UNIVERSITY OF ARIZONA.

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STATION.

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AGRICULTURAL * CONVENTION.

PART I.

EDITED BY

WM. STOWE DEVOL, Director,

Agriculturist and Horticulturist.

Tucson, Arizona, October, 1895.

Arizona Agricultural Experiment Station.

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The investigations are confined to matters affecting public interests, and no private engagements can be accepted by any member of the staff, except in his private capacity.

Questions upon subjects within the scope of the Station work will be cheerfully answered whenever possible.

Address all communications to

DIRECTOR EXPERIMENT STATION,
Tucson, Arizona.

ARIZONA AGRICULTURE.

Part I of the full synopsis of the proceedings of the first convention of Farmers, Fruit Growers and Stockmen of the Territory, held at Phoenix on Friday and Saturday, October 18th and 19th, 1895, under the auspices of the Arizona Agricultural Experiment Station and Phoenix Chamber of Commerce.

Edited by WM. STOWE DEVOL, Director.

FIRST DAY.

The first convention of farmers, fruit growers and stockmen ever held in Arizona assembled in Phoenix on Friday, October 18th, 1895, in response to a call issued by the Experiment Station and Phoenix Chamber of Commerce. A full report of all matters of importance presented at the first day's session is given in the following pages.

The meeting was called to order on Friday morning by Dr. L. H. Goodrich, vice-president of the Phoenix Chamber of Commerce; Mr. Wm. Stowe Devol, Director of the Experiment Station was elected chairman, and Mr. Bruce Perley, Secretary of the Phoenix Chamber of Commerce, was chosen Secretary. Upon taking the chair Mr. Devol explained briefly the object of the meeting and then proceeded with the programme as prepared for the occasion, consisting of papers and addresses

presented upon matters of importance to those in whose interest the convention was called. The first paper was upon

THE ECONOMIC DISTRIBUTION OF WATER.

By JAMES MCMILLAN, of Gila Bend.

"In the face of the fact that there are a number of new canals just entering the field of irrigation in this Territory, and the further fact that the methods now used by existing canals are not entirely satisfactory to either the canal companies or their patrons, the question of the best or most economical method of distributing water to the land, becomes a very pertinent one.

Let us look at the methods that are now in use by the canals on the north side of the Salt river, and see if we can discover wherein they fail of being economic.

The Salt, the Maricopa and Grand canals sell water by the inch, for the season, delivering the water to the farmer at the canal, he conveying it in his own private ditch to his land, perhaps miles away. It is safe to say that the farmer will buy as little water as he can get along with, and I am satisfied that the average purchase will not exceed 60 inches for a 160 acres of land. Were this 60 inches delivered on the land it would perhaps be sufficient; but in having to stand all of the seepage and evaporation from the canal to the land, it is probable that 50 inches or perhaps less is all that will reach it. This is not a sufficiently large head of water to irrigate with economically, either as to the water or the cost of irrigating, as it travels over the land too slowly.

These canals are in the habit of pro-rating the surplus, (that is the amount of water that the canal will carry when full, over the amount sold) when there is sufficient water in the river to fill the canals, and this surplus is taken into consideration when the water is purchased, and depended on to a great extent for the production of crops. This surplus is the cause of more contention between the farmer and the canal employee than anything else, and creates jealousies, bickerings and strife between neighbors. While the farmer is receiving only the amount of water he has bought,

through his measuring box which has been adjusted to receive it. any one can see that he is only getting his own, but as soon as surplus water comes and flows over the top of the measuring box then trouble begins; for we look at our neighbor's ditch with magnifying glasses, while the naked eye is good enough for our own.

Having bought this water for a fixed time, there is no reason why he should save it for the benefit of any one else, for it is his, he has bought it, paid for it, and he is going to have it whether he needs it or not.

The faults of this method seem to me to be in the selling for a fixed time, the delivering of surplus and the consequent purchase of too small an amount of water, and the carrying of these small heads in numberless small lateral ditches, when one large one would render better service and be a great saving in both seepage and evaporation.

The Arizona canal rents water by the season, but it delivers the water to the land to be irrigated through its own laterals.

What I consider a marked improvement over either of the above for the economical distribution of water is the hour or time method.

Under this method the canal company would deliver the water to the land to be irrigated—to the farmer—the amount of water desired, charging him for the use of it for the number of hours it remained on his land; he thus pays for only what he gets and gets what he pays for, and it is none of his neighbors business how much or how little he gets. The first result of this paying for what he gets is that he buys a large head of water in order to get over the ground quickly; then he does not call for the water until his ditches, borders or furrows have been gone over and prepared to receive it; and when he does get it he takes care of it night and day, for he is working for the benefit of his own pocket. He will also find that cultivation will take the place of irrigation to a marked extent and to the advantage of his products. Under this system I think we would see no water in the roads, there would be no neighborhood bitterness, and there would be a sufficient sav-

ing of water to make what we have now cover a much larger tract of land."

The next was a paper upon the same subject by W. S. Johnson, of Mesa. He spoke as follows:

"I will state a few facts to show the impropriety of dividing the water of our rivers into many canals and from them sub-dividing into numerous ditches when water is scarce. If a full head of water is divided into four canals will flow one mile per hour, the whole amount flowing through one canal will run two miles and a half, taking the stream two and one-half times as long to reach a given point as when flowing in one body.

The seepage of a full head of water divided into four canals is three and one-half as much as when held in one body. The evaporation is six times as much when divided into four parts as when held in one body. This comes from the fact that a small stream becomes much more heated than a large one. The small one runs slowly while a heavy body flows fast. Then there are four surfaces instead of one exposed to the sun and wind.

