have all got together and told me to write to your office people about it and they have select their men to look after the wells and spring work and are all willing to help what ever help we need and they all said that they all have organized a working party and will be willing to help and they have asked for these things to be furnished so that they can use them in building reservoirs and they said they are going to pull you people and have more wells dug south of Big Burrow spring as they said they needed wells down in that section of the country but as the well rig is slow coming through they said for you people to please send 6 plows 6 scrapers to be used in building their reservors, they are well pleased and willingly came over together to listen to what I had to say and I told them that we were suppose to help along with the work and to help ourselves for I told them every one has got some stock to look after and they said for you people please help them out, for they all claim that the reason the Indians do not all have stock and they just look up to the men who has got more cattle to think about the wells and springs but they said that they will all get together and work together and help you people and they themselves for they said they want the springs fixed and more wells dug. And they are going to all get together and work together so they said it will be easier for them to have more wells.

Well friends, I hope you will understand my writing and what I mean as though I am a very poor writer and has got a cripple hand and I am doing what I am asked to do by all the Indians. Well I will close my writing.

I remain your friend

Nelson Polacca.

P. S.

All the Indians are very much pleased and are thankful for the wells and all are well organized now every village has its own men selected to look after the work and they are going to help here at first mesa and other villages. There for they want help from you people and they do not ask for money but they are going to help along with the work and have more interest with the wells and springs.

Cencerly yours

N. Y. Polacca.

The progress in the spring work is best shown by the List of Springs, Hopi Reservation, which is added to this report as a supplement. A list of all of the known springs on this reservation has been prepared, and a statement made concerning the development or such other information as may be needed. It has involved considerable labor and is the result of several years' work and observation.



Bridal veil Falls.  
Havasu Canon Ariz.

WELL DRILLING.

Rig No. 1. During the year this rig has worked on four well, drilling 1780 feet of hole and bringing in four good artesian wells.

Well No. 115 was began before the first of the year, is 530 feet deep of which 295 feet has been drilled since July 1st and has a flow of 900 gallons per hour.

Well No. 117 has a depth of 550 feet and flows 2000 gallons per hour.

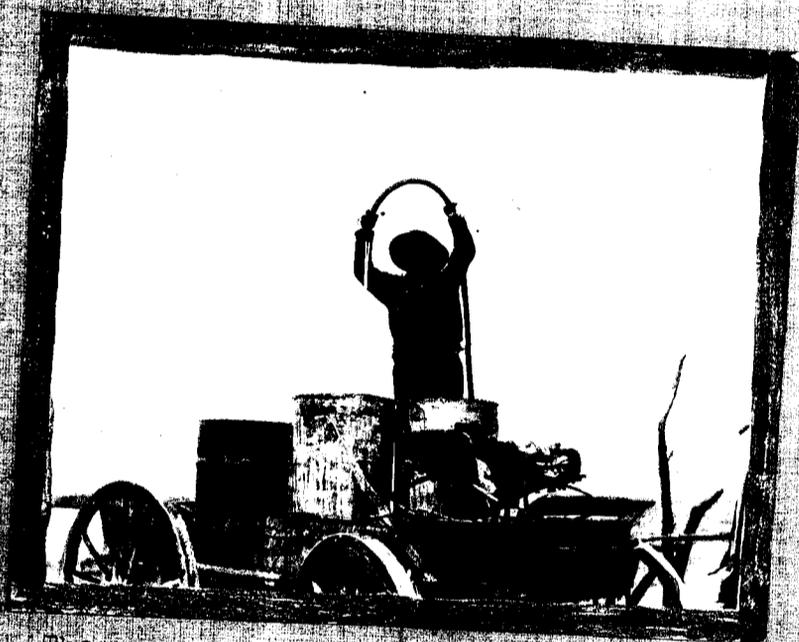
Well No. 118 has depth of 555 feet with a flow of 1025 gallons per hour.

Well No. 119 is 380 feet deep, and is flowing 1200 gallons per hour, and it is intended to shoot it and see if the flow cannot be increased. It is not quite finished, but it is probable no more dirlling will be done on it.

The costs of operating the rig and of each well will be shown on the cost data sheets accompanying this.

Rig No. 3. This rig and No. 4 are twin rigs and working in a similar country. This rig has not made as good a showing as have the other two in the Navajo country. The total depth drilled is 1233 feet and the number of wells, 7.

