TEXAS AGRICULTURAL EXPERIMENT STATIONS.

BULLETIN NO. 98.

AUGUST, 1907.

SUMMARY.

TEXAS BULLETINS NOS. 1 TO 94, INCLUSIVE.

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NOTE.—*The main station is located on the grounds of the Agricultural and Mechanical College, in Brazos county. The postoffice address is College Station, Texas. Reports and bulletins are sent free upon application to the Director.*

PREFACE.

The publication of this summary of bulletins is for the purpose of putting in a form convenient for reference the problems studied and the results obtained by the Experiment Station of the Agricultural and Mechanical College of Texas since its establishment in 1888. A glance at the summary will be sufficient to show that remarkably rapid progress has been made in the science of Agriculture during these years.

In the light of subsequent investigations some of the results published in the earlier bulletins have been either abandoned or greatly modified; for example, those dealing with costs of fattening animals, while true at the time, are, owing to the great change in prices of feed stuffs, no longer in all respects reliable; but those not depending upon accidental or changing circumstances are as true now as they were years ago, and will always be true—they have become incorporated into the body of permanent facts which go to make up the science of Agriculture as we know it today.

Though the summarizing may not be so skillfully done as it might have been if there had been more time to devote to it, yet it is sufficiently clear and accurate to serve the purposes of those who are really interested in such investigations. The work is given to the public with the hope that it may be suggestive and helpful to the thousands of progressive farmers, stockmen, and truck growers who are now doing so much for the advancement of the material prosperity of the State.

J. W. Carson,
Acting Director.

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A SUMMARY OF BULLETINS ISSUED TO JUNE, 1907,

BY THE

AGRICULTURAL EXPERIMENT STATION OF TEXAS,

AT

COLLEGE STATION, TEXAS.

CONTENTS.

SUMMARY OF BULLETINS.

BULLETIN No. 1. FEBRUARY, 1888.

THE PLAN OF ORGANIZATION.

This bulletin gives a brief sketch of the origin of the Texas Experiment Station. In 1887 Congress made provision for establishing and supporting Agricultural and Experiment Stations to be placed under the supervision of the Board of Directors of the State Agricultural and Mechanical Colleges, where such colleges had been established. The Act of Congress appropriated $15,000 per annum for the support of each experiment station.

As soon as the funds became available the Board of Directors of the Texas Agricultural and Mechanical College proceeded to organize the station by electing F. A. Gulley, Professor of Agriculture in the Agricultural College of Mississippi, Director, and by placing the work of the station under the general supervision of a council, consisting of Louis L. McInnis, Chairman of the Faculty; T. M. Scott, Agent of the Board, and F. A. Gulley, Director of the Station.

BULLETIN No. 2. MAY, 1888.

REPORTS ON FIRST EXPERIMENTS.

F. A. GULLEY, Director.
G. W. CURTIS, Agriculturist.
H. H. HARRINGTON, Chemist.
T. L. BRUNK, Horticulturist.
J. H. KINEALY, Meteorologist.

This bulletin contains a statement of experiments begun and planned —among others, those on *Cotton Blight,* on *Cattle Feeding,* on *Fertilizers,* and on *Drainage.*

The Agriculturist reports a test of the feeding value of cob and shuck ground with corn as compared with an equal amount of ground corn. The mixture was found to fatten the cattle a little faster than the pure corn, but hardly fast enough to pay for the extra labor involved.

The Chemist explains the terms used in analyses of fertilizers and feeds, and the method of valuing fertilizers; and gives analyses of ores, grasses, and fertilizers.

EXPLANATION OF ANALYSES.—FERTILIZERS.

In the determination of the commercial value of a fertilizer, only the total *nitrogen,* its equivalent in *ammonia,* the *potash,* and the *phosphoric acid* are considered. Three *phosphoric acid* determinations are made, in order to test further the value of this ingredient.

"The water soluble" has reference to that phosphoric acid which is readily soluble in cold water, and which the plant can, therefore, at once assimilate.

"The citrate soluble" is that part of the phosphate soluble in a perfectly neutral (neither acid nor alkaline) solution of ammonium citrate of a definite specific gravity. This part of the phosphate is supposed to be that which, once soluble, has reverted, or gone back into a state less soluble than the "soluble phosphoric," but which the plant can take up within a short time.

To "the citrate insoluble" is referred that amount of the phosphate that is undissolved by the above "ammonium citrate solution." It is believed to be generally of little immediate value as plant food, and is not accorded a commercial valuation.

The "total phosphoric," of course, means the whole amount of phosphoric acid present; while the "total available" is the sum of the citrate soluble, or reverted, and the water soluble.

The "potash" is what the chemist knows as *oxide of potassium;* and is the valuable fertilizing ingredient in all potash salts, such as muriate, sulphate, etc. "Nitrogen" is the most valuable ingredient in commerce, belonging to the fertilizer. In 14 parts it is equal to 17 parts of ammonia.

FEED STUFFS.

The manner in which the feed stuffs are reported will be noticed. A fodder or hay is never so dry, however it may seemingly be, but that considerable moisture can be extracted when dried at 212° F. (boiling water) for four or five hours. This loss is indicated as "moisture." If a fodder is burnt over a low flame until most of the organic matter is driven off, a semi-white substance consisting of mineral matter (ashes) is left behind. It contains, besides, a little unburned carbon. This mass is "crude ash." "Crude cellulose" is that part of a plant, or of vegetable matter, that is insoluble at a boiling temperature in very dilute acids and alkalis. It is *non*-nitrogenous, and is what remains of a plant after all the more soluble portion has been taken away. "Ether extract," or crude fat, includes everything which can be extracted from the dry fodder, by means of absolute ether, oils, fats, chlorophyl, etc. "Nitrogen free extract," or carbohydrates, means starch and sugar usually, though small amounts of gum and pectin substances are also present. "Albuminoids" may consist of a variety of substances chemically. They include all the nitrogenous part of the plant. The total quantity of albuminoids is obtained by multiplying the nitrogen found by $6\frac{1}{4}$, a calculation based on the fact that all the albuminoids contain about 16 per cent nitrogen. ($16 \times 6\frac{1}{4} = 100$ per cent.) This method is not absolutely accurate, but is sufficiently so for practical purposes.

VALUATION OF A FERTILIZER.

The commercial value of a fertilizer means the market value of its fertilizing ingredients. It is usually calculated on the amount of potash, available phosphoric acid, and nitrogen which it contains: though there are obviously some fertilizers that have not a value as-

signed to them in this way, their price depending upon local conditions. Such are gypsum, ashes, barnyard manure.

Available phosphoric acid is worth in the market about 8 cents per pound, nitrogen about 18 cents per pound and potash about 5 cents per pound. In some fertilizers, the available phosphoric acid may be small, and the fertilizer still of great value because of the large amount of total phosphoric acid present; for example, cotton seed meal, and bone meal. But, in these cases, the organic matter soon decays, and leaves the phosphoric acid as available.

The Horticulturist requests samples of new varieties of fruits and vegetables, and gives a list of fifty-four varieties of grapes planted in the Station vineyard.

The Meteorologist requests farmers to provide themselves with the necessary instruments—a thermometer and a rain gauge—and to become voluntary observers for the Station. He gives instructions for this work.

BULLETIN No. 3. OCTOBER 10, 1888.

GRASSES.

T. L. BRUNK, Horticulturist.

This bulletin gives the results of a number of tests to determine the grasses best adapted to the climatic and soil conditions existing at College Station. Of the fifty-three varieties of grasses tested, only twelve survived the summer drouth and made a profitable growth: Milo Maize, Bird's-foot Clover, Alfalfa, Japan Clover,* Sweet Clover, Teosinte, Pearl or Cat-tail Millet, Red Canary Grass, Bermuda Grass, *Paspalum plati-cauli, Paspalum dilitatum,* and Johnson Grass. Of the annuals that are good hay plants are the following: Large and small Canary Grasses, Hungarian Millet, Italian Millet, Rescue Grass. Those that are best suited for permanent pastures are: *Paspalum plati-cauli,* Bermuda Grass, Japan Clover, and perhaps Johnson Grass and *Paspalum dilitatum.*

BULLETIN No. 4. BOTANICAL SECTION. DECEMBER, 1888.