The waste of water running through foul canals or ditches is very great, as was shown by an attempt made on the 1st of October to irrigate twenty acres of alfalfa with 200 inches of water through a foul ditch; the water was sufficient to have completed the work in ten hours but at the end of the time but five acres were finished. On the 7th of October the task was again undertaken. This time the first five hours were spent cleaning the ditch and at the end of the next five hours the ten acres were all irrigated.

If 50 inches flow of water will cover one-fourth acre per hour, 100 inches will cover three fourths of an acre per hour, 200 inches two acres per hour, and 400 inches five acres per hour. The difference in a farmer irrigating five acres per hour and irrigating one-fourth acre per hour, is that to irrigate five acres per hour you must have two good men, while to irrigate one-fourth acre per hour you may use one boy only.

A full head of water will irrigate evenly, while a small stream will soak the upper end, while the lower end is yet dry.

My method would be to employ the hour system when the water gets low and apply it to the canals as well as to the farmers. Give each canal its water in bulk by the hour instead of a small constant flow. The canal running full capacity so many given hours a given length of time would give each man using water a full head for all the hours of his time: and a man when he knows he is going to get a good head of water in time of scarcity will clean up his ditches and be fully prepared for it when it comes; the same way with the canals."

Chairman Devol than announced that the question was open for general discussion.

Mr. Isaacs stated that he considered water received every 30 or 40 days would be sufficient to keep an orchard through the dry season provided there was plenty of cultivation. He cited an instance where a young orchard was without water for 110 days, yet few trees were lost. It is useless to attempt to irrigate by running a small, trickling stream continuously; but if the water can be held by combination with neighbors and get a full head for a short time much benefit may be derived.

Mr. McMillan said: "There is more water wasted in this valley in the way of delivering stock-water than would irrigate half a dozen sections of land. Water can be obtained from wells varying from 15 to 100 feet deep. The kind of water thus obtained for stock is much better than that which stands in ponds. In delivering water to stock from the canals it is run in little streams for miles involving great loss, whereas a well put down at a small expense would give much better water and save this loss."

Mr. Johnson concurred in these remarks and said farther that, "The water thus obtained is so much better that there is no comparison. We ought to stop watering stock from these pools because we are thus made liable to fevers and other diseases. The longer we keep it up the more dangerous it becomes." He cited instances where water was economically pumped with an engine and by using ponies.

Mr. Isaacs cited an instance where a dairyman had abandoned the pond system and succeeded in watering from a well,

drawing the water with buckets, cheaper than it could be run in the ditch for the stock. Upon his place, which is rented, he is satisfied it costs twice as much to water from ponds as it would have cost had a well been used.

Chaplain Winfield Scott stated that the lay of the land, its character, whether low, adobe or gravel, and things of this kind have much to do with the economical use of water. He found that the use of water for young trees was a different thing from irrigating large trees. He stated that if he could have all the water he wanted when it was cold and fill the land—a sandy loam—full of water he could make the trees live through the dry season with very little additional water. He considers cultivation the principal thing—cultivation, cross cultivation and sub-soil cultivation. He said that there is prime necessity for storage reservoirs in order that orchardists need not have so much trouble to secure water during 60 or 90 days of the summer. He believes that the solution of the stock-water question is to be found in wells. In the lower part of the valley wells from 15 to 20 feet deep will secure the necessary amount. Wells my be dug at a cost of $25.00 to $50 00 and be sufficient to water a hundred head of cattle. When water is short he uses the following method: "I have my ditches laid out in check boxes and have everything ready before the water comes, then turn the water on the first row, when it arrives, then shut down the gates and make it go to the next row, and so on. Do not spread the water over an area that it will not wet well. I find we try to run the water too far. Where we try to run it across forty acres the first get enough and do well, while the last in the row are very poor. I find that my apricots fruit the best where they get the most water—right on the ditch. There is water enough wasted to care for most of the ranches. I have never succeeded in getting figs to amount to anything. Peaches need more water than apricots. I made a mistake when setting out my orchard. I have pears, peaches, apricots and almonds all growing together and have to irrigate them all in the same manner. They do not all need the same amount of water, so some of them get water when they should not have it."

H. H. Logan belived in the system suggested by Mr. McMillan "The water here is sufficient to irrigate every acre now under the canal systems and to produce crops to their utmost perfection. One summer irrigation could be made sufficient for the year in adition to the winter water. We have in the Salt River, during the months of June, July, August and September, a flow of something more than one hundred thousand cubic feet, which is about forty inches to the cubic foot flow per second. As now practiced there is no encouragement to the farmer to make the most use of his water. He buys by the acre and by the inch. He pays an annual sum for all the water he can get. The economical handling of it, under the present system does not save him a dollar. I have heard it estimated by people who are in a position to judge with considerable accuracy, that four fifths of all the water of June, July and August was absolutely wasted. Stock-water is a curse to any country and it would be economical to the farmers to water all stock from wells. If the people would demand that water be sold by the gallon or by the cubic foot flow per second there never would be a time when there would not be sufficient water, and there would be no water go to waste."

In answer to the question as to how the four fifths of water was wasted, he stated that, "when ditches are running full there is comparatively little seepage, whereas when the water is low the weeds and broad expanse of exposure cause great seepage." In answer to a question he stated that "an acre-foot of water is the quantity of water necessary to cover an acre one foot deep, and a cubic foot of water flow per second is equal to two acre-feet in twenty-four hours; that is, a cubic foot of water flow per second will about cover two acres one foot deep in twenty-four hours. In the purchasing of water I would have a man buy it for the number of hours he wants it and the quantity he wants."