Well No. 354,	depth	304'	discharge	350	gals	per	hr.	Good	water
No. 355,	"	126'	"	400	"	"	"	"	"
No. 356,	"	60'	"	600	"	"	"	"	"
No. 357,	"	151'	"	140	"	"	"	"	"
No. 358,	"	212	"	600	"	"	"	"	"
No. 359,	"	204	"	300	"	"	"	"	"
No. 360,	"	136	not finished.						



The pressure in the artesian wells is  
sufficient to raise the water high  
above the surface of the ground

Rig No. 4. This rig has put down 13 wells, and drilled a total depth of 1871 feet, and in addition to this made one move early in the season of over 100 miles.

The following is the record:

Well No. 446,	depth 72'	discharge 240 gals per hr.	
No. 447,	" 85'		Dry hole.
No. 448,	" 124'	" 200 gals per hr.	
No. 449,	" 384'	" 600 " " "	
No. 450,	" 142'	not developed.	Dry hole.
No. 451,	" 116'	" "	" "
No. 452,	" 95'	Discharge 28 gals " "	
No. 453,	" 100'	" not developed.	" "
No. 454,	" 95'	Not developed, very little water.	
No. 455,	" 118'	Discharge 600 gals perhaps	
		Reported as good well	
		No report on flow.	
No. 456,	" 284'	Reported as good well.	
		No report on flow.	
No. 457,	" 180'	Reported as good well.	
		No report on flow.	
No. 458,	" 76'	not finished.	

Wells Nos. 456 and 347 were both shot and developed fine wells with more water than the pumps can handle, but no report was made on the gallons per hour.

The work done during the year by the three rigs has been diagramed and a study will prove of interest, showing as it does the work of drilling by days, and the progress of each crew from day to day.

Well Rig No. 5.

Because the conditions under which this rig has been working and the nature of the work done it has not been included in a comparative statement with the other three outfits.

At the beginning of the year the rig was directed to proceed to what is known as Canyoncito, a settlement of Navajos who live on the southeast slopes of Mount Taylor, far from their kindred, and under the jurisdiction of the Superintendent in charge of the Pueblo Indians, and classed with them in administration.

The section occupied by them is almost inaccessible and very dry. The first move was to build a road over which the rig could be moved. In this the Indians did much of the work without any compensation.

The first well put down, No. 543, was in a deep canon, with but a poor wind exposure, at an elevation of about 7000 feet, but with no water within seven miles and greatly needed. In fact in the whole settlement there was but one well and one spring which was in such condition that it gave but little water.

The conditions in here were very unfavorable for the development of any water. What was found was of very poor quality, most of it alkali, and the formation which held the water was without exception in a quick sand or soft muck very hard to control and difficult to develop the water in after it was found.

Four wells were put down and the one spring developed as follows:

Well 545. Depth  $57\frac{1}{2}$  feet, quality of water only fair. At 50 feet struck water bearing soft silt, from which it was difficult to separate the water. After pumping with the bailer well began to cave and it became necessary to fill hole with crushed rock as fast as it caved, to a depth of 58ft. After cave was filled the casing was driven through the rock. After screened casing was placed, water cleared after 4 hours pumping. Discharge 200 gals. per hour.

Well 544. Depth drilled 101 ft., afterwards cemented off at 60 feet as the water was unfit for use.

Quality of Water:

"Good, soft water was encountered at 31 ft., but the quantity was insufficient to warrant the erection of a windmill; so a hand pump was installed, making the water at this level, available for immediate use, for domestic purposes; and the Indians of the settlement being so well pleased with the quality of this water, have selected this location for a future day school, and through their anxiety for its creation, on December 5th, 1916, Mr. Platero and his helpers began sinking an underground storage cistern, adjacent to Well No. 544, with hopes of increasing the volume in the drilled well, they sank through sand rock to 27 feet, from which level, myself and helpers sank the remainder to 34 feet, and tapping the drilled well, which is 3 feet distant from the underground storage cistern; this development has greatly increased the water volume, so that a windmill was erected on the drilled well, and the hand pump with a  $1\frac{3}{4}$ " ball valve cylinder attached to a 2" Galv. pipe, standard iron pump head on a platform was installed on the dug well or cistern, and same having been covered by laying 4 iron cross joists over the opening at 4' below the surface on bed-rock covered same, with

sheet iron and flat rock grouted in cement an opening 18" x 30" walled with rock layed in cement to the surface to exclude rats and snakes which are very numerous in this section of the country. The dug well or cistern was lastly covered with 2" lumber on which the hand pump is set. The Indians of this settlement are now eagerly looking forward to a time, when the creation of a Day School will take place, some of which has been an urgent necessity for many years past."

