Held’s Method of Upland Farming

An Explanation of Summer Soil Culture

An Eight-Year Demonstration of Success
INTRODUCTORY REMARKS

LET me first of all confess that I am a FARMER and neither a scholar nor an editor. It will be evident to the average man that there is a vast difference between a pen and a plow, and that a person might be expertly proficient in handling the one and at the same time hopelessly deficient in the other. I want to gain the confidence of the readers at the very start of this exposition of my experience on the semi-arid farm by saying that I have no desire to pose as a superior person, or that it is my intention to paint the stubborn facts connected with the problem of successful farming in the semi-arid regions as a rose-covered pathway to wealth and independence. There are in the ups and downs of human enterprise instances where people have developed schemes that made them fortunes in a day, but no actual farmer that expects to make his living by sowing and reaping has ever fallen into this class. However, in the long run and in the sum of the world’s occupations, there is no calling or vocation that gives greater assurance for honorable and healthful returns than faithful and skillful labor in the fields. The practical and scientific application of labor to the soil of the western uplands is no exception.

It might be well to acquaint ourselves with some of the incidents, both of the immediate present and the recent past, that have contributed to the writing of this brochure, and in this way still further contract an agreeable frame of mind toward the motive and effort, which this entirely new departure in my life represents.

For a number of years there has been an incessant demand, both from individuals and different organizations, for information as to the ways and methods by which the product of the acreage has been more than doubled not only on my place but in every instance where the method has been employed. Because of these many and urgent requests, and believing that a more definite knowledge of this method will be the means of great good, I am now attempting to write out this knowledge so that those who wish to avail themselves of it may do so. Let me again caution the reader that I am no scholar, therefore no display of rhetoric should be expected.

The condition of everything today is the last link of a chain of events that reaches back into the yesterdays, recent and far away. In the year 1899 my father with his family settled in what is known as “the Frenchman country,” lying in the southeastern part of Logan county, Colorado, preempting and homesteading a fairly average half section of land. This was first known as the J. G. Held homestead, and has now attained considerable fame as the Phil Held place, through what I simply and plainly designate as Scientific Farming.

It is now twenty-three years since this land was taken up. For ten years I and the rest of the family farmed the place under the direction of my father. During this time the farming was carried on in the conventional way. No thought was taken in the matter of improving the results by any
special method; no one was interested in the place except some love-lorn gentlemen who looked wistfully upon several grown up sisters.

At the end of this period the folks moved to Sterling. In partnership with a brother-in-law, I farmed the place for two years. Since 1902 the place has been in my complete control and the experiments which I have carried on date from that time.

THE FIRST EXPERIMENT

Rumors of Scientific Farming were abroad when I took over the farm, but conventionality dies hard, and the universal practice of long standing methods of Illinois and Nebraska farming, especially for wheat and corn crops, were not to be put aside lightly. However, whether it was curiosity, foresight or what, an experimental acreage was tilled, seeded and harvested, when to the wonder and surprise of the community and myself the yield was more than double the amount ever raised in the way of a wheat crop in that section of the country.

There it was. Twenty-two acres of summer tilled ground with 640 bushels of prize drawing wheat.

That looked good, and a larger acreage was taken up at once. Each year the result was the same, and now, for the last eight years, from an acreage of from 30 to 60 acres each year, the average yield for the eight consecutive years has been 28½ bushels.

In order to give to this statement the importance which it deserves, and that it may make the strongest possible appeal to those interested, I want to enumerate the following detailed result, and to say that I have made affidavit and am ready to again swear at any time, to the correctness of the record. I will also give the amount of rain-fall or precipitation in each year, so that the average, the minimum and maximum of available moisture may be seen and taken into consideration in the formation of an opinion as to the average conditions and their bearing on the successful operation of upland farming in this section of the country.

Annual yield of fall wheat on summer cultured ground for eight consecutive years:

<table>
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<tr>
<th>Year</th>
<th>Bushels</th>
<th>Precipitation</th>
<th>Year</th>
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<td>16.57</td>
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<td>36½</td>
<td>25.23</td>
<td>1912</td>
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Average for eight years 28½ bushels.

BREAKING AWAY FROM OLD HABITS

For a number of years I stood alone, and in spite of the fact, known and rehearsed in every conversation on farming throughout the county that I was raising good crops every year, others having constant and almost complete failures, but few availed themselves of the new method.

That shows the stubbornness and non-progressiveness of human nature.