Mr. J. W. Wolffe stated that it has been demonstrated that a good head of water is necessary for economical irrigation. "On the south side they use from 120 to 400 inches of water, but it is quite frequently the case that from 300 to 400

inches or more are used at one time, while for some days no water will be flowing. If this were cut down to a continuous flow of 30 to 40 inches nothing could be done with it. It is better to have six hours run of water once in sixteen or twenty days with a full head than to have a continuous run of a proportionately smaller stream The co-operation of the several canals will after a time be brought about. After the farmers succeed in co-operating we may expect to get the ditches to do the same. I believe the system of watering stock from ditches is pernicious. With a few cattle one can save enough in one year to pay for digging a well."

In reply to the question as what would be done if the farmers wanted the water all at the same time, as the companies could not furnish it, Mr. McMillan stated that he believed the water belonged to the people and not to the companies, and that the people should control the canals and the distribution of water; they might thus arrange to distribute the water so as to give each a large head for a short time at long intervals. Under the present system, when the little stream is furnished all the time, the user gets only a proportionate amount of what he purchases.

Mr. C. T. Hayden: "In many parts of Kansas they have twenty-two inches of rainfall yearly and need twenty-six inches to make good crops and are supplying the deficiency by wind-mill pumps, a single pump often supplying a deficiency for twenty acres. To get the best contiuous crops from the Salt River Valley, it will require from one-half foot to six acre feet of water, depending upon the soil, location, crop and season. The maximum figure can be decreased by frequent, proper and continuous cultivation. Let one-half of the crops now requiring water in the four dry months take all the water supply of the Salt River, and add one-half the work now expended to the other half—the watered half—and it would produce greater returns than the whole now gives. One-quarter more land could be cultivated by the proper husbanding and distribution of the water."

The following is an abstract of the next paper, entitled:

THE ADAPTATION OF THE WATER SUPPLY OF ARIZONA TO ITS FARMERS.

By JUDGE C. W. CROUSE, of Phoenix.

After a few introductory remarks he said in substance: "Adaptation means an adjustment to an end, object or design. Over that part of the so-called American desert which has the most scanty rainfall nature seems to provide best to store it. The nature of the soil enables it to absorb the rain or melted snow rapidly Were it not for this absorbing nature of the soil, the rain-fall would quickly find its way to the ocean because of the unusual slope of the surface. These rivers are adapted in regard to time as well, for a portion of the year they are subterranean; this occurs at the proper season, when, if the water were exposed, it would be intolerably hot for man, beast or vegetation. The gravelly strata through which the water trickles, are not parallel with the surface of the country under which the water flows. When the stratum comes nearest the surface, the earth is easily and cheaply punctured in wells; in fact sometimes the stratum conveys the water quite to the surface. For awhile it forms a river above ground, but as it flows it finally sinks to find another stratum in which it cools again. Were it not for this the water of falling rain and melting snow would flow away rapidly, the rivers would soon be but dry beds, there could be no wells and the whole country would surely be uninhabitable. The banks of the rivers are usually very low, and sandy, and as the valleys and mesa are usually very sloping, the water is easily and cheaply conveyed from the river bed through ditches or canals to the fields.

In countries where the rain-fall is sufficient for agricultural purposes the water carries little or no food, while on the so-called American desert and other places of similar character, the water is rich in plant food, gathered on the mountains and in the light loamy valleys. Every time the ground is irrigated it is fetilized as well; and the more often it is cultivated and irrigated the richer and more valuable it becomes. Hence, there is no necessity for commercial fertilizers, for

nature furnishes all the necessary plant food. The eastern farmer who must pay hundreds of dollars for fertilizers will appreciate this fact most. Observe the valley of the Santa Cruz in the vicinity of Tucson. It has been cultivated by the Spaniards and the Mexicans more than a hundred years and the soil is richer to-day than it was when they began to farm it, notwithstanding it has been fertilized in no way except by irrigation.

In the valleys of the Gila and the Salt rivers a pre-historic people built giant canals for irrigating purposes. The most noted of these ancient canals was the one which took water from the Salt river near the town of Mesa and at the site of the Consolidated canal head. The banks of this wonderful canal are yet standing, and show that the canal was almost one hundred feet wide. The Mormons utilized these old canals for many miles when they settled in that valley near the Pima and Maricopa Indians. On the Pima reservation there seems to have been a magnificent canal which took water from the Gila river about twelve miles below the town of Florence; this canal was 20 miles in length, and it has washed out so much that it is now called the south branch of the Gila river. The laterals are evidences. The famous Casa Grande ruins are within two miles of the head of this canal, and there are evidences of laterals which conveyed the water from the large canals to the fields of the farmer. In addition to the Casa Grande ruins, there are many mounds and other evidences which undoubtedly mark the home of a people who made use of these advantages.

Adjourned for recess to 1.30 P. M.

The afternoon session opened with a paper entitled

WATER SUPPLY.

By PROFESSOR EDWARD M. BOGGS, Irrigation Engineer of the Experiment Station.

(This address was only partially committed to paper by its author, and that part which was written was not preserved. No attempt is now made, therefore, to present it in full. A synopsis of its most important features is as follows):

PRESENT SUPPLY.