ROOT ROT OF COTTON, OR "COTTON BLIGHT."

L. H. PAMMEL, Shaw School of Botany, St. Louis, Mo.

This bulletin presents a preliminary report on an investigation more fully described in Bulletins Nos. 7 and 22. It shows that the theories then largely held, namely, that the "dying of cotton" was due to alkaline, or other chemical or physical conditions of the soil, or to insects, do not accord with the facts; and that the real cause is a fungus, *Ozonium Auricomum,* feeding on the roots. This fungus is also found on the roots of sweet potatoes, cow peas, apple and pear trees, grapes and other plants.

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*Japan Clover has proved of value only in East Texas.

Preventive remedies are recommended: Rotation with cereal crops, such as corn, wheat, oats, millet, whose fibrous roots are not attacked by this fungus; destruction of infected plants; and drainage.

(See Bulletins Nos. 7 and 22.)

BULLETIN No. 5. AGRICULTURAL SECTION. MARCH, 1889.

CREAMERIES IN TEXAS.

F. A. GULLEY, Director.

This bulletin contains a discussion of the advantages of the creamery as compared with the farm dairy; and an account of plans of organization and control, and of different systems of creaming.

The creamery is recommended because it saves time and labor, especially of the women of the household. United effort and concentration of milk supply enables us to manufacture better butter at a less cost. Creameries will create a demand for milk, and so stimulate the breeding of better cows. They will keep money in circulation all the year, and in this way benefit the merchants, who should, therefore, subscribe liberally to creamery stock, even though small dividends may be expected for a year or two.

A description, with cuts, of a plan for a creamery follows. The following practical suggestions are given:

"The *best* cow will give but little milk with insufficient feed."

"Handle the cows carefully and quietly—*it will pay.*"

"See that the cows have access to plenty of good water."

"Salt regularly at least once a week—twice is better; or place good lump salt where the cows can have access to it."

"Milk regularly at a certain time morning and evening."

"Do not let the milk stand where it can absorb odors from the stable or barnyard filth. Milk is very sensitive in this respect, and good butter can not be made from foul milk."

"For small dairies, the barrel churn revolving endwise, or rocking like the Buckeye patent, gives good results."

"When coloring is used, add it to the cream when in churn."

"When cream is thick, add water, hot or cold, as needed. Temperature should be 63° to 65° F. in summer, and 69° to 70° in winter. *Do not rely on guessing as to temperature; use a thermometer.*"

"The time required for churning should be from 25 to 40 minutes. If the cream is too cold, the churning may take several minutes longer."

"Stop churning when the granules are almost the size of small peas, draw off the buttermilk through a small hole near the bottom of churn, and wash the butter clean with pure cold water."

"Take up the butter in the granule form, weigh it, add salt of the finest quality (½ to 1 oz. to a pound of butter). The salt should be evenly distributed and the granules pressed firmly together—not worked. Set away in a cool place for six to twelve hours, then work just enough to make mass uniform and compact, and print or pack for market."

For special trade, print butter in pound or half-pound packages neatly wrapped in parchment paper, will bring highest prices. For the general market it will be most economical to pack in ash tubs, sizes to suit churnings. Before using a tub, fill it with hot brine and let it soak for at least twenty-four hours. Just before using, scald with clean hot water and cool quickly with a rinsing of cold water. Fit closely a circle of parchment paper in the bottom of the tub. Press the butter firmly, and when full cover with a second circle of parchment paper and fasten on top.

Keep all vessels for milk, cream or butter scrupulously *clean*. Use hot water always, and if greasy, washing soda. For all tinware, it may be best to use warm water first, and then rinse with hot water or steam. In cleaning churns no soda should be used unless carefully removed by thorough rinsing.

BULLETIN No. 6. JUNE, 1889.

AGRICULTURAL SECTION—LIVE STOCK.

FEEDING EXPERIMENT

F. A. GULLEY, Director.
J. W. CARSON, Assistant to Director.

This bulletin gives an account of the first of a series of feeding tests, which the Director expected to continue for several years. These questions are asked:

1. Is it profitable and practical to shelter range cattle in feeding?
2. What feed stuffs that can be supplied in the State give best returns for cost?
3. Can the native Texas steer be fed profitably?

Fifty-five head of cattle were fed on different rations, made up of corn, hay, cotton seed raw and cooked, cotton seed hulls, cotton seed meal, and silage. Range steers were dehorned and fed loose under a shed, crowded together like sheep.

The results of the experiments established the following facts:

1. Steers dehorned and fed under a shelter made larger gains than steers not dehorned and not sheltered, and at less cost for food.
2. Silage and cotton seed hulls for roughness, and cooked cotton seed and cotton seed meal, with or without corn, made more rapid gains than hay and corn, and at less cost. Except in favored and exceptionally good hay-producing sections, cotton seed hulls in the vicinity of oil mills, and corn and sorghum silage elsewhere in the State, supply rough fodder in the cheapest form to the cattle feeder as the basis of food rations.
3. With a margin of 1 cent per pound gross between thin and fat cattle, steers may be profitably fed over a large portion of the State.

In this experiment cotton seed meal was rated at $20 a ton, cotton seed $7.00, hulls $3.00, silage $2.00, hay $6.00, corn fodder $5.00, and earn corn 40 cents a bushel.

This report also contains the results of analyses of the food stuffs employed, by Professor H. H. Harrington, Chemist, who says:

"There is a clear advantage from analysis in favor of Texas silage over that reported from Northern States. The water is lower, while the other ingredients are still higher, but the crude fiber not sufficiently so to detract materially from the value of the silage. We can not say if subsequent work will confirm these discrepancies.

"There seems to be little difference between the value of the corn silage and the pea-vine silage. The changes in the pea-vine silage in the silo are not truly such as have been expected. The nitrogenous matter in the silo decreased and the fatty acids increased, as would have been anticipated. But there was also a slight increase in cellulose and a decrease in nitrogen-free extract.

"The sugar cane *bagasse* is not equal to silage in nutritive value, but it makes a good showing and requires further investigation. A remarkable thing about it is the *large percentage of fats.*"

This feeding experiment was continued the following winter, and reported in Bulletin No. 10.

BULLETIN NO. 7. BOTANICAL SECTION. NOVEMBER, 1889.

COTTON ROOT ROT.

L. H. PAMMEL, of Ames, Iowa.

This bulletin presents a detailed report of the work outlined in Bulletin No. 4, page 9, confirming its conclusions, and adding many valuable facts.

The parasitic fungus, *Ozonium Auricomum,* occurs in many different soils, and is worst in those which are poorly drained, and in wet seasons. Chemical analyses have shown that the constituents of the soil have nothing to do with it. Fibrous-rooted plants like the cereals and grasses, seem to be immune; but it attacks weeds and forest-trees, and such crops as sweet potatoes, cow-peas, watermelons, tobacco, Irish potatoes, okra, and many fruit trees.

In the early stage of the disease, if the roots be examined before the plant has wilted, a white mould-like fungus will be found on them. Wart-like bodies, masses of the fungus, will also be found, and these will retain the infection for a long time.

Rotation of crops, planting for three years in grasses, is the only efficacious remedy. Fertilizers were found to do no appreciable good in checking the disease. Drainage is helpful.

BULLETIN NO. 8. HORTICULTURAL DEPARTMENT. DECEMBER, 1889.

WORK IN HORTICULTURE.

T. L. BRUNK, Horticulturist.

This bulletin contains:

I. Notes on Experimental Vineyards.
II. Experiment and Notes on Strawberries.
III. Notes on Blackberries and Raspberries.
IV. Notes on Grasses.

V. Best Varieties of Fruits for the Different Sections of Texas, with Notes from Correspondents.

VI. Lists of Fruits Growing in Experimental Grounds.

VII. List of Forest, Shade and Ornamental Trees in College Arboretum and Shrubs Growing on the Campus, with some Notes.

(See later bulletins.)

BULLETIN NO. 9. HORTICULTURAL SECTION. MAY, 1890.