Let me say here that if anyone has an idea or notion that he would like to avail himself of the benefits of scientific farming he can not do it by dreaming and thinking about it. One can neither wish, pray or lift himself by his boot-straps into new and better methods. It must be done by deliberate and actual self-operated brain and hand action. He must begin to
do it and continue to do it until, like the old method, it becomes a habit, and the only thing that he can and will do. There is a saying, that "Hell is paved with good intentions." So are the old methods of doing things. In the adoption of the new and scientific way, there is a prejudice and contrariness as intolerant and immovable as that which put science to the stake in the dark ages, and to this the adoption of scientific farming is no exception.

If you would be scientific and reap the benefits of the better way, you must break with the old habits and customs and look at things as they are, adapt yourself to what you would like to be, and have, in spite of everything. Slowly the new method is gaining ground, and just to the extent that people are using it are they prosperous. Each year a few more are falling into line and a more rational system of living, learning and laboring is becoming the habit and custom of the people. I am saying this for the reason that I have been surprised at otherwise good and intelligent men, so set in their ways that it would take a blast of dynamite to move them from their pedestals and adapt themselves to new and better ways.

Some of those who have conducted their farming along scientific methods for several years, under slightly more favorable conditions with respect to precipitation, have had larger yields than mine. My own highest yield has only been 36 1/2 bushels per acre, while in several instances as high as 40 and in one field as high as 46 bushels were obtained.

None of these people who had the initiative to start farming under the new method would think of trying to farm their land in any other way.

**BENEFITS OF SUMMER CULTURE.**

It is not only for one year that the effect of the summer tillage is available, but for at least the two succeeding years and probably for a much longer period. For instance, under normal conditions the moisture in a summer tilled field is usually from three to four feet in depth. If the year following, when the fall-wheat is making its growth, the precipitation is normal, the conserved moisture from the previous season's summer-tillage remains mostly in the ground. Plant this same field into corn the next year and a large amount of the conserved moisture will be available for the corn. Again, by the proper and scientific cultivation of the corn a large amount of the precipitation of that year can be conserved and be retained for the spring grains of the following year.

The assertion that in a properly summer-tilled field moisture can be retained to a depth of from five to eight feet, seems to the novice an incomprehensible proposition. But this has been demonstrated again and again by actual tests.

**DEPTH OF MOISTURE.**

Some time ago I was greatly amused at a certain important person that was sent all the way from Hungary in Europe to investigate American methods of farming, and who was directed to me as the one who could most likely furnish the desired information.

Long and seriously did we dwell on methods, principles and conditions. It was a very agreeable visit and not without profit. But when I insisted that with an average of less than 16 inches of precipitation I had raised
wheat going 36½ bushels to the acre, and that I could show him moisture in my summer tilled field to a depth of over four feet, he exploded and told me by his maneuvers that I was an impostor and that the thing was impossible. Whereupon, I took the good gentleman out, and armed with spade and post-auger, proceeded to the fields. The first excavation was made from a field from which I had just harvested a ten bushel per acre crop of spring wheat. Having had quite a heavy shower of rain a few days before, there was visible moisture to a depth of about eight inches and a slight trace to about twelve or fourteen inches. Below that the soil was ash-dry. Next we went across the road to the raw prairie and the slight trace of moisture reached less than six inches. Then we went to the summer tilled field which was about ready to be seeded to fall wheat. First we dug down a foot or more with the spade and there was packing moisture. We went down another foot and the moisture was the same. Then we took the post-auger and went the full length—four and a half feet from the surface—and there was still moisture enough to make mud-balls.

That took the important gentleman's breath, and his gesticulations became quite exciting. But he went his way rejoicing, and was very outspoken in his praises as to the value of the demonstration.

**RIGHT KINDS OF CROPS ESSENTIAL TO SUCCESS**

And by the way, let me relate a little of what this gentleman told about agriculture in his own country. For more than three hundred years uplands similar to our own, yielded a ten bushel per acre crop of rye and Australian corn, a few potatoes and other root crops, and not producing a half per cent on the land value. Some years ago an Hungarian emigrant returned from South Africa who brought among other various kinds of plants a certain variety of grape-vine. This, with the other things, he planted in carefully prepared soil on the Hungarian uplands, and the grape grew and became an attraction in the neighborhood. Cuts were planted and they grew and the vines yielded an abundant and delicious fruit. Today the same desert uplands are covered with vineyards that yield the richest harvests in money value in Europe. That is what change and experiment gives to the world. And that is Science.

**GETTING A NEIGHBOR INTERESTED**

I want to relate in connection with this, still another incident—how a neighbor became addicted to the new method of farming.

This neighbor came to my place for some millet to sow in a certain seven acre corner that because of the lateness of the season he thought he might yet make a little millet.