Practically no unappropriated waters now remain in the

streams of this territory. In many cases the waters are over-appropriated, that is to an extent far in excess of the usual summer flow. A notable exception to this is the great Colorado river, whose vast discharge has not yet been more than touched. The scarcity of water during the irrigating season being so grievous the most natural mode of relief is for all interested parties to practice rigid economy. There are many sources of waste, all of which could be materially reduced if not wholly prevented. Some people irrigate too much. The truth of this statement is invariably denied by the guilty ones, and perhaps not fully accepted by others. Arguments will not be directed against this form of waste of water at this time, but mention will be made of the other forms which are more readily recognized. Perhaps the most common among these is the multiplicity of small lateral ditches. The usual custom in this locality is for each individual to have his private lateral from the canal to his land. In some places as many as three or four of these small ditches will be found on each side of a public road. As these are sometimes of great length, generally carry but a small head of water, and are always used intermittently, their aggregate loss of water is enormous. Much could be saved by a number of neighbors forming an association and maintaining a single lateral for their common use, and, when the supply is very low, by adopting the time system of pro-rating water. By this method a consumer would have a good serviceable head for a shorter time instead of a small, perhaps insignificant stream for a longer time. Inasmuch as time is more easily and cheaply measured than water, it is very easy to secure an equitable division of water by this plan.

A great deal of water is lost through breaks in the banks of laterals and distributing ditches, whereby public roads and unoccupied land is flooded. It is no uncommon sight to see a large quantity of water wasted from the lower side of a field. Same of the waste may be caught and used by a neighbor, much is irrecoverably lost, and all of it is a total loss to the man who paid for it. Not only the water is a loss, but in many cases it carries away from the field much value in the form of fertilizers and elements of plant food taken from the

soil. A large amount of water is lost in gopher- and squirrel-holes. These animals should be exterminated, and the holes discovered and tightly closed. The prevailing system of watering live-stock has no argument in its favor, not even that of cheapness, for it is certainly profitable to give domestic animals clean and wholesome water. Stagnant water will preserve life but that is no reason why it should be depended upon for profit. Cattle will drink it—under protest—but they do not thrive with it. Whether fed for growth or for dairy purposes they need wholesome water. In addition to the effect upon live-stock is the large loss of water occasioned by running the small heads of stock-water through the ditches.

ADDITIONAL SUPPLY.

In a great many cases those who already own water rights in existing canal systems can well afford to incur an extra expense to secure a supply which shall be free from fluctuations, especially the disastrous minimum. To the home seeker who proposes to come to Arizona the question of additional supply is of paramount importance, since but little if any more land can be brought under successful cultivation without an increased supply of irrigation water, except along the Colorado river as already mentioned.

The chief sources of additional supply are the following: The great valleys of Arizona are generally underlaid with water at no great depth. While the quantity of water is not sufficient to irrigate all the land above, it is large enough to supply a great many farms somewhat separated from one another. The problem of pumping this water depends mainly upon the factor of cost of fuel. Pumping machinery may be had at a moderate cost per acre, and where fuel is cheap the expense of operating is not prohibitive. In some localities wind mills would do much of the work of irrigating gardens and small orchards. While the total wind movement may be ample for the work required, it is irregular and sometimes lacking when most wanted. A horse-power pump may be used alone, or to supplement the wind mill.

Artesian water is a great source of supply to many local-

ities in the United States. Thus far it has not been found in large quantities in Arizona, although small flowing wells exist in the San Pedro, Sulphur Springs and upper Gila valleys. The fact that it has not been dicovered does not prove that artesian water does not exist in a large scale in Arizona. But little has yet been done toward the systematic investigation of this subject. Geologists have stated the opinion that the conditions are favorable and there is reason to hope that it will yet be found.

Works for the development of underground waters by gravitation have been the subject of vast amount of discussion, and many attempts in this direction have been made, with a considerable percentage of failures, or but partial successes. In some localities, particularly in California and Kansas, such projects have been notably successful. Where the catchment basin is extensive and other conditions favorable underflow development may be undertaken with justifiable confidence, but in general it may be said that this source of supply is the most uncertain of success of any. Where the water-bearing strata are of limited extent, or composed of clayey material or fine silt, the flow of water into a drainage channel excavated at a considerable cost may be disappointingly small. It is a common experience where a region has been irrigated for some years, to find the ground water level rising near the surface. Sometimes this rise is so pronounced that the surface is converted into a swamp; often under-drainage becomes a necessity, and the increase of flow in the lower reaches of streams where formerly dry becomes important.

The great hopes of future agricultural development in Arizona lies in its superb possibilities for storing the surplus waters in time of flood. A number of these projects have been under construction for several years past. The financial depression has prevented their completion as yet, but returning prosperity has revived activity to an encouraging extent. Several of these proposed reservoirs are of stupendous size, not exceeded by any in existence. The cost of storage reservoirs is usually too great to permit the use of their water in any other than an economical manner, nor can any but highly

productive crops be profitably grown under their systems. The following statistics may be of interest in this connection:

COST, DIMENSIONS, ETC. OF A FEW AMERICAN STORAGE RESERVOIRS.

NAME.	LOCATION.	HEIGHT-FEET.	MATERIAL.	CAPACITY-ACRE-FT.	COST OF DAM PER ACRE-FT. CAPACITY.
Sweetwater	California	94	Masonry	18 000	$40 90
Bear Valley	do	64	do	40 000	5 30
Hemet Valley	do	150	do	138 000	10 00
Cuyamaca	do	40	Earth	11 500	9 00
Long Valley	do	96	do	32 900	2 25
Merced	do	54	do	15 000	26 60
Bowman	do	100	Timber and Lose Rock,		11 20
Castlewood	Colorado	64	Loose Rock & Masonry	5 300	38 00
Walnut Grove	Arizona	110	Loose Rock and Timber	7 000	16 10

The average cost per acre-foot of capacity of 16 reservoirs, from among which the foregoing were taken, was $15.10. This does not include the cost of distributing canals or other works incidental to the irrigation system. It is probable that the cost of storage reservoirs in general will average higher than the above amount. Objection is often urged against reservoirs that they are a constant menace to lives and property in the valleys below them There have been enough dreadful disasters in our country to show that a cheaply constructed or improperly maintained dam is a constant danger; but these facts should be considered as warnings to the people to provide for the inspection of these structures while building, and for constant supervision over them afterward, rather than reasons why they should not be built at all. The failure of the Walnut Grove dam in Arizona a few years ago is still fresh in the minds of the people, but they have taken no measures to prevent a repetition of such a catastophe on even a larger scale.

