Research Navajo & Hopi

December 10, 1914.

Memorandum.

Wells, Navajo and Hopi Reservations
ARIZONA.

The Navajo and Hopi Reservations are about as unfavorably for supporting human beings as any in the United States.

The scanty and unfavorably distributed rainfall, great areas of drifting sand, vast lava beds, irregular topography of mesas and canyon, brilliant sunshine, drying winds, all are factors in making this a region of unsatisfactory water supply.

Both the Navajos and Hopis have large flocks of sheep and other domestic stock, and one of the great problems of their life is to find water for their stock near grazing grounds. At points where there is permanent water, the country is entirely grazed out; other places where there is fair grazing ground, there is no water, or at best, water holes which exist only in the spring and after seasons of rainfall.

Because of these conditions, it was determined by the Indian Office, several years ago, to develop water in such parts of the counrty as would be possible, by means of well drilling and the development of seeps and springs where practicable.

As a preliminary step, arrangements were made for co-operation between the Indian Service and the Geological Survey for the examination of the greater portion of this area. Professor Herbert E. Gregory, who occupies the chair of geology at Yale, and who spends his summers in the field, was sent out to make examinations and recommendations relative to the development of both

surface and underground water.

He has made several reports, accompanied with maps which have been the basis of ~~of~~ the search for and development of water in this section.

In 1911 a well rig was purchased and put in the field, and met with such success that a second one was built and later, two more were authorized and purchased for use on these reservations.

The result of our work has shown that it is difficult to predict where water will be secured, though it is often very evident where it cannot be found and often the most promising site will prove to have no underground water.

The examinations made by the Geological Survey and the special maps furnished by them haveb en of great assistance, but the predictions made have not always been verified.

When first put into the field, well drilling Rig No. 1, which has a capacity up to 18" in diameter and depth of 1500 feet, put down five wells at Leupp Arizona, did some exploration work north up the Oraibi Wash valley, and was later moved to Keams Canyon and put to work on a deep well to test out the theory of the Geological Survey that there was artesian water in that part of the country, and if wells with a good supply of water whether flowing wells or not would allow a limited amount of irrigation in a country otherwise arid and unproductive although supporting a large population. The prediction was made

that when the drill penetrated the shale and entered the Dakota sandstone, flowing water would be found, and judging by the thickness of the shale in the surrounding country, it was estimated that this would be about 700 feet thick. Not reaching the bottom of the shale at 800 feet, Professor Gregory, upon whose judgement the work was undertaken, was communicated with and in reply, he wrote as follows:

> "To my mind, it is highly important to sink this well through the Dakota. It will be so even if the well is a failure, for a failure here will mean that the deep rock wells in the region of the Moki villages and elsewhere about the southern edge of the Black Mesa are likely to be dry. If, however, flowing water is secured from the Dakota at Keams Canyon, it is highly probable that wells sunk to this horizon anywhere along the southern edge of the Black Mesa will be successful".

Work was continued to a depth of 1308 feet, constant communication being kept with Professor Gregory and he was furnished with samples of the material through which the drill penetrated. At this depth, he gave it as his opinion that it was useless to continue further as the formation was entirely different from what the general conditions had lead him to conclude.

Twenty eight holes aggregating 2501 feet have been put down by this large rig, in addition to the deep hole, developing 10 good wells and 18 dry holes. This large rig has now been moved east, over the line into New Mexico and is now engaged in putting down a deep well in the Choiska valley, near Tohatchi, with every indication that flowing water will be secured as at 400 feet the water has risen to within 20 feet of the surface.

This is the extent of the artesian development in this part of Arizona.

Beginning in 1912 three smaller rigs were built and put to work and to June 30, 1914 had put down 108 holes varying from 22' to 175' deep.

Of these, 54 made good wells, aggregating a depth 4031 feet.

In no part of this section has any gravel been found, and all of the water developed has been in a porous white sand stone or in beds of fine sand. For this reason the water movement is very slow and no well of any great capacity has been or can be developed unless artesian water is found in deep holes. At Leupp five wells 12" in diameter were put down and four of these are coupled up to one pump and enough water raised to irrigate about 40 acres of school farm.

Most of the other wells are 3½ inches in diameter and have a limited capacity, but in all cases sufficient water for stock purposes has been developed.

All of the good wells are being equipped with pump, windmill, tank with a capacity of about 3000 gallons and troughs for stock controlled by a float valve.

There are many localities where water is needed that the geological conditions preclude anything but the remotest possibility of finding water, and so far operations have been confined to such localities as the Geological Survey have indicated. Later work should include actual search in other localities.