I do not remember just how late it was, but I know that I talked him out of the millet idea and into the notion to put the seven acres in summer tillage. I told him how to go at it and encouraged him with talk that the experiment could at least do no great harm and that it might do some good. I kept tab on the progress of his experiment and engineered the process to some extent, but after investigations as to results in the conservation of moisture, and the fine, mellow, weed-free field, his enthusiasm brightened up and the field became an object of considerable importance, especially when the fall wheat that he had put on was threshed. It was not easy to persuade himself, and much more difficult to convince others
of the fact that the yield from the seven acres was 336 bushels or 48 bushels per acre. This was in 1907, and since that time this same neighbor has led them all in the community in the raising of wheat. His average in 1912 from a field of 40 acres was 46 bushels per acre.

PRINCIPLES OF THE CONSERVATION OF MOISTURE.

As already indicated, the rotation of crops is inseparably connected with summer tillage. The beginner must plan and decide how he will divide his farm and what he intends to plant on each division, and how much he will put under summer culture. This he should do during the winter months. And in this he should not be careless, but use his best judgement, which is the only asset that will make him a scientific and successful farmer.

Naturally, raw prairie cannot be considered in the selection of what is to be put into summer culture. Nor is it likely that one would select ground farmed less than two seasons. The ground selected for this purpose should be the oldest and most intensely farmed portion of this place. Select this as your starting point. As early as the weather permits double disc it thoroughly. The purpose of this is to destroy the pores which the winter’s precipitation may have formed by the moisture descending downward into the ground. By this downward flow, little hair-like cavities or pores are formed which leave the soil porous or in a sponge-like condition. As soon as the moisture on and near the surface begins to dry up, the moisture further down rises, just like oil rises through a wick and is burned up.

CAPILLARY ATTRACTION.

Another good illustration may be given in connection with a dry sponge. Put some water in the bottom of a dish and put a sponge in it. In a very little while all the water will haveisen into the sponge and the dish will be empty. In the same way the soil in a porous condition will absorb moisture and as the top becomes dry it will rise and, as in the case of the oil will burn; or, as in the case of the sponge, if the sun or other heat were applied to it the moisture would continue to rise until it would be perfectly dry. This is what the familiar, yet sparingly comprehended expression “capillary attraction” means. Suppose now, that the wet sponge were covered with a slight covering of flour. No moisture would soak through it, and even if considerable heat were applied to it not even the steam would go through it. Or suppose a piece of leather would be connected to the upper part of the lamp wick, how much oil would rise to the burner? There would not be any light.

MULCH.

The fine dust-like or feathery covering on the surface of the ground keeps the moisture from evaporating. This covering is often referred to as “mulch.” Naturally when the top of the soil has a greater amount of moisture, as in the case when it is raining, the water will soak down, just the same as a sponge would absorb water from the top, or as a lamp-wick would convey a greater amount of oil at the top downward. In the process of the rain fall, or precipitation soaking into the ground, the little hair-like ducts or pores called capillaries are created, which leaves the ground in a sponge-like condition. The chief object of summer-tillage is to get as much moisture into the ground as possible and then keep it there by the
proper cultivation. The kind of cultivation that will accomplish this the most successfully is the most scientific, and is the solution of the conservation of moisture.

The most important thing is, therefore, not any particular method, but the principle. The prevention of capillary evaporation by a dust-like covering of the soil or mulch is the object. By whatever means this may be done most successfully is the key to successful farming in the semi-arid regions.

This applies not only to the summer tilled ground, but should be made a leading principle in the preparation of every seed bed. Much moisture may be conserved by keeping in mind this principle in the cultivation of all crops planted in rows, as corn, milo, cane, broom-corn, beans, potatoes and other such crops. The space between the rows can be kept clear of weeds and the soil can be so disturbed after hains that but a small percentage of moisture will be wasted. Of course it is understood that both on the summer tilled ground, and everywhere else where crops are growing, every weed represents so much moisture lost to what is planted. And, whatever may be said of science and farming, when a farm is covered with weeds, it is in the extremest sense not a scientifically conducted farm. Weeds and evaporation kill everything if they are not prevented.

There is now on the market a tool known as the Paralizer Pulverizer, especially adapted for early spring use on ground to be summer tilled, as well as other ground to be seeded or planted. It not only acts as a perfect pulverizer, but destroys and prevents the growth of weeds very effectively.

MANURING

One of the greatest helps in conditioning the soil for resisting evaporation, as well as to make it mellow and porous for the water to be absorbed during dashing and heavy showers, is manure or any decayed plant and animal matter. The soil of the plains is rich in mineral matter but deficient in plant and vegetable matter, and this is one of the reasons that as land becomes more thoroughly farmed, and stubble and other remnants are left on it, the soil becomes more productive even if no manure is used. The more the decayed roots and remnants of crops are incorporated into the soil of the plains the greater will be the proportion of the precipitation that will be absorbed. It is important, however, that all plant, vegetable or animal matter when hauled upon the fields should be thoroughly rotted and decayed. When straw or cornstalks not thoroughly rotted are plowed under they destroy the connection of the cultivated soil and the moisture below, by cutting off the capillaries through which it must rise to reach the roots of the crop. While it is of the greatest importance that all manure and remnant plant matter should be returned to the fields it is equally important that it should not be made a detriment to growing crops. It should be well rotted when hauled out, and it should be scattered after plowing rather than before. It then takes the form of a mulch, helping to retain the moisture in the soil.