Many persons are of the opinion that the general government should aid in the construction of these great works. Perhaps it should; but nothing is much more certain than that it will not do so in time to benefit the present generation. The most that can be hoped for is the cession of the arid lands to the Territory in order that we may work out our own destiny. Perhaps even this measure of justice will not be given us. In

that event it will be the more necessary for us to give all possible aid to every legitimate enterprises which rises among us."

In reply to a question Professor Boggs stated that in the Salt River valley it is claimed that one acre-foot of water produces four crops of alfalfa. He thought, however, this was too great a return, as alfalfa is said to use all the water it may be given. As to the water-shed of the Salt River valley, he said that as far as he could remember the water-shed of the Verde is about six thousand square miles and the Salt River about seven thousand square miles.

Mr. Scott: "I lived thirteen years under irrigation before I came here, yet I have seen no valley that can compare with this. There is no country in the world with a climate so beneficial as in this Territory. I believe that with an increased population in the United States, some of the millions will come here for climatic conditions alone, until this shall be made the most prosperous and beautiful valley of the world. Every time a farmer comes here he adds to the wealth of the territory. If we can bring producers here as well as consumers, it will add value to every acre of the land. When this has a population of fifty thousand, as it will fifteen years hence, or one hundred thousand, as it will in twenty years, our little ranches will be worth much. We must be careful and not let this water question divide us. With the proper use of the resources at hand we can make this a garden spot so we can be a happy and blest people."

Mr Hayden: "The law gives us priorities. We don't want this water distributed to four people when there is only enough for one. The man possessing the right to water should have all his crop wants and no more, and under the law he can take no more."

The next paper was entitled:

"THE PREVENTION OF BLIGHT IN THE STRAWBERRY AND TOMATO PLANT."

By Alfred C. Lockwood, of Glendale.

"In January 1894, I set out about half an acre of strawberry plants on ridges raised slightly above the general level

of the ground. They grew well through the spring and early summer and were cultivated after each run of water with a Planet Jr. horse cultivator. The plants bore a small amount and started a large number of runners and until about July did very nicely. About that time I noticed that some of the leaves were withering and drying up at the edges and by the first of September all except about 800 plante were dead. Of these 800 many I at first thought dead, but as cool weather came on they started up from the crown and grew well. The greatest loss was in runners which died first.

In January 1895 I reset the whole bed and the plants again grew well until August. This year I was particular to irrigate only at night and drain the water off in the morning before the sun was hot. Besides cultivating between, the rows were hoed on top very fine and primed down every two or three weeks while the ground was moist.

The summer before I had noticed that most of the plants which lived were those in the shade of some volunteer watermelon vines, which I allowed to grow after the berry crop was over. Thinking that the shade might have something to do with it, I planted castor bean plants every fifth row for shading the plants. It seemed to help some but not very much. I also tried spraying with Bordeaux mixture as soon as the extreme summer heat began and the plants were through bearing, but with little effect.

The only plan I have tried that promises much success is mulching with straw, as is done in the east before winter sets in. Six rows were treated thus and about 80 per cent. of the plants lived. Several neighbors around who have set out beds have been troubled the same way. My ground was not manured until after planting and then very lightly. One neighbor manured very heavily before planting and the plants grew well till the summer heat began and then died like mine. Some have suggested that it is owing to alkali in the soil. This may be and probably is part of the cause, but then why do some of the plants start up again when cool weather begins?

Tomatoes are affected about the same way when they be-

gin to set fruit. The leaves turn yellow and the plant seems to shrivel up, but some of the hardier plants struggle feebly for a while and then take new life and start again, bearing heavily till frost.

Volunteer tomatoes seem to do better than those from eastern and California seed, though they do not bear as good fruit. I have had fair success in treating these plants with the Bordeaux mixture."

Chairman Devol: "As the next speaker may throw some light on this subject in his address we will hear it before opening the subject for general dicussion."

"ECONOMIC FUNGI."

By PROFESSOR JAMES W. TOUMEY, Botanist and Entomologist of the Experiment Station.

(The following abstract of his paper was prepared by Professor Toumey.)

The term Fungi, to the ordinary person, carries with it very little meaning. As yet few persons understsnd the specific characteristics and established life histories of these peculiar forms of vegetable growth. It is still the popular idea among many people that toad-stools, mushroons, and the like are some form of excretion from the material upon which they grow. In like manner they consider the rusts, moulds, smuts and various forms of allied fungi, more as exudations from the plants upon which they exist than as true plants in themselves, parasitic or saprophitic, upon their respective hosts.

We may in general divide fungi into two classes. 1st. All of those which live upon decayed or decaying matter. Examples of this class are the toad-stools, mushroons, and those large shelf-like bodies which are frequently found on decayed logs in the woods. 2d.—Parasitic fungi; or those forms which live upon live matter. Fungi belonging to this class we find upon our grape vines, wheat, corn, apple trees and strawberries. In fact it is hard to find a cultivated plant which has not its own particular fungus, which under proper conditions of moisture and temperature will destroy or retard its growth. In many cases not only does the plant battle against one form of fungus, but there may be ten or a dozen or even more different forms sapping the vitality of a single plant.