Well 545. Depth drilled 85 feet, amount developed all that a 2 $\frac{1}{4}$ " cylinder can pump.

This well gave great trouble in its development and it would have been abandoned but for the fact that the locations was a central one and it seemed almost absolutely imperative to make a well here if possible.

The formation where this well is located was evidently an old lake bed in the bed of a canon which has been filled with silt and drift sand to water level and which has been covered with adobe at a later date. To give an idea of the difficulty in developing a well here the following excerpt is made from the daily log of the driller:

3. Drove casing 3' and bailed sand.
4. Bailed sand. Succeeded in removing sand to 66' from surface. Sand raising as much as fifteen feet in casing. Sand coarser and water more abundant.
5. Succeeded in driving casing 2 $\frac{1}{2}$ ' deeper which cuts off quicksand. Casing resting on heavy blue clay.
6. Mud rose in casing 9' during the night. After bailing same to bottom of casing at 72' or one foot below casing sand and mud again rose 15' in casing. Succeeded in bailing this out after which filled the casing with 2 feet of hard crushed rock. Drew casing back 6" and bailed balance of day. Water beginning to clear.
7. Found 35' of water standing in casing in the morning. After pumping with bailer two hours, sand again caved and cut off all water. This was drilled and bailed out to bottom of casing when water again came in. After

bailing this water (4 gallons per minute), till nearly clear it again caved and shut off the water, and repeated this three times during the afternoon. Indications are quite discouraging.

- 8. Sunday.
- 9. Found 34 feet of water in well in morning; sand had risen only 3 ft. Pumped out sand, mud and water for 2 1/2 hrs. Well did not cave during day. Worked on perforated screen balance of day.
- 10. Rain the entire day. Worked on screen etc.
- 11. Rain all day. Between showers well again bailed. Find sand again rose in casing and shut off water. Placed screen in well which failed to hold sand back.
- 12. Made fishing tool for drawing screen back but found quicksand held same so tight that it could not be withdrawn by engine. Drilled out bottom of screen and again started water, but less in quantity.
- 13. Rain all day.
- 14. Rain until noon. Found quicksand had risen 9' in casing. Drilled this out to 69' from surface, there being only a small amount of water.
- 15. Sunday.
- 16. Made general repairs to drilling rig and wagons.
- 17. Drilled and bailed all day trying to clear casing and to start water which was cut off by sand cave.
- 18. Succeeded in starting water and continued bailing sand. Prospects for clearing water promising.
- 19. Bailed sand till 2 P. M. water nearly clear when well again caved shutting off all water. Drove casing 2' and again and again drilled and bailed out sand and mud.
- 20. Added 21' of 6" standard pipe to casing which extended to surface to ground and when pumping was resumed found sand risen in casing 19'. Succeeded in cutting off sand at 5' from bottom at quitting time.
- 21. Sand did not raise during night. Drove casing 3'--to 76' in clay. Encountered small amount of gravel which seemed to close off part of sand. Pumped and bailed balance of day. Water nearly clear. Promises to be O.K.
- 22. Sunday.
- 23. Pumped well with bailer, then filled in 2' of hard crushed rock. Resumed bailing after 5 P. M. and found water again shut off by a new cave.

(Work was transferred to the developemnt of a spring some distance from there, the development consistng of blasting back into the rock and making a basin to hold the trickle of water).

28. Owing to the fact that I had no more 6" casing in camp and the sand and mud continued to come in I concluded to case with the 3½" casing inside of the 6". Six feet of the bottom of the 3½" has 60 - ½" perforations, covered with galvanized iron, slotted perforations 1" x ½". These perforations are held apart by winding a coil of galvanized wire over the casing and over this the galvanized sheet iron with nearly 1000 of the slots. I could not clear the sand to the bottom of the large casing so had to drive the small casing from 71 feet. Succeeded in getting down 81 feet where I found some sand rock. I hope to pump with bailer to clear water.
29. Sunday.
30. Found sand cut off and water rising to 36 feet from bottom of well. Pumped with bailer till noon. Water coming in nicely and entirely.