PLOWING

The plowing of summer-tilled ground is not of particular importance, either as to the time it is done or as to the depth of the plowing. Any time in June or up to the middle of July will do, and eight inches deep is about right.
It is only important that the soil be well and thoroughly stirred. A complete dislocation and granulation is of greater value than especial depth. And just as it is of the greatest importance that the top covering should be as non-porous as it can be made, so the cultivated stratum beneath should be porous instead of packed. First, for the reason that the moisture may easily sink down and through it, and second that it may, sponge-like, cause the moisture to rise from below when the crop growth or a period of drought has exhausted the moisture near the surface.

I am strongly of the opinion that instead of packing this second or sub-surface soil that it should be only near-firm. In this sub-surface the process of growth takes place, and the idea appeals to me that the organization of plant life is conditioned more properly in near-firm and porous soil than in packed soil. Besides, the packing as recommended by some involves intensely heavy work for teams and men. I have never used the method, because I have been unable to comprehend the value of it. My best results, taking everything into consideration, have been obtained in a near-firm or porous second surface. This is sufficiently created by the pressure of the horses' feet, the weight of tools used in cultivation and the natural firming up of the soil between plowing and seeding.

**BREAKING SOD**

As there is a constant stream of settlers coming from the old eastern farms, it might be well to touch on plowing other than for summer culture. Many of these settlers go on raw land and have perhaps never had an opportunity to come in contact with the tillage of western sod.

Excepting a very small percentage, all the unbroken land lying in the semi-arid regions is what is known as Buffalo sod. All this sod-land is adapted to the same method of cultivation, and also to the same kind of crops. The sod is first broken to a depth of three or four inches. A complete turning over of the furrow-slice should be the end in view, so that the ground is practically as level after the breaking as it was before. This can be done most successfully when the ground is moist. Spring and summer is usually the time for the breaking to be done, both with regard to moisture and cropping. To bring the sod in perfect contact with the sub-soil beneath, a straight-set and weighted disc harrow will do good work. A mulch may then be formed by several good harrowings with an ordinary tooth harrow. The soil is now ready for planting and if the soil was moist when the breaking was done, or if later rains wet it, fairly good yields may be expected.

**SOD CROPS**

Sod corn of the flint variety is perhaps the most popular crop on sod. The corn is planted with a disc drill 18 to 20 inches apart and three and one-half feet between rows.

Flax has lately come to be regarded as a well-adapted crop for the sod, and in normal seasons has given good results. Flax may be drilled in with a press drill, using about 20 pounds of seed to the acre. The middle of May is the proper time to sow it.

Milo maize, cane, kaffir, broom-corn, potatoes and melons have been raised with fairly good success.

Late breaking has been put in fall wheat and yielded exceptionally well.

**BACK SETTING**

A serious condition that is to be avoided in connection with new break-
ing is what is known as back-setting. The turning under of any lumpy un-rotted sod is fatal to the crop planted on such land. No back-setting should be attempted within a year after breaking. Spring wheat after sod corn is the rule, but the ground must not be plowed. It should be double disced and harrowed.

Before any back-setting is done all unrotted sod should be completely pulverized, so that when turned under there will be no open air spaces, that the soil will firm up and form the required compacted seed-bed.

Another way of handling sod is what might be called semi-summer-tilling during the summer, after the breaking was done, and put it to fall-wheat. In this way the sod can be thoroughly worked up and a proper seed-bed prepared.

**Harrowing**

In connection with the pulverizer, the harrow is the main tool used in summer-culture. The pulverizer is ordinarily not used more than twice between plowing and seed-time, and then only when weeds appear to such an extent that pulverizing is necessary in order to destroy them, or when heavy rains have packed the surface so that the harrow cannot properly restore the required pulverized covering.