Prof. Burrill says that in Illinois alone there are 25,000 species of fungi. They occur everywhere and at all seasons of the year although most numerous during the latter part of summer and early fall, especially if the weather is wet and warm. At this season of the year all of you have, likely, noticed brownish or blackish spots on various kinds of foliage. You have seen a whitish or powdery substance on many leaves. In the orchard you have observed the scaley appearance of some of the apples, making them grow one sided and gnarly. You have seen the grapes rot and wither upon the vines. The rusts, smuts, mildew, blights, rots, etc., each year rob us of many dollars. All farmers know the loss which the oat and barley crops sustain in some sections, in unfavorable seasons, from the smut alone, when on the day of threshing he sees his oats not filling the measure but escaping in the air and straw in the form of minute spores which he calls smut.

In general it is the province of fungi to destroy. To-day beautiful fruit may be ripening upon the vine, to-morrow some blight has rendered it worthless. You may ask how do these minute plants which we call fungi perpetuate themselves. You all understand readily enough how the corn and wheat and plants of this nature repeat themselves season after season. Using the meaning in a broad sense fungi perpetuate themselves in the same manner. The higher plants produce seeds. The lower plants or fungi produce spores. The office of the spore is the same as that of the seed, viz.: to perpetuate its kind.

In general we may say that parasitic fungi injure the plants upon which they live in the following ways:

1st. By depriving them of nourishment.

2nd. By restricting their power for assimilation.

3rd. By abnormally increasing or decreasing growth, causing distortion.

4th. By producing decay in ripe fruits before or even after removed from the plant.

5th. By a diseased plant causing the infection of healthy plants of the same species.

Very likely the question you would ask is this: Is there not a remedy whereby the ravages of many of these destructive forms of fungi can be checked or entirely overcome? Experiments have demonstrated to us that there are a number of chemical compounds which are efficient fungicides, if applied in time. Some of our most destructive plant diseases, especially diseases of vines and small fruits, have been treated with success. In large fields of grain it is impracticable to apply a fungicide. In such case it is better to look for some preventive, such as rotation of crops, and the selection of perfectly clean seed. We have some forms of fungi, which the only way to destroy is to dig up the affected plant, root and branch, and burn it. This is rather a severe remedy but it sometimes arrests the spreading of the disease.

So far my remarks have been in regard to fungi in general. It is my purpose now to endeavor to acquaint you with a few of our most destructive plant diseases, and where I can, to give you a remedy. As yet we are but slightly acquainted with many of these forms of parsitic fungi. When their habits and characteristics are better known, very likely we will be better able to combat them. In general we may say that the less vigorous plants are the ones more liable to suffer from fungus diseases, and the farmer who keeps his crops in good condition is less liable to suffer from their ravages.

With us the most serious fungus diseases are the southern tomato blight, strawberry blight, peach curl, and the rust of oats and barley. The limited time at my disposal will not permit my going into detail in regard to description and treatment of these diseases. The tomato blight first makes its appearance by a few withered leaves toward the top of the plant, or frequently the entire plant will wilt in a day. When the disease appears it is too late to save the plant. It had best be pulled up and burned to prevent the disease, which seems to be contageous, from spreading to non-infested plants. Bordeaux mixture applied early in the season when the plants are a few inches high may be of some value in checking the blight or in preventing its development.

I am confident that much of our trouble with strawber-

ries during the past summer has been the result of improper irrigation, rather than the true strawberry blight (*Sphaerella fragariae*). In cases when the blight occurs, the spots showing the fungus are brownish at first but soon become somewhat dry and white, with a circle of red discolored appearance. At best Bordeaux mixture is of little value in preventing this blight. Some varieties are much more susceptible to blight than others. The first year or two if beds are set upon clean land there is little danger of blight. The best preventive is to change your strawberry beds after the second years crop has been harvested.

Of the fungus diseases with which the farmers of this valley have to contend the smut is the most easily subdued by proper treatment. This is a subject of more than ordinary importance because of the large loss each year which might be easily prevented, at little expense, when the nature of the disease and the method of applying the remedy is understood. Without giving a description of the disease I will outline the method of treatment, which is based on the fact that the main source of infection lies in these spores attached to the seed. The two processes of treatment best known are the copper sulphate and the hot water treatments, either of which is entirely successful when properly done.

In the former treatment 8 ounces of blue-stone is dissolved in one gallon of water, and the solution passed over the grain. The above amount will be found sufficient to thoroughly wet four bushels of grain. Stir the grain occasionally while drying that the solution may come in contact with each grain.

In the latter or hot weather treatment the seed is immerged for a few minutes in scalding water. The hot water kills the smut spores without injury to the grain. The water should be kept at a temperature of 132½°, not rising above 135°. A ten to fifteen minutes immersion is recommended. In treating large quantities of seed it is best to first warm the grain by placing it for a few minutes in warm water (110°–130°), as this will enable one to keep the first vessel of hot water at a more even temperature. The grain when immersed in the large vessel of hot water should be placed in a basket or gun-

aysack or any convenient utensil that will allow free and even access to the hot water. After withdrawing the seed from the hot water plunge it into cold water and spread out to dry."

In answer to a number of questions Professor Toumey made the following statement: "The black knot is not found in Arizona. There are half a dozen different kinds of root-knot. The one referred to is the crown root-knot or root-gall; a spongy growth which occurs most frequently in the crown of trees, but it may occur down deep upon the root. In character it is soft and spongy and may be picked apart easily, differing in this respect from other knots I believe nobody knows what causes it. It is therefore difficult to discuss remedies. The only one that seems to have done any good is to cut off the knot. I should dig around the trees and cut the knot off even though the tree should die afterward. The reason the tree is killed is that the knot appears at the crown and restricts or cuts off the circulation. Knots upon roots are not apt to kill the trees."