PEAR STOCKS.

T. L. BRUNK, Horticulturist.

SOME PARASITIC FUNGI OF TEXAS, WITH NOTES.

H. S. JENNINGS, Assistant in Horticulture and Botany.

The first half of this bulletin is devoted to a discussion of the question of the value of French pear or apple stocks on which to graft the Le Conte and Keiffer pear. The claim that these foreign stocks would come into bearing sooner had made a number of Texas horticulturists try them. On examination of these trees, the author found that in every case when the scion had made an early growth, it had done so *on its own* roots. He concludes that it is best to grow Le Conte and Keiffer pears from cuttings, or else to side-graft a piece of root of French pear or apple seedling to support the cutting until it sends out its own roots, and in the fall, when removing from the nursery, cut off the grafted root.

SOME PARASITIC FUNGI OF TEXAS.

H. S. JENNINGS.

This treats of ninety-five species collected mainly at College Station, 1889-1890. Those of economic importance described are:

Cæoma Nitens—Orange Rust of Blackberry.
Tuberculina Persicina—A parasite destroying the above.
Cladosporium Fulvum—A fungus on Tomato leaves.
Cladosporium Viticolum—Grape-leaf Blight.
Exoascus Deformans—Leaf Curl on Peach.
Glœosporium Decipiens—On the leaf of the Green Ash.
Glœosporium Fructigenum—Bitter Rot of Apple.
Læstadia Bidwellii—Black Rot of Grape.
Plowrightia Morbosa—Black Knot of Plum.
Glœosporium Lagenarium, var. *Follicolum*—On Watermelon.
Puccinia Coronata—Oats Rust.
Puccinia Graminis—Grass Rust.
Puccinia Pruni-Spinosa—Peach and Plum Rust.
Sphaceloma Ampelinum—Anthracnose of Grape.
Sphærella Fragariae—White Rust of Strawberry.

(See Bulletins Nos. 4, 7, 22, 23, pp. 9, 12, 23.)

BULLETIN No. 10. MAY, 1890.

AGRICULTURAL SECTION—LIVE STOCK.

FEEDING EXPERIMENT NO. 2.

F. A. GULLEY, Director.
J. W. CARSON, Assistant Director.

The experiment reported in this bulletin is a continuation of the feeding experiments reported in Bulletin No. 6.

Several matters are investigated, but the two leading questions are:

1. What is best to feed with cotton hulls?
2. What is best to feed with silage?

Incidentally we ask:

(a) If sweetening the ration will make it more palatable to cattle?

(b) Is corn silage a better cattle food than dry corn fodder?

(c) What is the comparative value of cotton seed and cotton seed meal for feeding?

(d) Is corn the best grain to feed with corn silage?

(e) Will changing the ration stimulate the appetite and cause cattle to fatten more rapidly?

(f) Will hogs do as well running after silage and cotton meal fed cattle as after hay, corn, and cotton seed fed cattle?

(g) Will cotton seed improve the corn and hay ration?

(h) Is cotton hulls and cotton meal a good food to fatten sheep?

The cattle were fifty head of *twos and threes,* and twenty-two head from four to six years old. The former were fed ninety days, the latter seventy-nine.

The conclusions were:

1. The experiments for the two winters show that, of our different cattle foods, a ration made up of cotton hulls and cotton meal is equal, if not superior, to a ration of any other two feed stuffs used for fattening cattle, but a cheaper ration may be compounded of silage and cotton seed, or of corn, hay and cotton seed, at the prices given.

Prices of feed stuffs were as follows:

Corn fodder $5.00 a ton, silage $2.00, cotton seed raw and cooked, $7.00, hay $6.00, corn and cob meal 40 cents a bushel, cotton seed meal $20, molasses 20 cents a gallon, and cotton seed hulls at $3.00 a ton.

2. That the addition of some other feed stuff to the cotton hull and cotton meal ration makes it more palatable to cattle, and produces better results in gain in weight. Corn meal, hay, silage and molasses, any one of these added to a ration of cotton hulls and cotton meal, made larger gains than hulls and meal alone, in the order named, molasses giving the best results.

3. Of the several rations containing silage, silage, cotton hulls and cotton meal gave the best gains; silage and cotton seed meal second; silage and boiled cotton seed third; silage, corn and cob meal and cotton meal fourth; silage, corn and cob meal fifth. Dry corn fodder did not give as large gain as silage. Molasses did not improve the ration containing silage.

4. Cotton hulls and cotton meal with hay, corn, silage, and molasses gave larger gains than silage and cotton meal, or silage and cotton seed.

5. Cotton seed meal, with other feed stuffs and fodders, gave larger gains than cotton seed with other feed stuffs and fodders.

6. Cotton seed, with other feed stuffs and fodders, made gains at less cost for food per pound gain than cotton meal with other feed stuffs and fodders.

7. After any one of the rations was used without change for sixty days the daily gain diminished, until finally, in some pens, it ceased entirely; but, with a change of ration, the daily gains in all the pens was largely increased, in some pens exceeding the average of the first period of feeding.

8. Hay and corn alone is more costly, and will not fatten cattle so rapidly as rations containing cotton seed and meal, with hulls or silage; and boiled cotton seed added to the corn and hay ration makes more rapid gain than corn and hay alone, and at considerably less cost per pound for the food consumed.

9. The waste from cattle fed on hay, corn, silage, and raw cotton seed was worth considerably more for hogs running after the steers than the waste from cattle fed on silage, cotton hulls, and cotton seed meal.

BULLETIN No. 11. AGRICULTURAL SECTION. AUGUST, 1890.

EFFECT OF COTTON SEED AND COTTON SEED MEAL ON BUTTER PRODUCT.

GEO. W. CURTIS, Director.

This bulletin is a discussion of the questions (1) whether it is true, as generally believed, that feeding cotton seed makes the butter firmer, white, and of poorer flavor; and (2), if this is true, how much cotton seed may be fed, and with what other foods, without lowering the quality of the butter?

Chemical analyses made by Professor H. H. Harrington and W. Wipprecht showed that the melting point and volatile acids rose steadily as the amount of cotton seed, or meal, increased. Therefore, cotton seed butter would be firmer and easier to ship and to handle in hot weather. It is true, that in hot weather *heavy* feeding of such rich food is not advisable; but moderate feeding of cotton seed meal all the year is practicable if combined with the proper roughage. A moderate ration of cotton seed meal increased the flow of milk, and hence increased the yield of butter.

Samples sent to experts in New York, Illinois, Iowa and Louisiana showed that the quality of butter fell off as the proportion of cotton seed meal increased. When the cattle received plenty of fresh grass or ensilage, they could eat more cotton seed without injury to the flavor or the texture of the butter.

Cream from cows fed on cotton seed mead had to be churned at a higher temperature to bring the butter.

A discussion follows, of the value of sweet cream butter, which the author considers as good as that from sour cream.

(Note.—Later experiments at the Mississippi Station bear out the results as to cotton seed feed raising melting point of butter, and making it hold up better in hot weather, but fed in amounts of 4 to 5 pounds of meal or 6 pounds of seed per cow per day, along with wheat bran and roughage, butter scored about as high as with any other combination of feed.—W. C. Welborn.)

BULLETIN No. 12. VETERINARY SECTION. SEPTEMBER, 1890.

THE SCREW WORM.

M. FRANCIS, Veterinarian.

This bulletin gives the life history of the screw worm, an account of its injurious effects on animals, and a discussion of remedies used.

The fly seems to be well distributed over the American continent, for Dr. Williston, of Yale College, writes that "it occurs everywhere from Canada to Patagonia." Although so generally distributed, only in Texas does it bear an economic importance in the United States. Of all our domesticated animals, cattle suffer the most from its ravages. They occur in wounds from horns, castrating, spaying, branding, dehorning, barbed wire injuries, and often where ticks have burst on the brisket, flank, or just behind the udder of cows. Screw worms often occur in the vulvæ of cows, after calving, especially if there has been a retention of the *placenta* or afterbirth. Young calves are almost invariably affected in the naval, and often in the mouth, causing the teeth to fall out. "One case occurred in the first stomach (paunch, or *rumen*) that is worthy of mention: Last September the writer had occasion to kill a Jersey bull calf, probably two months old, that had screw worms in both hind legs just above the hock joint. On opening the abdomen, I found hair-balls in the stomach (*rumen*), and, to my surprise, about twenty-five fully matured screw worms almost buried in the wall of that organ.