How often the ground should be harrowed depends entirely on conditions, and every farmer must use his own judgment and decide when and where harrowing is needed. It would be useless to say that the field must be harrowed after every shower, for that might be practically impossible. The chief guide as to when the ground should be harrowed is when it begins to burn up the moisture, or when the mulch is destroyed by the formation of a crust. As long as the top surface is comparatively moist, the conserved moisture below will not rise. When the surface becomes thoroughly dry then only will the moisture below become affected. As long as the capillaries are full, on top the tendency of the moisture is to go downward, and if the weather is not too hot it often takes a week or more before the capillary attraction becomes dangerous. If the rains are comparatively regular, very little harrowing is needed; but in a heated period of several weeks duration, with only light showers or no rain at all, then is the time when the use of the harrow becomes of the greatest importance. Once let the surface begin to burn with the capillaries open and the rising of the moisture and its consequent evaporation is a matter of short duration. The greatest vigilance should be exercised in this matter. A good double harrowing at the right time may be the means of assuring an abundant harvest for the coming year. To neglect it may be the cause of but a half crop or entire failure.

Both pulverizing and harrowing should not only be done length and cross-wise but also corner-wise or diagonally. This will have a tendency towards levelling the ground, to more effectively dislocate clods and close up the capillaries, and, besides, to catch the weeds from a different angle and so better destroy them.

It should be remembered that summer-tillage is not conducted to enrich the soil or rest the soil particularly, but because the precipitation of moisture is not sufficient unless the greatest part can be conserved for the use of the crops to be raised. Then again, on the other hand, because of long spells of dry, hot, windy weather, which, even if there should be a large precipitation, would burn it up and waste it. Were it not for the peculiar quality of
moisture to soak upward where the burning is going on, cultivation for the preservation of moisture would not be necessary.

SEEDING.

Harvest time has its joys, and in every age and country the gathering of the fruits of faithful and long labors is celebrated with festival and hilarity. But to him who has prepared a seeding place such as the summer-tilled field offers, if the work has been scientifically and faithfully done, he also has joy, if not in actual realization, then assuredly in the hope of the rewards that a well-performed task promises.

Take a field of forty, fifty or seventy-five acres, as the case may be, of perfectly mellow, level, weed-free land, and the comprehension of it and the anticipations that it will create in the faithful farmer's breast are something worth while. And if he does not celebrate openly, he nevertheless has many happy thrills, that lift his head and heart to a higher altitude of civilization and culture.

SEED BED

At seeding time the second or sub-surface has attained to a comparative firmness, and if the season has been anywhere near normal and the work has been scientificaly done, there is a good storage of moisture not more than three inches from the top of the ground. In contact with this moisture the seed is to be deposited as nearly uniform as possible.

SEED PER ACRE.

The safest quantity per acre is about twenty pounds. This will seem to the inexperienced in semi-arid farming as an unmitigated and disastrous imposition. But there is a philosophy connected with this twenty pound seed proposition that is entirely effective in refuting all controversy.

In the first place, it is a fact beyond dispute, both from my own personal observation and from the testimony of others, that the tonnage of organic growth per acre is limited almost to the hundred-weight of available moisture. In the case of heavy seeding the moisture may be readily absorbed in the setting and rooting, leaving nothing for the jointing up and the formation of grain. And since fall wheat, the plant with which we are at this time particularly concerned, is planted for the sole purpose to develop and produce grain, this ought to be the only consideration: What is the proper thing to do, not only in the matter of cultivation but in everything pertaining to the successful realization of the aim and intent?

Under certain conditions it is well and proper to sow forty pounds of fall wheat to the acre. This is the amount used in the best irrigated districts. Here the moisture is practically unlimited, and not only enough to start the plant but at any time when the moisture is needed to provide any amount that in the judgment of the learned wheat grower may be required to produce the best results.

But on the uplands, under semiarid conditions, the supply of moisture is absolutely limited, and that in many instances to an average available rain-fall of, we will say, sixteen inches. Suppose now that forty pounds of seed is used, and suppose further that it will take eight inches of the moisture in sprouting, rooting and setting and the other eight inches in stooling and jointing up. There can be no development of grain without moisture; and if the growth of the roots,
blades and straw has used up all the available plant-stuff, there will be no moisture left for the grain and the whole enterprise will be a failure.

Let us now consider the twenty-pound proposition under the same conditions. It will only take four inches of the rain-fall to sprout, root and set the crop, four inches more for stooling and jointing. That is as far as the moisture with forty pounds of seed would reach. But now with only twenty pounds, half the moisture is still in the ground. Four more inches will make the grain, and four inches would constitute a reserve to be drawn from in case of any special emergency, such as an extended period of drought.

This is the philosophy, and its logic is incontestable.

Plant a few grains of anything into a foot square space and the plants will grow and reproduce themselves, twenty, thirty, fifty, or a hundred fold. But throw a handful of seed into the same space and the available plant matter will be used up in rooting and setting, leaving nothing for the development of seed or grain. Whatever stems and grains may form, will be stunted, just to the degree of the thickness of the seed. Two pigs to a pail will make handsome shoats, but four or five will only make runts.