Chaplain Scott stated that though he cut the knots from the roots of his almond trees they all died.

STRAWBERRIES.

Mr. J. B. Broomell: "In my judgment a light loamy soil is the best for strawberries. The many soils we have here which bake hard under water are not fit for strawberries. I think Mr. Lockwood's trouble arose from his soil not being well adapted to strawberries and to the lack of water. To bear well, strawberries must be watered every fourth day. If he had mulched his plants with a heavy coating of straw instead of cultivating I think they would have lived."

Professor Toumey stated that he had not yet seen any strawberry blight in the valley and asked that specimens of leaves of so-called blight be sent him.

Mr. Williams: "The past season, about the first of September I went to the mountains and when I returned found my strawberries nearly all dead. The man in charge had not given them enough water. My neighbor's near me were all right, though not 200 yards away."

In answer to a question Mr. Wilson stated that he had a

strawberry bed five years old and still doing well. "Old plants won't bear runners, all these have to come from new plants."

The next on the programme was a paper entitled:

"THE EXPERIMENT STATIONS."

By WM. STOWE DEVOL, Director of the Arizona Experiment Station.

(The following is a brief abstract of the paper):

"The history of the Experiment Stations covers but a brief period. It was in 1834 that Mr. John Bennett Lawes began experimenting in a small way upon his estate in England, giving his attention chiefly to the application of fertilizers. Accurate records and full notes have been kept upon the work from that time to this Nine years after beginning Mr. Lawes associated with him Dr. J. H. Gilbert as chemist. About the same time Bousingalt began the development of another phase of the agricultural problem through the study of the physiology of plants and plant nutrition. In 1851 the first experiment station receiving support from the government was established at Moeckern, Saxony. Two years later another was established in Saxony, and since then the experiment stations have multiplied rapidly in Europe until there are now more than one hundred. In the United States the first effort towards securing a station was made in 1873, led by Dr. W. O. Atwater. The movement was not successful, however, until Mr. Orange Judd offered $1,000 upon his own behalf and the use of the Chemical Laboratory of the Wesleyn University at Middletown, providing the Connecticut legislature would appropriate $2,800 a year to help the experiment station scheme. From this the first experiment station in the United States was established in October 1875 with Dr. Atwater as its first director. In 1877 North Carolina established a station, then New Jersey, New York and Ohio followed. Tennessee and Massachusetts then established stations and others followed until fourteen were established in the United States, when on March 2nd, 1887, Congress passed the Hatch Act, appropriating $15,000 a year for each State and Territory that would establish and maintain an agricultural experiment station, the money

to be expended exclusively in the investigation of problems in agriculture The number of stations increased at once to fifty and there are now seventy-four in the United States, counting the branch stations, in which 576 trained specialists are employed. The range of investigation covered by the experiment stations includes the products of the farm, garden and orchard, and the raising of domestic animals, together with their study from every point of view from which it is thought something may be obtained for the good of the farmer; the study of the soils, the waters and the climate in all their relations to agriculture; the flora and the insect fauna and their relation to man, his stock and his crops; in fact nearly all questions directly affecting rural economy. The work of the stations has already saved to the farmers many times their cost, as had been demonstrated again and again. Each of the stations publishes not less than four bulletins a year and an annual report, which are distributed gratis by the stations to all applicants within their respective states and territories and usually to those engaged in farming in other states or territories who may apply for them. These bulletins contain the results of the investigations carried on by the scientific men forming the station staffs. In addition to these the Department of Agriculture is publishing a journal containing a digest of the work done at each of the various stations and also short bulletins containing results obtained through original investigations and by the stations, and these bulletins from the Department are sent gratis to all applicants.

The Arizona agricultural experiment station is located at the university at Tucson, and the members of the station staff are also members of the university faculty. This staff consists of a president, who is chief executive and president of the university; a director, who is also agriculturist and horticulturist of the station and professor of agriculture in the university; an irrigation engineer and meterologist, who is professor of civil and hydraulic engineering in the university; a botanist and entomologist, who is professor of biology; and a chemist, who is professor of chemistry in the university. In

addition to these there is a machinist, an assistant in chemistry and an assistant in horticulture.

The station is actively engaged in an effort to solve some of the many problems confronting the Arizona farmer, fruit grower and stockmen. As soon as results are obtained they are published in the form of bulletins which are sent free to all applicants. The station solicits correspondence from all those who may have questions to ask or suggestions to make. Back bulletins are sent to all applicants as long as the supply holds out. Several, however, are already out of print.

After a rambling discussion in which some business matters were considered the meeting ajourned until 7.30 P. M.

The opening address of the evening was

"FARMING IN ARIZONA."

By Governor L. C. Hughes.

He said in subtance: "I wish to congratulate you, the farmers, fruit growers and stockmen of Arizona who have assembled here and met with so much success in forming the Arizona Agricultural Association. I congratulate you because it bespeaks a very thrifty condition of affairs throughout the Territory. There is no greater interest than husbandry.

The rulers of antiquity showed wisdom in giving so much encouragement to husbandry, and in commending agriculture as the most honorable pursuit, ranking it even higher than the profession of arms. Cyrus the Conqueror was extolled because he planted trees; Cincinnatus left his plow to save Rome; Washington, Lincoln and a host of American statesmen and military heroes were products of the farm.

Agriculture makes a settled and stable community. They who cultivate the soil and plant trees, also plant homes, the school house, the church and social conditions. The mercantile house and the manufacturer follow, for these depend upon the stability begotten of agriculture. All industries anchor to agriculture. How true it is that when the farmer is prosperous all people rejoice, for then prosperity reigns everywhere.

