Ladies and Gentlemen of the Arizona Grain Research and Promotion Council; it is with the greatest humility that I thank you for reviewing my project.

I come before you with this one question, this one answer. What is it that keeps much of our state from participating in the titanic agricultural markets available to the states to our West and East? Is it not the blessing of water?

Yet God long ago gave to Arizona the same blessings he has "showered" upon the agricultural giants to our West and East. But God in his wisdom did not make those blessings apparent to the eye.

For untold eons Indians and specifically the wise Hopi have lived upon the face of this dry state of ours- and thrived. How was such a thing possible? The Hopi and the other tribes of Arizona had no tool shops, no foundries, no means of mass transportation, no science as we know it today. Yet they had the science of the human mind- something which still surpasses our understanding today. And with that science, they discovered ways to grow grains, beans and other foods in their harsh environment, turning it to a paradise.

To them I bow and without their efforts and graciousness at allowing their methods to be cataloged, I would never have developed the understanding and techniques needed to perfect a modern, mechanized version of their *dry* farming system.

Lest you think me mad, please bare with me as I present evidence below of the large amounts of grain grown from this region by their dry farming methods.

The Hopi processed massive amounts of corn from dry land where no one yet -before or since- has had the intelligence, temerity or wisdom to do so. As evidence I take you to the last century and the efforts of our Department of Agricultural to document the very life of the Hopi and other Indians of our state.

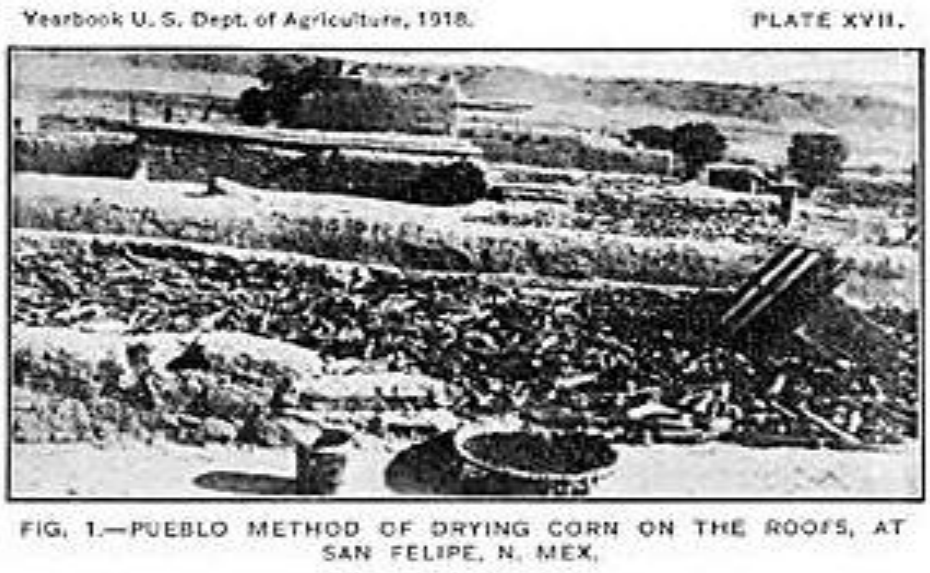


FIG. 1.—PUEBLO METHOD OF DRYING CORN ON THE ROOFS, AT SAN FELIPE, N. MEX.