(Work resumed on spring to give well time to cave or otherwise misbehave before finishing.)

Well 547. Depth of well 110 feet. Good flow of water. Quality fair, from the standpoint of the Indian for stock purposes but not fit for domestic purposes. It is located in an open valley and much needed for stock.

Well No. 546 is the Platero Spring and was developed. This spring was but a trickle of water in the sandstone, and was developed by following it back into the rock until it was certain all of the water was found and then making a good cement lined reservoir into which the water was led and preserved. Driller Miller reports as follows:

"The completing and developing of Project No. 546 known as the Platero Spring, from a small seep in a sandstone crevice, to a modern, up-to-date cistern or well, whose capacity has been increased to deliver forth a stream of water, approximately one barrel per hour, of excellent, clear, pure, soft water, which is conveyed from the cistern or well through an 1½" pipe to a watering trough 30" wide, 12" deep and 16" in

length, whose ends and one side are of stone laid in concrete and whose wall and bottom are plastered with concrete also.

The developing of the spring, rendered it, as being one of the most valuable water properties now possessed by the Navajo Indians of this settlement. Heretofore, this spring was the only source of their water supply, through winter and early spring months, both for domestic and stock purposes, for several decades past. Occasionally, during the rainy periods (such periods at times being few and at long intervals) the surface water was utilized until it was exhausted by stock consumption and evaporation and also at certain periods, this section of the country has been a victim of "Drouths" which after times forced the inhabitants of the settlement to flee to the "Navajo Reservation" where food for themselves and pasture for their flocks and herds could be procured.

But now, since their water supply has been developed it stands to reason that they will be better equipped to combat with the elements of nature in whatever form they may make their future appearance.

Proud and thankful owners are they, to know and realize that the "Great White Father" at Washington, has at last come to their rescue, by sending men and machinery with which to develop their water resources."

The work for these Indians was completed in February and the driller was sent to inspect the wells put down heretofore for the Pueblos of Acoma and Lagunas, word having been received that they were in bad shape and many of them not working.

After they were put down they were turned over to the custody of the government farmers, but it would seem that they either failed to understand the necessity of frequent inspection and care of neglected it.

Well after well visited was found to be either entirely out of commission or in very bad condition, and many of them required new parts and several should have entire new pumping heads.

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The drilling rig was sent on to Isleta and stored there, and such tools and equipment as was needed was taken with the crew to the Acoma and Laguna villages. About fifteen of the wells were over-hauled, some of them were not entirely finished owing to the delay in getting repair parts. Early in May it was seen that there would not be sufficient funds to carry on the work to the end of the year and a request was made for additional funds, but there was none available, so the rig was closed down and the men laid off until July 1st.

With the new year we will finish putting these wells in shape and following that will move on up the Rio Grande putting in wells for the various river pueblos for domestic water.

LEUPP, ARIZONA.

Authority was given to expend the sum of \$900 on building some dykes at this place to guard the Agency and School from flood waters which come in from the south, a portion being surface water from higher lands to the south and a portion being overflow water from the Little Colorado at extreme floods.

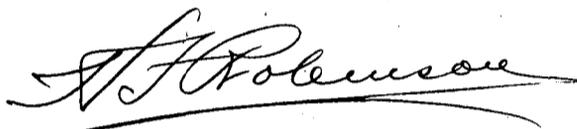
The work authorized was the building of two levees, one about 1000 feet long and 5.5 feet in height and the other about 3000 feet long with an average height of 2.4 feet.

Two other dykes needed to be repaired and strengthened, and the Agency forces combined with ours and this work was also under our supervision.

The work consisted of the moving of 3700 cu. yds. of earth at a total expenditure of \$877.22, and the agency should now be well protected against the floods by the work done. There is still danger of the river at some time changing its channel and doing further damage, but that cannot be counted upon nor guarded against with a reasonable amount of expenditure.

There is attached to this narrative report numerous maps, plats, diagrams, photographs and tables, most of which have been referred to in the text as well as the cost data sheets of the various projects, all forming a most necessary and important part of this report.

Very respectfully,

A handwritten signature in cursive script, reading "A. H. Robinson". The signature is written in dark ink and is underlined with a single horizontal line.

Superintendent of Irrigation.