I have watched this process very carefully, and the amount of crop that can be matured properly with a limited supply of nourishment is as immutable as the nourishment necessary for a pig, a calf or a child.

If the season is dry all plants will be more or less retarded in their growth; but the thinly planted are by far the best conditioned to mature normally. While if the season is normal, or wet, the thinly planted will stoil to almost the exact amount of available moisture and in this way make approximately the same amount of grain that a heavier planting would make. Taking all things into consideration, twenty pounds per acre of fall-wheat on summer-tilled ground is the safest and will insure the best possible results on the average. This applies to all crops, grain or roots. Use only about half the amount of seed used in humid regions.

HOME GROWN SEED THE BEST

Another fact which cannot be too strongly emphasized is that the seed used should be grown under arid conditions. Well-developed seed grown nearest to the locality where it is to used is the best. It is the custom of farmers to attach their "hearts" to a certain kind of wheat, oats, corn, potatoes, etc., and when moving into the arid west to bring their favorite seed with them. Nothing will insure a more certain failure than this very thing. The habits of plants are as marked and as stubborn as those of men. In humid regions the roots need not reach out to any extent for moisture and, therefore, there is no great root development necessary.

Now this eastern seed is not conscious of this requirement in the semi-arid west and keeps on in its former habit and forms an eastern root that is expecting an eastern supply of moisture. Then when the rains fail and all the near-moisture is absorbed the plant droops and dies, because it did not know about any extended dry periods and, therefore, neglected to provide for plenty of far reaching roots.

Then again, the eastern seed goes right on in the formation of a huge mass of foliage, having no knowledge of the fact that this is wasting what will be presently very needful in the formation of bloom and seed. This east-
ern seed is just like the eastern farmer who will waste a lot of seed on a field that has not sufficient moisture to mature it. The analogy is perfect. Like men, seed will also adapt itself to new conditions, but it takes time.

HOW AND WHEN TO SOW.

Hand and machine sowing should be avoided as much as possible. On summer-tilled ground a press drill should be used. Great care should be taken that all seeds are planted to the required depth, so that they will come near or in contact with the moisture under the mulch covering. Also that the seeds are placed singly and the proper and uniform distance apart. Early seeding should be practiced in all instances as far as conditions permit. Summer-tilled ground should be seeded between the tenth and twentieth of September. A good growth in the fall helps it through the winter and promotes an early harvest. A good growth in the early summer months helps to resist wind and drouth later, because of the shade it provides, which to an extent prevents evaporation.

CROP ROTATION

I have already indicated that the rotation of crops is a natural accessory to summer tillage. It is now generally understood by a large majority of farmers everywhere that a change of crop is required more or less frequently to assure the best results. Somehow there is a sensibility in the organization of plant life that will permit absolutely no combination except what may be properly assimilated, or perhaps, rather, matter is so constituted that it will select only the particular combination with which it may enter into an agreeable affiliation and it will reject all others. Therefore, when a certain crop is raised continually on the same ground those particles which will associate with that particular crop will become exhausted. But when another crop is planted on this ground a different kind of association is represented and particles which refused to join the former crop may readily join the latter.

An apt illustration may be given of this process by comparing the association or formation of plant life with that of social life. For instance the Masonic lodge is the only organization in a town. By and by all those persons which are so disposed that they will join the Masonic lodge will have joined it, and the material that is Masonically inclined has become exhausted. But let the Woodmen or the Knights and Odd Fellows come along and each will form an organization as large as the Masons. Plant units have a life as conscious and sensitive as the most intelligent social unit. The seed may well be said to represent the organizer, but no matter what organizer is represented, only those units of a sympathetic nature will unite.

This is the physiology of why crops should never be grown continually on the same ground. After the crop of fall wheat on summer-tilled ground, corn or other crops in rows should be planted. No hard and fast rules need be followed as to the kind of crops that may be used in rotation. Corn alternated with beans, or milo with root crops may be continued for several seasons, with no danger of exhausting the necessary elements which enter into the formation of these plants.

What effect the dislocation and exposure caused by cultivation may have in the generation of plant matter has never yet been fully demonstrat-
ed, but there is no question in my mind that there is a connection between fertilizing the soil and cultivation.

How this takes place is not entirely clear to me, but either the dislocation and exposure places what plant matter may be already in the soil into a condition favorable for plant organization, or it is an original generator of such matter.

The rotation, which I have followed, with but slight variation, is: First year, summer tillage; second year, fall wheat; third year, corn, or other crops in rows; fourth year, spring grains, and then summer tillage again.