This association can be made the means of advancing husbandry in all of its branches, and in the rapid growth of

farming and encourage immigration from every section of the Union. Develop agriculture to the highest state, and demonstrate the profits to be derived from this industry. This may in a measure be accomplished by coming together as now, and learning from each other's experiences, and by co-operating in making experiments and reporting results. The United States experiment station with its able scientific staff, will be of great aid in this works in determining what is best adapted to given localities, and discovering the causes and finding the remedies for pests and diseases. Then we want to utilize every opportunity to add profit to farm life by encouraging tributary industries. The building of aqueducts and reservoir systems will give water power for manufactures. The farm must furnish the raw material, the factory the consumers for the farm products.

The encouraging and fostering of our mining interests will enable the miner to exchange his silver, gold and copper for your meats, grain, poultry and garden products This suggests the importance to the farmers of Arizona of producing every pound of farm products necessary for our people. It is a fact that outside of Maricopa and Graham counties most of the garden truck, poultry and dairy pioducts are brought from foreign markets. This should not be allowed to continue. Maricopa county ought to furnish sufficient of the products of the soil, the dairy and the poultry yard for the entire Territory. Northern Arizona can furnish the potatoes and the cereals. Every pound of pork should be supplied by the home producer, for we can raise swine on our alfalfa at less cost than elsewhere in the country.

The value of poultry produced annually in the United States is one hundred million dollars greater than that of the wheat crop. There is no more cheerful and profitable employment for mothers, sisters, daughters and boys on the farm. The apiary is a pleasant and profitable employment and the bee works ten months in the year in this favored climate. Again there are hundreds of dollars expended for cut flowers brought from foreign markets to this land of perpetual flowers. This should not be. Our Arizona women can raise all

the flowers we need. Every home in the Territory should have its flower garden. There is no more elevating employment. I appeal to the wives, daughters and sisters to cultivate flowers and have Arizona export throughout the land these beautiful blessings of nature, instead of importing them as now.

Every piece of land which is irrigated ought to have its fish pond and produce sufficient for the farm table. A surplus can easily be produced for the home market, especially during the winter season. This would be another agreeable and profitable employment for the boys and girls of the farm. There is profit in tree-planting. Nearly every farm has little nooks which cannot be utilized for farming. The ash, the cottonwood, perhaps the eucalyptus, and other fuel growing trees ought to be cultivated on the borders of canals, and the main laterals might be planted with one or more rows of trees; they would grow here without irrigation and would serve as a wind-break, and thus aid in preventing the moisture of the field from being absorbed by hot winds sweeping over them. They would have a tendency to check evaporation from canals and laterals by shutting out the rays of the sun, and at the same time it would provide homes for thousands of the feathered tribe who would pay for their lodging many times in the destruction of insects, as well as by providing free concerts for the farmer's family.

There is much more profit in small fruits and garden produce, in localities near towns; but to make the most of this there should be a greater diversity. I once heard a farmer say that he always noticed what his neighbors planted and then planted that which they skipped, and he always produced for a profitable market.

I would call your attention to the importance of the preservation of the forests, the natural reservoirs of our water supply. This subject must appeal to every reflecting farmer, as the relation which every valley holds to the mountain forests at the head waters of the streams is of the very life of our farming interests. The destruction of the forests means drougths and death on the farm. I will also call your attention to the importance of the safe construction of the great

water reservoirs now going on. The safety to both life and property is a consideration of much gravity. I have recommended to the Secretary of the Interior the necessity of appointing a board of irrigation engineers to supervise and inspect the construction of these aqueducts as a means of protection to both the land they will serve and the people upon it.

The statistics of last year show Arizona to be enjoying more than average prosperity. We have more than five hundred thousand acres under cultivation. We have reservoirs and canals under construction which will add upwards of half a million more within the next two or three years. Our exports in value last year reached nearly fifteen million dollars, the products of mines, farms and ranges. I believe this output will be doubled during the present year.

You should all take personal interest in the coming Irrigation Congress to convene here next year. It will prove the most important gathering ever held in the Territory.

Our physical and climatic conditions are like unto those lands of antiquity, where from the cultivators of the soil came the greatest men and conquerors, the builders of the empires of the world. They tilled the soil by irrigation, so did the prehistoric races of this region which we are now engaged in again reclaiming. We are standing on the ground of that ancient civilization. Its history is a mystery, but it has left for our study its mark upon the face of the earth in the ruins of canals, reservoirs and cities.

It took the Hebrews forty years of struggle and conquest to reach the promised land of Canaan, but it was reached. It took the Arizona pioneer forty years to wrest this land from Apache savagery, and at what a sacrifice the thousands of graves bear witness. How much our beloved Arizona is like unto that land of the olive, the pomegranate and the vine, a real land of milk and honey, and all the delicious fruits and rich breads of the earth. We are now preparing to gather the fruits of that pioneer conquest. The silver hairs of the pioneer fathers and mothers bespeak their trials and the approaching end, but they see in the vision of the future the harvest of

their sowing. They hear the tramp of the millions who are coming, the rejoicing of a great and good people who will inhabit this land, and who will build monuments to their memories, and sing songs of their victories. Let us all work diligently while we have the opportunity to hasten the consummation of this hope."

After the Governor, President Howard Billman of the university spoke for a half hour respecting the educational advantages of the university. He showed that this institution of learning is prepared to educate the young people of the Territory to best meet the conditions existing in this region. The local conditions prevailing in this Territory are kept in view at all times. A student can attend the University of Arizona at an expense not to exceed $150 per year, and receive under the instructors the best of individual attention such as can not possibly be provided in larger institutions where the attendance is very great.

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