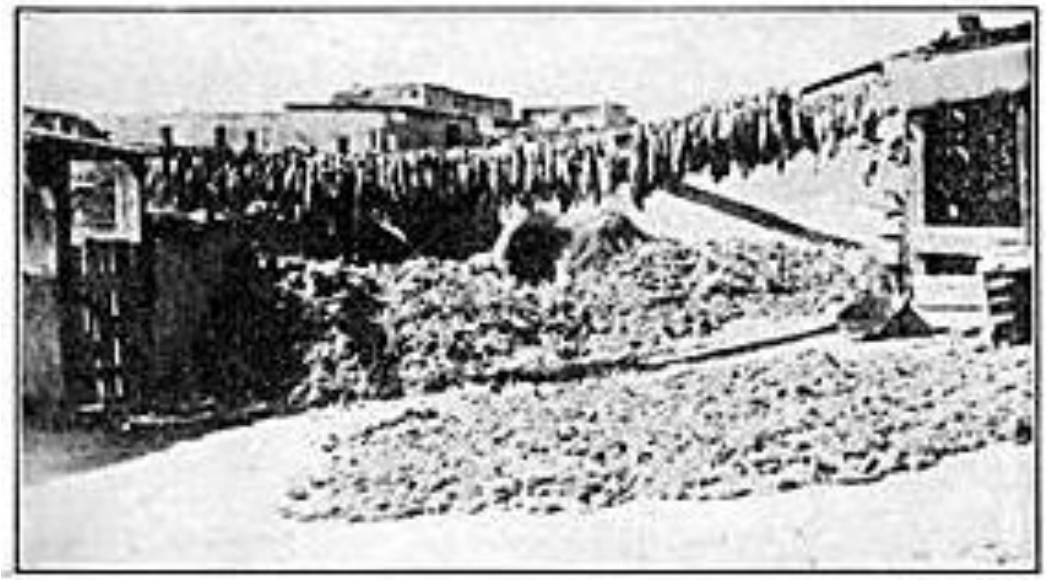


FIG. 2.—CORN DRYING IN A YARD AT LAGUNA, N. MEX.

FIG. 3.—AN INDIAN CORNFIELD IN NEW MEXICO.

This visual evidence shows that dry farming is not only possible, but can produce rich yields. The corn plants above are standing six feet plus in a region where it has not rained for months. To this day, Hopi and others still practice this method of farming. Though tried and true it does not lend itself to mechanized production methods.

Project Deep Roots seeks to combine the wisdom of the ancient Hopi with our modern production methods to bring rich yields form the dry desert.

Though Project Deep Roots may sound more like "Project Pipe Dream," I ask that you review the findings presented herein with an open mind. Further, I apologize for the long winded presentation, but new concepts are not easily presented in a paragraph.

Project Deep Roots

Dry Farming Grains in the Desert Regions of Arizona

History of Dry Farming in the West

To understand the history of dry farming in the West is to lay the foundations of success. Therefore, a brief overview is in order.

Use of the Moisture Cycle, Barrier & Bank

The ancient Hopi and his Indian brothers understood how and when to use the moisture barrier and cycles.

The enterprising gentleman on the left is using a planting stick to penetrate the moisture barrier. Sticks were made that penetrated up to a foot to eighteen inches into the ground. Once a hole was made, up to a dozen corn seeds were dropped into it. This produced a "corn bush" rather than the furrow of the modern method.

A typical Indian would plant two crops per year. One with the spring rains in April and one with the summer monsoon rains. The Indians had a total understanding of the moisture cycle, moisture barrier and the moisture bank.

It should be noted that the Hopi would plant beans and squash along with their corn, the three working together in a triple braided cord of strength.

Beans affixed nitrogen to the soil and provided important nutrients to the Hopi. Squash acted as a ground cover, preventing weeds and retaining moisture. Corn provided the calories. Together they were known as the three sisters.

The sisters cared for the Hopi well. It was only after the introduction of modern transportation methods and cheap multiple food sources that the Hopi largely abandoned their dry farming methods.

John A. Widtsoe & Dry Farming - A System of Agriculture for Countries Under Low Rainfall

Mr. Widtsoe was the President of the Agricultural College of Utah in 1910 when he wrote the above mentioned book. In this amazing treatise, Mr. Widtsoe explains the why, the how and *the need* for dry farming in the West. Further he explains the science behind what Project Deep Roots terms the "moisture bank." To him, I am as grateful as I am to the Hopi and other Indians of this region.

What he could not have envisioned was the coming together of modern machinery, the chemically enabled farmer and modern transportation systems. These technologies made it possible for the agricultural giants West and East of us to supply the country and the world with ample grain and foods. What he did envision -with unfailing doubt- was that

someday, by methods unknown to him at the time, the Western deserts would bloom under the dry farmers hand.

And now -with grain prices spiraling ever higher, world populations rising, demand for meat products at an all time high and the rise of bio fuels- is Mr. Widtsoe unfailing vision proved right. The time of deserts providing for the world is upon us.

Widtsoe documents in his book a total understanding of the moisture cycle for no less than four major portions of the United States. (Indeed these four may be applied to the world.) He recognizes various soil types, fertility of each and how they became that way.