I placed some of the worms in moist earth, and in ten to twelve days they hatched out genuine screw worm flies. How did they come there? My opinion is that the calf licked the sores on his legs, and in doing so took in some eggs that hatched and developed in the stomach."

Horses and mules are not so often attacked. In them they are usually found in barbed wire injuries, and occasionally in the sheaths of horses, the vaginæ of mares, and the navels of colts.

Hogs are more liable to become affected than horses. They are frequently wounded by dogs and by fighting, or there may be barbed wire injuries, wounds from castration, etc.

Sheep are comparatively free from attacks unless injured by dogs.

In all animals alike, the eggs, after being laid by the fly, hatch into larvæ or so-called "worms." The exact length of time this requires seems to vary with circumstances. My present opinion is that, if the eggs are laid in a moist place and on a warm day, it requires less than one hour; whereas, if laid in a dry place they seem to dry up and lose their vitality. The young larvæ when first hatched are small and easily overlooked. If they are hatched on the surface in a drop of blood from a ruptured tick, for instance, they attempt to perforate the skin, and if

hatched in wounds they at once become buried out of sight. They seem to attach themselves by their heads, and burrow their way under the skin, completely devouring the soft flesh. Occasionally a few are seen moving from one place to another, but usually they remain fixed at one point. The worms grow steadily in size, and the hole in the flesh becomes larger every day. Sometimes the worms make tunnels, but not to any depth; they usually stay on the surface. They evidently produce considerable irritation, for the part is always swollen and constantly bleeding. This swollen, gaping appearance in the wounds, together with the constant discharge of blood, are characteristic of the presence of worms. It seems to require about a week for the worms to become fully grown. At that time they are about five-eighths to six-eighths of an inch long. They then leave the sore and go into the ground, where they pass their pupa state and hatch out as flies in from nine to twelve days. Of several hundred hatched out by the writer, the shortest time was nine days and the longest fourteen days, but in the majority of cases it required from nine to twelve days. While the larvæ are thus developing the flies are constantly laying fresh eggs in the wounds, so that the young worms take the places of the matured ones, and thus keep up a constant and progressive loss of tissue. If the worms are not killed they eat constantly deeper, and often kill the animal. Sometimes the abdomen is opened and the bowels escape—especially in cases of heifers spayed through the abdomen. At other times a tail is eaten off, or extensive caverns are made into the muscles.

The treatment usually employed in these cases consists simply of killing the larvæ with Cresylic Ointment, Calomel, Chloroform, or Carbolic Acid. The selection of the most suitable remedy will vary somewhat with the location, character, and extent of the sores. In some cases bandages are useful. In others the sores can be filled with oakum and a few stitches taken. All treatment should be supplemented by daubing the margins of the wound with pine tar to ward off the fly. A vast number of cases can be prevented by keeping cattle free from common cattle ticks.

BULLETIN No. 13. CHEMICAL SECTION. DECEMBER, 1890.

SORGHUM; VALUE AS A FEED STUFF; EFFECT ON SOIL. TEOSINTE; ANALYSES AT DIFFERENT STAGES OF GROWTH.

MISCELLANEOUS ANALYSES.

H. H. HARRINGTON, Chemist.
DUNCAN ADRIANCE, Assistant Chemist.
P. S. TILSON, Assistant in Chemistry.

SORGHUM.

This study of *Sorghum,* begun the previous year, proposed to learn (1) the chemical differences between varieties; (2) the best time to cut sorghum; (3) its values as a feed stuff; (4) its effect on the soil.

The conclusions were:

1. The sweet sorghums are best, but there is little difference among the sweet varieties.
2. Ripe sorghum contains more nourishment than sorghum in the "dough state," but when intended for hay it should be sown thick and cut earlier, because it is more palatable.
3. When fed green with dry feed it is a good milk producer. Its digestibility compares favorably with that of corn except for the nitrogenous matter.
4. Sorghum removes as much nitrogen from the soil as wheat or corn, more phosphoric acid, and four times as much potash.

TEOSINTE.

A similar study made by Mr. Walter Wipprecht showed:
1. *Teosinte* is inferior to corn or to *Dhoura* as a food stuff; and
2. It improves in value as it matures.

Analyses of sorghum and corn silage showed the corn silage to contain much less water and to be more nutritious. Kaffir corn silage more nearly approached the composition of corn silage than did the sweet sorghum.

Digestion experiments were made with sorghum fed in the dough stage to milk cows. About 73 per cent of the dry matter was digested, showing it to be an excellent feed.

A sample of *muck* from Greenville showed in the air-dry material nearly 2 per cent of nitrogen, which should give it a value of several dollars a ton for fertilizing.

BULLETIN No. 14. AGRICULTURAL SECTION. MARCH, 1891.

EFFECT OF COTTON SEED AND COTTON SEED MEAL ON THE DAIRY RATION.

GEO. W. CURTIS, Director.
J. M. CARSON, Assistant Agriculturist.

This is a continuation of Bulletin No. 11, and is a report of experiments undertaken to find out if cotton seed and meal in the ration made it any easier to separate the cream.

When the milk was set and the cream skimmed, only about half as much was retained in the skimmed milk if the cows had been fed cotton seed; but if, instead of using this "gravity process" a centrifugal separator was used, it made no difference what the cows were fed, the separator practically got out all the cream. Therefore, the use of the separator would save to the dairyman about $9.75 per cow each year.

Chemical analyses in this bulletin were made by Assistant Professor Tilson.

BULLETIN NO. 15. CHEMICAL SECTION. MAY, 1891.

INFLUENCE OF CLIMATE ON COMPOSITION OF CORN; DIGESTIBILITY OF SOUTHERN FOOD STUFFS; ASH ANALYSES; ROASTED COTTON SEED.

H. H. HARRINGTON, Chemist.

This bulletin describes experiments carried on in co-operation with the stations in Connecticut, Georgia and New York, to find out if changes of climate affected the chemical composition of corn. The results indicated that Southern grown corns are richer in albuminoids, and fats, with a corresponding diminution of the less important ingredients.

Experiments with cotton seed hulls and fodder showed that when these were fed to cattle very little of the nourishment in the hulls was digested; but that corn fodder was easily digested.

Digestion experiments were made with cotton seed hulls and corn fodder (stripped leaves of corn). The hulls were found to be about 45 per cent digested and of the corn fodder over 59 per cent was digested.

Ptomaines were found in the stomachs of hogs which died after being fed on cotton seed.*

An analysis of *roasted* cotton seed showed no marked change.

BULLETIN NO. 16. HORTICULTURAL DEPARTMENT. JUNE, 1891.

WORK IN HORTICULTURE.

S. A. BEACH, Horticulturist.

This bulletin contains *Drainage Experiments,* on Irish potatoes, cabbage and strawberries; a list of Russian fruits and ornamental trees which the Station desired to propagate in co-operation with Texas horticulturists; a list of fruit trees in the Station orchard—167 varieties of the peach, 68 of the plum, 32 of the cherry, 113 of the apple; and a list of 67 forest trees and 28 shrubs given by the gardener, Mr. G. E. Eberspacher, as having been successfully grown for two years on the Campus.

The drainage experiments were of special value, showing an increase of 170 per cent in the yield of Irish potatoes on the drained plats, while the cabbages were much larger and earlier. The strawberries were not allowed to fruit the first year, so no results could be reported in this bulletin. A method of setting strawberries is described and recommended.

BULLETIN NO. 17. AUGUST, 1891.

GENERAL INFORMATION REGARDING THE STATION.

G. W. CURTIS, Director.

This publication contains a review of the acts of Congress and of the State Legislature under which the Station was established, a brief account of the organization of the Station, with lists of officers, a sum-

*See Bulletins 21 and 78, pp. 21 and 72.

mary of the results of experiments, an outline of the work in progress, an inventory of the Station property, and a financial statement for each year during which the Station had been in operation.