**AMOUNT OF LAND REQUIRED**

As to how much land may be required to conduct a farm successfully after this plan depends on conditions. Some have insisted that nothing less than a half section would do. But many are making a fairly good living on one hundred and sixty acres. Of course up to this time there has at all times existed a more or less open range for some stock, and even now there is considerable vacant land that may be used free for pasture or rented very cheaply. The probability is that with a little more intensive farming of the right kind one hundred and sixty acres will produce as much in the future as the half section has in the past.

**FARMING MADE EASY**

One of the mistaken ideas about summer tillage is that it is connected with a large amount of extra labor. But this is more apparent than real. Of course the field while under summer tillage requires careful cultivation, and in exceptional seasons almost constant watching and tending. But for the next three years after summer tillage the ground is in such a condition that scarcely any labor is needed. No plowing is done at any time until plowing for the next summer tillage. After the fall wheat is harvested the field should be disced as soon as possible, this for two reasons: First, to make the top soil mellow so that it will receive the precipitation—rain and snow—during the winter; and, second, to form a mulch to prevent evaporation. In the spring the ground is again disced, when corn or some other crop in rows is planted. It requires no great amount of cultivation to keep the corn in rows free from weeds. Perhaps no more than two cultivations will be necessary, unless some extra work is done for conservation purposes. After the crops in rows the ground need not be gone over till the next spring, when it is again pulverized and put into spring grains.

**WHAT IS A FERTILIZER?**

In treating upon this subject, I wish to say that it will be in the nature of relating an impression rather than of experience. In my close attention and observation of growing plants the inner cause of plant organization has at various times in a manner spoken to me of a sort of consciousness that had in it a feeling of relationship that seemed to me almost human. Why is it that certain little invisible, incomprehensible points of matter organize themselves into plants and why is one kind of plant preferred to another? I have learned to think of plant matter or of any other matter as in a manner conscious of its environment. There seems to be an instinct, intuition or intelligence that knows when it is contented and when it is in an undesirable condition. This not only of organic matter but of all the universe—the electricity that will mix with iron and copper, but not with rubber or stone; the water that will change to ice or turn to steam
when the temperature changes and the plant matter that will not go to the wheat or corn but to the potato or turnip. Is the organization of plant matter into plants, like the farmer's wife with a pail of feed calling the chickens together, or is it like when they come together when they see a chicken hawk? Is it from a sense or desire to attain pleasure, or from a desire to escape distress and pain?

We say that a long succession of the same crop impoverishes the soil; yet it impoverishes the soil only of a certain kind of plant matter. In what way does a change of temperature, dislocation, water, electricity affect plant matter, and by what process may it be most successfully induced to unite into organic forms?

What we know as fertilizers is matter that has gone through a process of dislocation, exposure and various changes of temperature—heat, cold, wetness and dryness. Shall we say that through this dislocation and exposure matter becomes discontented and seeks relief through organization, or shall we regard it as a mere mechanical action?

We speak of harnessing steam, electricity and make them our slaves. That is the task of the engineer and inventor. How the plant-atoms may be most successfully induced to unite themselves into desirable plant-forms is the task of the farmer; and to my mind the latter is not only more important but by far the most interesting. The former has to do only with mechanical relationships, but the latter with the problem of life.

Every increase in quantity, every improvement in quality, involves the conditioning of living matter that is responsive to its environment. How may the "Little men" in the soil be coaxed, or forced into great wheat crops, corn crops, sugar crops, milk crops? This is the great and vital problem of scientific farming. Anything that will induce plant-matter to organize and unite is a fertilizer; and the scientific man is constantly on the lookout for the best. He will not blindly follow any particular method, but consult and experiment with men human, and with the human "Little men" in the soil. And how wise and sensitive these little men are! How exact the conditions must be to have them respond to the farmer's wishes! A little too wet or a little too dry, or just the slightest mistreatment, and the incentive to build crops and harvests is lost. How wonderful!

PRESENT AND FUTURE PROSPECTS.

The agricultural season of 1913 opens in a decidedly encouraging way. The excellent condition of the wheat and the bountiful moisture in the soil puts the uplanders naturally in a cheerful mood, and, for this very reason there exists a hope and promise that invite a propagation of our faith in the possibilities of successful farming in the semi-arid regions.

And we believe that this faith is an entirely rational one, and should be both attractive and convincing, because founded on facts and demonstrations beyond a reasonable doubt. The semi-arid farmer who can show to the prospective settler from Iowa or Illinois a prosperous-looking field of winter wheat and relate a story of 35, 40 or more bushels per acre, is very likely to cause an increase in immigration of people and capital into Colorado. The average practical person like the man from Missouri, wants to be shown. A fine field of winter wheat appeals with great favor to his interrogative mind.
As I see it, the prospects in the eastern counties of Colorado at this time must be regarded as particularly bright. A large expansion in the agricultural area is bound to take place. With a continuation of the present favorable conditions and a repetition of the yield of 1912 a considerable increase in the value and demand for land will be certain. Even in the event that the result should be 25 per cent below that of last year the conditions would justify a general raise in the price of land.