Further, he comments on how to use these moisture cycles to the dry farmers advantage. Now this may seem obvious that one wants to plant when it will rain, but Widtsoe's wisdom goes against all understanding. He sees the soil as a moisture bank, from which the dry farmer is able to make withdrawals and deposits- *at will.*

Mr. Widtsoe's wisdom was well based of fact, experimentation and communication with others of his time. What caused this wisdom to pass from our memories? Only the aforementioned trio of modern life- chemicals, machinery and transportation. Grain from our East became so cheap and so plentiful that all need or thought of dry farming in the driest parts of the West has slipped from mind.

Project Deep Roots seeks to reawaken our memories to a time when dry farming was practiced in the deserts of Arizona; to a time when people thrived off of the meager moisture available here. Imagine the potential acreage available for dry farming in Arizona. Imagine the profits and the benefits to be made to local communities if these areas could be opened to dry farming?

I am not saying all land can be farmed, but where the soil is deep enough, great fertility and moisture wait to be harnessed by understanding the moisture cycle and using the moisture barrier.

Understanding the Moisture Cycle

The appearance of much of Arizona gives an overwhelming impression of desolation. Yet spend an evening on the back porch of any desert dweller and you will be impressed and overwhelmed with how much life is here.

In the desert regions of Arizona, rainfall comes in cycles. Short winter/spring rains are followed by long months of dryness. Summer brings the sudden gifts of monsoon thunderstorms. Rain can fall by the gallon. To us, these cycles appear all too brief. But to the ancient Hopi they were seen as the trigger of the semi annual planting events.

The Hopi understood that the land had a natural defense against the long dry spells that pervade our state and region. They took notice of the ground and its moisture barrier.

Understanding the Moisture Barrier

Ground in Arizona is notoriously hard. Digging a simple hole for a fencepost can represent substantial effort. But as one digs down the ground becomes soft, moist earth.

The photo below shows the existence of the moisture barrier in June of 2009.

The first two inches of soil show no discoloration. The soil is uniform and consistent in moisture content.

At four inches in depth, there is a noticeable change in soil color and consistency. The soil becomes darker. This point is illustrated by the arrow in the photo to the left.

Further, the soil becomes loose. The difference *is moisture!*

This barrier acts as a bank vault door, allowing the storage of moisture accumulated during the brief rain periods in Arizona. Moisture is stored behind it as a bank stores capital in a vault, ready to be directed for the useful purposes of nature or man. One only needs to learn how to swing open the moisture vaults door to make deposits and withdrawals.

Understanding the Moisture Bank

In order to understand dry farming in arid regions, one must first understand the soil and its moisture retaining principals. Project Deep Roots thinks of the soil as a bank that deals in the currency of moisture. The goal is to understand the principals of the banks operation and rise to the level of manager.

Many soils of the West and primarily of Arizona have an abundance of microscopic particles. One only needs leave their windows open to see the fine silt brought by the wind. Each of these particles is a miniature world with a potentially vast sea of moisture clinging to it. All needs be is for the moisture to be deposited. Hydrostatic tension- the tendency of water to cling to other objects and itself- is Widtsoe's bank teller. All moisture passes through the tellers hands, regardless of direction. This simple principal need only be proved by placing ones finger in water. Upon withdrawal, moisture clings.

This is hydrostatic tension. Like ones finger, microscopic grains of soil have trillions of nooks and crannies that moisture will cling to.

In Widtsoe's treatise, he outlines how the microscopic soil particles charge themselves with water. Further, how these charges are not overcome by the forces of gravity and evaporation.

Project Deep Roots seeks to bring together a complete understanding of the soil and its properties, use of the moisture cycle, use of the moisture barrier and a true understanding of the moisture bank. The Project then seeks to adapt these understandings to modern agricultural methods to bring about a greening of the Arizona Deserts. (And by extension the greening of the desert lands of the world.

Becoming the Bank Manager

To understand hydrostatic tension is to become Widtsoe's Bank Manger. The soil becomes the teller, answering to your instructions. Whether or not one breaks the bank depends wholly upon their skills as Bank Manager. Project Deep Roots seeks to find the skills to effectively mange Western soils in order to supply the bank with the needed capital to operate. Further, to have that capital pay rich dividends.

In the West, water *is* capital. Its aggrandizement and safe storage in the soil is *the business* of the Western farmer. It is to the farmer as capital is to the banker.