BULLETIN No. 18. VETERINARY SECTION. OCTOBER, 1891.

LIVER FLUKES.

M. FRANCIS, Veterinarian.

This bulletin shows that the common liver fluke, *Distomum Hepaticum,* occurs quite abundantly among cattle and sheep raised on the coastal prairies of Texas and along the river bottoms for one hundred miles or more into the interior of the State. No new facts in regard to its life history are given, but attention is called to the fact that one stage of the development of the fluke is passed in the body of a small water-snail, and that in the *cercarian* stage the embryo fluke escapes from the snail and encysts on water-grasses, which are devoured by animals. Thus the disease only occurs when stock have access to pools of stagnant water and the herbage around them. Cattle ranging in *salt* marshes are not seriously affected. This parasite appears in great numbers, and seriously injures and frequently kills both sheep and cattle, causing dropsy, "water jaw" and "scours." Medical treatment is of little value; a *pure water supply* is the only efficient remedy.

During this investigation an undetermined fluke was often found in the liver tissue of cattle, which was given the provisional name *Distomum Texanicum.* Its life history was not determined. (Stiles has restudied this fluke and regards it as *Distomum Magna,* described by Bossi, as occuring in some deer in Italy.)

BULLETIN No. 19. AGRICULTURAL SECTION. DECEMBER, 1891.

CORN FODDER.

GEO. W. CURTIS, Director.

This bulletin discusses methods of saving fodder. Three methods, "topping," "pulling," and "topping and pulling," were tested, and results compared with regard (1) to effect on corn; (2) to value; (3) to yield; (4) to digestibility, and (5) to cost.

"Topping" was found to give best results for yield of grain.

"Pulling" gave the most valuable fodder; "topping and pulling" the greatest yield of forage, the yield of leaf-fodder being about half that of the tops.

"Pulling" gave the most digestible fodder, the nutritive ratio of pure leaf-fodder being 1:6.1—second only to clover hay.

The cost of "topping" was least, the cost of "pulling" being more than three times as much as that of "topping."

Rating labor at $1.00 a day and a man and team at $2.00 a day, the

cost of a ton of forage would be, according to the method of saving and storing, as follows:

Topping, $2.13; pulling the leaves, $7.67; topping and pulling leaves, $2.25. It will thus be seen, two of the methods gave quite cheap forage. Pulling leaves yielded 427 pounds fodder; topping 1093 pounds; topping and pulling lower leaves gave 1467 pounds; all acres from corn yielding about 17 bushels of shelled corn.

Pulling fodder seemed to decrease the corn yield about a bushel per acre, but other methods did not.

All these kinds of fodder were found to be about 56 per cent digestible, being much higher in this respect than timothy hay.

BULLETIN No. 20. CHEMICAL SECTION. MARCH, 1892.

GRASSES AND FORAGE PLANTS—A STUDY OF COMPOSITION AND VALUE.

TEXAS GRAINS—COMPOSITION.

H. H. HARRINGTON, Chemist.

This bulletin reports analytical work done in 1891, by Duncan Adriance, Assistant Chemist, on the composition and feeding value of *Johnson grass, rescue grass, alfalfa, burr clover;* and *ash* analyses of *alfalfa* and of several grains.

The bulletin also gives reports of analyses of corn, oats, wheat, rye and barley from various parts of the State.

The bulletin also contains analyses of six samples of water.

BULLETIN No. 21. AGRICULTURAL SECTION. JUNE, 1892.

EFFECT OF COTTON SEED AND COTTON SEED MEAL IN FEEDING HOGS.

GEO. W. CURTIS, Director.
J. W. CARSON, Assistant to Director.

This bulletin gives an account of an experiment conducted for the purpose of finding a satisfactory answer to the following questions:

1. Will cotton seed kill hogs?
2. If cotton seed, or cotton seed meal, can in any form be fed to hogs with safety, can the cost of gain per pound be cheapened by the use of low-priced cotton seed or meal, instead of high-priced corn?
3. What method of preparing cotton seed for feeding hogs will give the greatest gain?

The experiment was conducted under the following conditions: Feeding was begun on February 8, 1892. There were five pens, each containing three shoats—one large, one medium, and one small. The shoats designated as "large" were from ten to twelve months old; those

designated as "medium" were from five to seven months old, and those designated as "small" were from three and a half to four months old. All were grades of the Essex breed, and had not been fed at any time previous to the test, more than was sufficient to keep them in healthy growing condition. The animals were all healthy and in even condition at the start. Each pen was supplied daily—morning, noon, and night—with the alloted food, and an abundance of water. By a close observation of the appetite of the animals, the waste was reduced to a minimum. Each pen was kept supplied with ashes, salt, and sulphur—as ordinarily mixed for such a purpose. The conditions as regards heat, ventilation, room for exercise, etc., were the same for all. Of the five pens, one contained shoats fed on cotton seed meal and corn; another, those fed on raw cotton seed—soaked—and corn; another, those fed on boiled cotton seed and corn; another, those fed on roasted cotton seed and corn; and another, those fed on corn only.

The same quantity of corn was allowed each of the first four pens, viz., five pounds of shelled corn a day. The cotton seed, or cotton seed meal for the same pens, varied in amount to suit the appetite of individual animals. The length of time involved was shortened by the death, or sickness of animals in certain pens. Weights are reported only for the first thirty-three days, although the food was given for a much longer period. Weights of all foods given, were taken dry and afterwards prepared for feeding.

The results of the experiment give an affirmative answer to Question 1. Of the twelve shoats fed on cotton seed, seven died—two out of three in each pen—except the one in which boiled cotton seed was fed, where only one of the three died. The deaths were confined to the small and the medium-sized shoats; the larger ones all survived. This fact, however, was not regarded as having any special significance. There were no deaths in the pen where only corn was fed.

Question 2 received a decisive negative answer. The cost of a hundred pounds gain for shoats fed on corn only was $2.51; for those fed on boiled cotton seed and corn, $2.56; for those fed on roasted cotton seed and corn, $3.21; for those fed on raw cotton seed—soaked—and corn, $4.27; and for those fed on cotton seed meal and corn, $4.34. In these results, no account is taken of the loss due to the large percentage of deaths among the shoats fed on cotton seed.

(In this experiment, the price of corn was estimated at 40 cents a bushel, raw cotton seed at $6.00 a ton, and cotton seed meal at $20 a ton.)

As to Question 3, the experiment showed that, all things considered, boiled seed gave better results than roasted seed, raw seed, or cotton seed meal.

The results arrived at in this experiment agree in all essentials with those of a similar experiment conducted by Messrs. Curtis and Carson, in 1891.

NOTE.—See also Bulletin No. 78, p. 72.

BULLETIN NO. 22. SEPTEMBER, 1892.

ALFALFA ROOT ROT.

GEO. W. CURTIS, Director.

This disease was identified by Professor Geo. F. Atkinson, of the Alabama Experiment Station at Auburn, with the *Cotton Root Rot, Ozonium Auricomum.*

(See Bulletins Nos. 4 and 7.)

BULLETIN NO. 23. HORTICULTURAL SECTION. NOVEMBER, 1892.

BLACK ROT OF THE GRAPE.

R. H. PRICE, Horticulturist.

This bulletin treats of the life history of the fungus which causes the *Black Rot,* and discusses methods of treatment. The plant itself can be seen only with a microscope. The grapes affected shrink to about two-thirds their normal size; the skin grows dry, and hard, and dark, and is raised into strong, prominent irregular ridges, pressing closely upon the seeds.

When the rot attacks the *grape,* it is too late to treat it. But it may be successfully treated in its earlier stage, when it is found on the leaf, in the form of irregular dark-brown spots, lighter in the center. They have, as they develop, little pustules in the center, and the same may be seen on the grapes affected. The rot on the leaf appears two or three weeks earlier than on the fruit, and it may be destroyed by spraying with Bordeaux mixture. When it reaches the fruit, it can destroy one-third of the crop in twenty-four hours; and in twelve days a second attack may be expected.