We are constantly reminded by a certain class of people that semi-arid farming is a risky proposition. It seems that farming is not all together without risk in other parts of the nation. Droughts, excessive rain, frosts, winter-killing, hailstorms and floods are common afflictions. While we are subject to more or less deficiencies in moisture, we are entirely exempt from the great devastations caused by floods. There is scarcely a year but that hundreds are driven from their homes and lose their crops in the east and south.

Then again we are told that semi-arid farming requires a great deal of hard labor. That is not the case at all. To him who knows how to divide his work properly heavy work or unreasonable hours can be quite readily avoided. Of course the work must be done and some cannot be done by whittling sticks in the shade. But when and where did the production of any useful thing not involve labor and hardship? The man at the bench, in the factory, in the mine, or on the railroad is not exempt from more or less constant and tiresome labors. Make it that the labors on the farm are never more tiresome than the labors in almost any other manual vocation, and the independence and healthfulness of farm life should not be forgotten. With the up-to-date implements and tools for all purposes, farm work is to the scientific farmer rather a pleasure than a hardship. The old drudging way of farming has to a great extent become obsolete. There is no reason why a farmer should work any harder or longer hours than any other workman, and he doesn't.

Science has not only contributed to the improvement of the conservation of soil and moisture, but also to the improvement of the work and working conditions.

Deep plowing, firming up the seed-bed and mulching the surface are no longer peculiar to semi-arid farming. Their beneficial effects are being demonstrated everywhere. The conservation of plant-matter in the soil through summer tillage and crop rotation is much in favor even in humid states.

Our Eastern Colorado upland is well worth the thoughtful consideration of both the home-seeker and the investor. Its merits are being demonstrated by a constant increase in both the quantity and quality of our harvests. The time is near at hand when all the desirable acreage will more than double in price. The next ten years will see thousands of thrifty homes and new communities where there is little else than desert waste.

The public and private organizations that are planning to attract and assist new settlers are engaged in a perfectly proper and legitimate enterprise. There is no longer any question about results when proper methods are used.

Why should we not, therefore, exert ourselves to our utmost in behalf
of an accelerated reclamation of our semi-arid plains, which mean so much to us and the use of which for practical and profitable farming is beyond all controversy.

THE EFFICIENCY OF CROP ROTATION.

In this edition of the Republican-Advocate, we have related the gratifying past achievement that characterizes Logan County, upon which we base in a large measure, our predictions for further achievement. In this we have held strictly to authentic and statistical record, and have not drawn conclusions or made assertions on a theoretical basis.

As an example of what can be accomplished by careful and proper use of the soil and a thorough consideration of crop needs, attention is called to the record of Phillip Held, who for the past eight years has conducted experiments and made detailed notes of the results of his quarter section of land five miles from the Leroy postoffice.

With a view to conserving his soil Mr. Held has given particular attention to the rotation of crops. Realizing that different plants possess different chemical properties, and knowing that some enrich while others deplete the soil, he has sought to replace soil elements by not only alternating crops, but by careful soil culture as well.

A forty-acre tract of Mr. Held's ground is always idle; during these periods, this tract has an opportunity for rest and recuperation, so to speak, but he does not permit it to lay unattended. He plows, harrows and cultivates it with as much care as though he were growing a crop upon it. This enlivens the soil and causes an intermixture of the various elements, giving fertilizers opportunity for enrichment that would not be the case if the entire vitality of the fertilization were being drawn upon by growing plants.

After a season of idleness, this tract is planted with fall wheat and after that with crops that require extreme care in cultivation, such as corn, beans or potatoes. Another 40-acre tract will be sown to grain, while the fourth tract will not be planted at all. The growing of the cultivated crops necessitating thorough cultivation, which adds to the strength and value of the soil, lend elements essential in the maintenance of its quality by imparting certain of their own properties. Grain growing abstracts from the soil and leaves little in the place of what is taken, to the end that soil that is called upon to produce grain crops year after year, eventually becomes wholly depleted, as is demonstrated in certain New England localities, a condition that is largely responsible for promoting the idea of soil and other conservation which has gained such endway within the past few years.

After a season or two of cultivated crops, a tract of land may be given over for a like period to the production of grain crops with gratifying results—enabling an increased yield of the grain crop without consuming soil vitality. Then a season of rest, and the tract may be planted to fall wheat and cultivated crops and spring grains.—Prosperity Edition of the Republican-Advocate, Sterling, Logan County, Colorado, 1913.