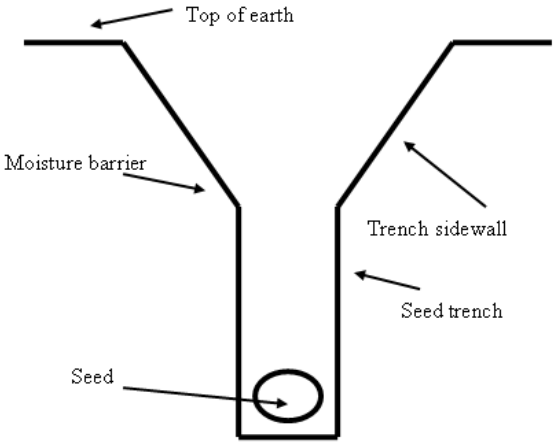
Funding the Bank

Presented herein is a method for opening the moisture barriers vault door and harnessing the moisture cycle.

The Trench Method

The importance of the discovery of this method cannot be overstated. It is the key to the moisture barriers vault; the key to bringing all types of grains into generous production in Arizona.

The picture on the right shows the basic concept behind Project Deep Roots trenching methods.



In essence it acts as a catch basin allowing for a charging of soil with water during times of rain. Trenches are cut diagonally to the flow of water across a field. As the water passes over them, they fill and hold moisture far longer than normal. This is one technique by which the soil may be

charged with moisture and one that allows much more moisture than normal to be stored in the soil.

Further, the trench acts as a miniature wind barrier- another critical component used by the Indians of this region to prevent evaporation. As the wind blows, the trench tends to fill with sand and loose pebbles- used by the Hopi as planting beds because they acted as moisture retainers. This method requires some special tooling, but even less effort is required than a normal plowing. Trench depth was defined in my previous experiments with a depth of four to twelve inches depending upon the crop.

The trench method allows for a charging of the soil with water and retaining that moisture via Widtsoe's hydrostatic tension- *without tilling.*

There may be times when one wishes to till the ground, but with the high winds of Arizona, frequent tilling is not recommended. Further the trench method allows one to apply fertilizers with targeted accuracy, thereby tailoring there strength and effect to the plants needs. Over fertilization and the resulting problems of nitrates, weed growth and natural imbalances need never be an issue.

Development of the Trench Method

Development of the trench method started with my first attempts to grow corn for animal feed in 2006. I had a difficult time, even with irrigation, bringing corn to maturity. Heat seemed to be the biggest issue, causing wilting even when watered. However I was aware of the areas rich agricultural traditions and knew it was possible to farm here.

Thus began my search for methods of dry farming corn and other crops.

In 2007 I hit upon the idea of using water pooled in trenches to grow corn, sunflowers, beans and other crops. Original trenches were shallow and dug by hand. Over the next two years, trenches became wider, much deeper and a method of planting was developed that takes advantage of Widtsoe's observations on desert soils and their hydrostatic principals.

Project Deep Roots Future

For 2009, Project Deep Roots is continuing development of two desert seed corns, adapted specifically to deep rooting in deep trenches. This is a three year project, bringing a desert dry farming sweet corn for human consumption and a larger yielding corn for animal feed production. (Either as silage or grain.) Further, this is our second year of sunflowers. Desert dry farmed sunflowers are nearly a reality now, with a near certainty of a deep rooting desert strain by spring 2010.

Other crops starting this year are wheat, oats, barley and perhaps rye. (Dependent upon availability of a suitable seed.)

With an early spring and a summer planting each per year, it does not take long to develop a non desert strain into an excellent desert dry farming crop. Already the sweet corn has been adapted to a minimal moisture dependency. Root depth is excellent; with roots reaching deep to find the moisture locked in the deserts soils. Yield is very good and has been greatly enjoyed by friends and family. Planting of our first completely dry farmed trench strain begins in May 2010.

Quantities are small, as most of the work is manual in nature. However, I feel that at least three crops will be ready for planting upon an acre soon. This will require the use of a small tractor and specialized tooling.

Further, moisture testing will begin in 2010 to provide direct observation of the moisture barrier and the moisture bank by using a backhoe to dig down to depths of eight feet. Moisture samples may then be taken directly, proving Widtsoe's theory on using the principals of hydro static tension to directly charge the soil with moisture. Further, exact rooting measurements may be taken of each crop as it grows and adapts to a desert dry farming strain.