The fungus is carried over winter in the tissues of diseased grapes, and possibly in the leaves also. All dead grapes and leaves should, therefore, be dstroyed before March.

BULLETIN NO. 24. VETERINARY SECTION. DECEMBER, 1892.

THE CATTLE TICK.

I. BIOLOGY.—COOPER CURTICE, M. D., D. V. S., Moravia, N. Y.
II. PREVENTIVE MEASURES.—M. FRANCIS, Veterinarian.

The first half of this bulletin contains a description and life history of the cattle tick, *Boophilus Bovis,* which transmits the micro-organism of Texas fever. Dr. Curtice gives a full account of his observations in 1899 on the eggs of some cattle ticks which he set to hatch October 10, 1889, producing ticks which were allowed to go through all their changes till they in turn produced eggs. The time required for each stage was carefully noted, and later observations have confirmed

every fact recorded here; and upon the life history as here set down recent successful methods of preventing Texas fever have been based.

We, therefore, give these parts of the bulletin in detail:

DATE.	STAGE OF EXPERIMENT.	TIME CONSUMED IN VARIOUS STAGES.
October 3.	—Egg laying begun.	
October 10.	—Egg laying finished.	Ovipositing, one week.
November 4.	—Ticks appeared.	Hatching three and four weeks.
November 15.	—Rearing begun.	(Unnecessary interval of one week.)
November 22.	—First moult, larva to.	Lasted one week.
November 29.	—Second moult.	Lasted one week.
December 11.	—Female half grown;	with male about two weeks later.
December 16.	—Experiment closed.	

The eggs are laid in a little mass; the young ticks are at first small "seed-ticks." They can not reproduce in the larval or nymphal stages. At first the males and females differ little; but in the last change the females are much larger, and they increase in size enormously after they have become half-grown, swelling with the blood sucked and the eggs formed within them. When *fully gorged, the females drop off and lay their eggs.*

The conclusions drawn by Dr. Curtice are:

1. That the ticks were probably brought with the cattle from Southern Europe or Northern Africa, bringing the fever-germs with them.
2. That the life history of ticks is, first, an egg; second, a six-legged "seedtick"; third, an eight-legged asexual nymph; fourth, an eight-legged adult (which must drop off to lay its eggs).
3. That ticks dropping off where cattle are confined or spend the most time, cause these places to be the most infested with the young.
4. That ticks are associated with a disease in cattle, and that their removal has prevented the disease from being communicated.
5. That by taking advantage of the climate and the use of remedies, cattle and certain pastures may be freed from ticks.
6. That all cattle intended for transportation to Northern fields and markets should be freed from ticks.

The second half of the bulletin treats of experiments at College Station in ridding cattle of ticks by means of sulphur, salt, oils, and other remedies. Sheep dip was found to be the best of these, and an apparatus for dipping the cattle is described with drawings.

(See Bulletins Nos. 53 and 63 for more recent work on this subject.)

BULLETIN No. 25. CHEMICAL SECTION. DECEMBER, 1892.

TEXAS SOILS—A STUDY OF CHEMICAL COMPOSITION.

H. H. HARRINGTON, Chemist.

In this bulletin the soils of the State are considered in six divisions:

1. The Coast Belt.
2. The East Texas Belt.
3. The Black Prairie Belt.

4. The Fort Worth Prairie Belt.
5. The Panhandle Soils.
6. The Alluvial Soils.

Analyses are given of soils from Cherokee, El Paso, Fort Bend and Brazoria counties; from Terrell, Pecan Gap, Forney, Manor, Belton, Waxahachie, New Braunfels, Abilene, Wichita, etc. Methods of reclaiming alkali soils are suggested. These methods will vary according to the kinds of alkali—chloride of lime or carbonate of soda. A chemical analysis will show what is needed. Deep cultivation, flooding, irrigation, planting of beets and sorghum, and application of gypsum, are means suggested for the reclamation of alkali soils.

BULLETIN No. 26. AGRICULTURAL SECTION. MARCH, 1893.

COST OF COTTON PRODUCTION AND PROFIT PER ACRE.

GEO. W. CURTIS, Director.
J. W. CARSON, Agriculturist.

This bulletin is compiled from reports made by six or eight planters, and from experiments at the Station, but has only an historical value now, as the items of cost have varied greatly in the past fourteen years.

BULLETIN No. 27. JUNE, 1893.

AGRICULTURAL SECTION—LIVE STOCK.

STEER FEEDING.

J. H. CONNELL, Director.
J. W. CARSON, Assistant to Director.

The objects of the experiments reported here, made in the spring of 1892 and in the winter of 1892-93, were as follows:

First—To test the relative feeding values of cotton seed, roasted, boiled, and raw.

Second—To compare cotton seed, corn and hay rations with a ration of corn and hay only.

Third—To test a ration of cotton seed meal, hulls and silage with the other rations fed.

The cattle were forty native steers, twenty coming two years old, the other twenty coming three years old in the spring. They were fed 50 days and 100 days.

The conclusions were:

First—Roasted cotton seed do not have the laxative qualities of raw seed, and are more palatable.

Second—Faster gains are made by feeding the boiled seed, but at a greater cost per pound gain.

Third—The advantages to be gained in the use of roasted seed hardly justifies its general use.

Fourth—Boiled seed are more palatable than raw seed, less laxative and make faster gains. May continue to be used with profit.

Fifth—Steers fed on raw seed, eating a less quantity of seed, ate slightly more hay in consequence.

Sixth—Cotton seed, at usual prices, is a good and cheap addition to a corn and hay ration.

Seventh—The best beef ration found by previous experiments—cotton seed meal, hulls, and silage is not here proven the best when calculated at former prices—raw seed, corn, and hay being better.

Eighth—When value of raw seed is raised to near present market price, $10 per ton, the meal, hulls, and silage is again the better ration; raw seed, corn, and hay being the next best.

Ninth—The average cost of gain per pound in all 2 cents; at present price of foods 3.64 cents.

Tenth—The cheapest food per pound gained for all steers fed, when raw cotton seed is valued at $10 per ton, was raw seed, corn, and hay.

BULLETIN No. 28. HORTICULTURAL SECTION. DECEMBER, 1893.

SWEET POTATOES.

R. H. PRICE, Horticulturist.

This bulletin discusses the value of the crop, and calls attention to the feeding value of potato tops, as shown in an analysis by Professor Adriance.

Thirty-one varieties were tested, and a chemical analysis of the tubers made, showing some varieties, like the yellow yam, higher in sugar content than the others, and therefore more desirable for Southern markets; while dry varieties like Nansemond are best for shipping North.

A classification follows.

The Vineless, Shanghai, and Nansemond made the highest yields of several varieties tried.

(See Bulletin No. 36.)

BULLETIN No. 29. CHEMICAL SECTION. DECEMBER, 1893.

EFFECTS OF COTTON SEED AND COTTON SEED MEAL ON BUTTER, BEEF TALLOW, LARD, AND SHEEP SUET.

H. H. HARRINGTON, Chemist.
DUNCAN ADRIANCE, Associate Chemist.

This bulletin gives results of experiments to test the volatile acids found in the fats of stock which had been fed cotton seed meal, and to find out if these acids were a measure of the purity of butter fat, as had heretofore been supposed. "The effect of the experiment was to show that the former standard of volatile acids existing in pure butter was unreliable, and that, judged by this standard alone, or taken in

connection with the melting point, even pure butter derived from cotton seed or cotton seed meal might be mistaken for butter adulterated with other fats."

Analyses were made not only of butter from the milk of cows fed on cotton seed meal, but of tallow, lard and suet from different parts of the body of animals fed on it.

The conclusions were:

1. The melting point of butter is raised several degrees by a feed of cotton seed or cotton seed meal. The iodine absorption is greatly increased. The volatile acids are greatly lowered.

2. The effect became apparent on a one-fourth ration of meal or seed, but was not sufficient to affect, materially, the quality of the butter.

3. To a less degree the feed seems to influence lard and tallow; while on mutton suet its influence is almost as marked as on butter.

4. Oleomargarine, or more properly "butterine," made from beef tallow derived from steers fed on cotton seed meal and hulls, might give Beechi's test: confusing ordinary chemical tests for pure butter.

5. The effect of digestion on the different oils of the food is a matter of interest. Since cotton oil contains a large amount of olein, liquid at ordinary temperature, we would expect it to *lower* the melting point of butter, as well as the melting points of the other fats operated on; but in each case the effect seems to be the reverse.

BULLETIN NO. 30. VETERINARY SECTION. MARCH, 1894.

VETERINARY SCIENCE.

I. Glanders Experiments.
II. Tuberculine Experiments.
III. Lump Jaw of Cattle.
IV. Notes on Parasites.
V. Texas Fever Experiments
VI. Device for Destroying Ticks.

M. FRANCIS, Veterinarian.

This bulletin shows the value of Mallein as a diagnostic agent in glanders. The experiments show that, in cases of glanders, there occurs a well-marked fever reaction eight to twelve hours after the subcutaneous injection of 152 cc. of Mallein, and that this reaction does not occur in horses not affected with this disease. It shows also that Mallein is a reasonably stable preparation, as material which had been kept a year at ordinary room conditions had not apparently changed. A graphic record of the reaction curve is also shown.

The bulletin also contains an account of four cows that were tested for tuberculosis by subcutaneous injection of 2 cc. of tuberculin. No reaction occurred. The conclusion reached was that no tubeculosis was present. The point of interest in this work is that non-tuberculous animals show no reaction or at least a very feeble reaction, when injected with a 2 cc. dose of tuberculin. This information becomes of value in testing dairy herds in a practical way.

Section III gives an account of several cases of lumpy-jaw of cattle treated with iodide of potash, given internally. Four cases made satisfactory recoveries when given doses ranging from 5 to 15 grains daily for a week or ten days. One case that showed enormous enlargement of the bone was too badly diseased to recover, as the tumor was discharging pus and fungi several months after the treatment was given.

Section IV gives the results of some experiments made to show whether Texas Fever can be communicated by the lone-star tick, and also to confirm whether the common cattle tick will convey this disease.

Lot "A" consisted of young lone-star ticks.

Lot "B" consisted of young fever ticks.

Both lots had been hatched at College Station, Texas, and were sent at the same time to the Kansas Experiment Station in 1893. Lot "A" were put on two calves. They grew fairly well for awhile, then disappeared; only a few matured. A careful record of the temperature for sixty days indicates that no infection occurred.

Lot "B" consisted of fever ticks. These were hatched September 15th. September 28th about 100 of the young ticks were put on a three-year-old heifer. October 10th a high fever began, which continued about a week and caused death of the animal. The experiment shows very clearly that the common cattle tick, B. bovis, may convey Texas fever, also that the lone-star tick, A. unipunctota, derived from the same source, failed to produce Texas fever in susceptible animals. [Later work has abundantly confirmed these observations.]

Section VI gives the plan and dimensions of a dipping vat for cattle. This is simply a modification of the vat built by R. J. Kleberg several years before. No experiments of the effects of the various dips are given.

BULLETIN No. 31. JUNE, 1894.

INSECTS INJURIOUS TO STORED GRAIN.

R. H. PRICE, Horticulturist.

In this bulletin are described the corn weevil, three bean weevils, the rice weevil, the grain beetle, the grain moth, and the pea weevil.

It was advised:

1. To store corn early, and to examine it often.
2. To disinfect all bins with fumes of "high life" (carbon bisulphide), and by sprinkling naphthaline in them.
3. To use carbon bisulphide to kill insects already in the grain. It will not injure the grain for seed used too long, or too strong; but care must be taken not to keep it near a fire.

NOTE.—The Entomological Department has notes made during the past year on experiments to test the injurious effect of carbon bisulphide on seed corn. These will be published as soon as possible.

BULLETIN NO. 32. HORTICULTURAL SECTION. SEPTEMBER, 1894.

VARIETIES OF PLUMS, APRICOTS, AND PERSIMMONS, AND INJURIOUS FUNGI AND INSECTS.

R. H. PRICE, Horticulturist.

This gives results of two years' study of varieties, and of injurious insects, and diseases affecting the plum.

Conclusions:

1. Over twenty varieties of plums have originated in Texas. Some of them, belonging to the Chickasaw group, are more productive and more free from injury by insects and fungi than other varieties tested here.

2. The following varieties of the Chickasaw group are recommended for general orchard planting: Caddo Chief, Lone Star, Marianna, Munson, Newman, Paris Belle, Robinson, and Transparent.

3. The Wild Goose group does not seem so well adapted to Texas as the Chickasaw group.

4. The Chickasaw group seems better adapted to Texas than the American group.

5. The European species of plums have almost entirely failed.

6. The Japan plums are of good size and flavor. Very attractive, and would ship well. Many of the varieties need to be sprayed to prevent injury by insects and fungi.

7. The following Japan varieties are promising: Abundance, Burbank, Douglas, Georgeson, Kelsey, and Norman.

8. Marianna as plum stock does not do well for all varieties, especially when they are set on dry upland.

*9. Nearly all injurious fungi and insects can be prevented from doing injury to plums by spraying the trees with three ounces of London purple stirred into every twenty-five gallons of Bordeaux mixture. Spraying should begin early, before the blooms all fall off, and be repeated every two weeks till the fruit is half grown.

10. It is often necessary to spray once after the fruit is gathered, to prevent blight defoliating the trees in the fall.

11. Plums are more fruitful if several varieties which bloom near the same time are set close together in the orchard.

12. The following apricots are the most promising which we have tested: Myer's Early and Royal.

13. Japan persimmon is a very promising new fruit which seems well adapted to Texas. It grows well when budded upon stock of the native wild persimmon. The most promising varieties tested are Hachiya, Tane Nashi, and Xengi.

The tough skin of the Hachiya and the fact that it has a long ripening period make it desirable for shipping.

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*NOTE.—See Bulletin No. 89 for more recent recommendations.

BULLETIN NO. 33. AGRICULTURAL SECTION. DECEMBER, 1894.

FEEDING MILK COWS.

J. H. CONNELL, Director.
JAMES CLAYTON, Agriculturist.

This bulletin reports experiments carried on in 1894 to determine the relative value of different feeds in milk and butter production. The feeds tested were cotton seed hulls, alfalfa hay, prairie hay, and silage; cotton seed meal and corn meal.

These questions, considered and answered, were:

How much cotton seed hulls is equal to 1 pound alfalfa hay? Answer—1.58 pounds when combined with 3 pounds cotton seed meal and 5 pounds corn meal.

How much cotton seed hulls is equal to 1 pound choice prairie hay? Answer—1.45 pounds when combined with 3 pounds cotton seed meal and 5 pounds corn meal.

How much choice prairie hay is equal to 1 pound alfalfa? Answer—1.12 pounds when combined with 3 pounds cotton seed meal and 5 pounds corn meal.

Does the addition of silage to a ration of common hay cheapen the ration? Answer—It does.

Having cotton seed meal, what single forage should be fed with it to produce largest flow of milk? (Forage tested—cotton seed hulls, alfalfa hay, silage, and prairie hay.) Answer—Cotton seed hulls.

Having common prairie hay, what single grain is the best to feed with it to produce largest flow of milk? (Grains tested were cotton seed and cotton seed meal.) Answer—Cotton seed.

Having cotton seed hulls, what single grain is the best to feed with it to produce largest flow of milk? (Grains tested—cornmeal and cotton seed meal.) Answer—Cotton seed meal.

BULLETIN NO. 34. AGRICULTURAL SECTION. FEBRUARY, 1895.

FIELD EXPERIMENTS AT COLLEGE STATION, AND McKINNEY, AND WICHITA FALLS.

J. H. CONNELL.
JAS. CLAYTON.

These experiments include tests of thirty-one varieties of cotton, thirty varieties of peas, a large number of grasses and other forage plants, sixty-one varieties of corn, and more than 200 varieties of wheat.

The object was to learn what new varieties of these field crops can be profitably introduced into different sections of the State; and if manures can be economically used, what sorts and how best applied, and how much is needed, for several characteristic soils.

There were fifty-seven varieties of wheat planted at McKinney, and fifty-three at Wichita Falls, each of which gave larger yields than Mediterranean.

None of the fertilizers used on corn or wheat at McKinney proved profitable. At Wichita Falls, fresh and rotted manure gave a profit

on wheat lands. Subsoiling cotton land at McKinney more than paid for the extra cost. [Note.—Subsoiling at various stations has generally proved unprofitable.]

The grasses and forage plants that succeeded best were:

At McKinney—Melilotus, alfalfa, alsike clover, English rye grass.

At Wichita Falls—Alfalfa, melilotus, rye grass, meadow oat grass and timothy.

At College Station—Alfalfa, burr clover, crimson clover, Japan clover, rescue grass, and rye grass. [Note.—Alfalfa and Japan clover have generally not succeeded at College Station. Acid phosphate and stable manure were profitably used on corn at College Station.]

BULLETIN No. 35. CHEMICAL SECTION. MAY, 1895.

MISCELLANEOUS ANALYSES.

H. H. HARRINGTON, Chemist.
DUNCAN ADRIANCE, Associate Chemist.
P. S. TILSON, Assistant in Chemistry.

This bulletin contains analyses of twenty-two mineral waters; eleven samples of soils; clays, marls, limestone, iron ore, bat guano, cactus, natural gas, and crude petroleum. The latter was from Corsicana, and proved to be a good oil.

BULLETIN No. 36. HORTICULTURAL SECTION. JULY, 1896.

VEGETABLES AND INSECTICIDES.

R. H. PRICE, Horticulturist.
H. NESS, Assistant Horticulturist.
H. H. HARRINGTON, Chemist.

I. *Sweet Potatoes* (R. H. Price). This reports results of experiments begun the year before, carried on through 1894. Fifty varieties were tested; and the work embraced cultural methods, methods of propagation, chemical analyses after storage, fertilizers, and comparative productiveness of varieties.

"General Grant" made the largest yield for one year; "Shanghai" for two.

Slips from very small tubers were found to grow as large potatoes as slips from large tubers.

"The vineless yam" is highly recommended, owing to the greater convenience of cultivation. The tops of this variety may be cut with a mower, and fed green to stock. Only one strain of "Vineless" is recommended.

The fertilizer tests showed best results for bone black, 300 pounds, and potassium sulphate, 200 pounds, in this soil. Nitrate of soda and muriate of potash decreased the yield.

Some tests made at Hulen by Professor F. W. Mally are reported.

Experiments with patent transplanting tools are reported. To transplant successfully, the ground should be somewhat moist—not wet—

well prepared, and the plants set on a cloudy day, or late in the afternoon; the earth should be pressed firmly about the roots. If the roots be "puddled" in thin mud before being set, they will not dry out, and may be transplanted into a furrow, and covered by a turning plow.

The crop should not be gathered till fully matured; a mature potato heals over when cut; a green one turns greenish-black. A sharp rolling coulter on the beam of a turning plow just in front of the point will clear away the vines. No bruised potatoes should be stored; it will take two weeks to dry them. They may then be stored in a ventilated potato house in fresh sand. The purple-skinned sorts kept best.

Soft rot, *Rhizopus Nigricans,* may be best prevented by careful drying and sorting of tubers before storing.

Black rot, *Ceratocystis Fimbrista,* is likely to be carried from diseased slips, and, therefore, vine cuttings are recommended.

Stem rot, *Nectria Ipomese,* comes from infected slips, and from the egg-plant. Sweet potato scurf, *Monilochaetes Infuscans,* may also be propagated from diseased tubers.

The sweet potato borer, *Cylas Formicarius,* mentioned here, has since been more fully treated in Bulletin No. 93 (which see).

Varieties are divided into three classes, by their foliage.

II. *Water and Sugar in Sweet Potatoes, as Affected by Keeping* (H. H. Harrington). Three analyses, made November 1, December 20, 1893, and March 6, 1894, of sixteen varieties of potatoes, showed that the vineless (or Early Bunch) Yam proved to be the best potato for table use, in the South, where a dry potato with a large amount of sugar is wanted.

III. *Varieties of Onions* (R. H. Price), contains information given more fully in Bulletins Nos. 60 and 77.

IV. *Muskmelons and Cantaloupes* (R. H. Price) describes varieties and methods of culture, better treated in later publications.*

V. *Celery* (R. H. Price) describes experiments in 1893 and 1894 with eleven varieties of celery, in spring and fall, on rather poor dry upland soil. Giant Paschal, Henderson's Rose, and Golden Self-Blanching were the best varieties. The crop is strongly recommended wherever sufficient water supply, natural or artificial, can be obtained.

VI. *Beans* (R. H. Price) and

VII. *Cabbage, Cauliflower and Tomatoes* (H. Ness) are more fully treated in later bulletins.† The best cabbage out of thirty-three varieties was Jersey Wakefield; the best cauliflower, Erfurt Earliest Dwarf; the best tomato, Atlantic Prize.

Some notes on insecticides are added.

BULLETIN No. 37. DECEMBER, 1895.

SUNDRY BRIEF ARTICLES.

J. H. CONNELL, and
Other Members of the Station Staff.

This contains miscellaneous matter selected from the "Press Notes" of the previous year.

*See Bulletins Nos. 64, 89, 94. †See Bulletins Nos. 52, 57, 65, 69, 84.

BULLETIN NO. 38. CHEMICAL SECTION. MARCH, 1896.

CANAIGRE—THE NEW TANNING PLANT.

H. H. HARRINGTON, Chemist.
DUNCAN ADRIANCE, Associate Chemist.

This bulletin describes the canaigre plant (*Rumex Hymenosepalus*), and the methods of growing, and preparing for the market; and gives results of analyses of seventy-two specimens, from various localities, showing surprising divergences in the amount of tannic acid produced; and discusses the value of the crop as an industry.

Most of the data, and most of the specimens analyzed, were drawn from the field experiments of Mr. R. J. Kerr, who, ten years before, introduced the plant from Tucson, Arizona. On his plantation at Monahans, in West Texas, and at Pomona plantation, near Hockley, in Central Texas, he was at the time cultivating the plant for commercial purposes, with profit.

1. *Description.*—The canaigre is described as a species of dock, springing up from year to year from the roots, which increase in tannic acid for eighteen months, and resemble sweet potatoes; they are from six to eight inches long, and not more than two and a half inches thick, smooth, light yellow to dark-brownish red. When dried, they become very hard.

The plant is propagated by tubers, and takes two years to form roots for commercial purposes.

2. *Cultivation.*—Any soil suitable for sweet potatoes will grow canaigre. Plow the ground thoroughly six to eight inches deep; harrow with a disc harrow, and finish with an Acme or common tooth harrow to get the ground well pulverized; bed up, thirty-six inches apart, like sweet potatoes and plant in drills. Plant the whole root, ten inches apart in the drill, and as shallow as possible, not over three inches deep. One carload, of twelve tons, will plant fifty acres. Plant from May 15th to September 15th. Cultivate four to six times during the season. Potash fertilizers are recommended.

3. *Preparation and Marketing.*—The roots can not be shipped green. They may be sliced and dried, or the tannin may be extracted. Freezing does not injure them, but fermentation does. The slicing machines cost from $125 to $300. In West Texas, it costs $1.60 to the ton of green roots, to slice, dry, and sack; in Central Texas, 75 cents per ton. It is recommended that co-operation be adopted by neighboring farmers, in establishing driers; or that one farmer establish one, and buy roots from his neighobrs. In slicing, the roots are cut into chips about one-twentieth (1-20) of an inch thick, which must be dried rapidly at a low temperature—120° to 130° F. Extract factories are recommended.

4. *Cost and Market Value of Crop.*—It is estimated that the lowest average yield per acre is 17,640 pounds; that it can be raised at $2.00 per ton, f. o. b. cars; that it can be sold at $5.00 per ton. It is said to produce a very fine mellow leather, of a beautiful yellow color and great durability.

5. *Conclusions.*—Canaigre, though it does well on any soil that is

not too cold and too moist, seems particularly adapted to West and South Texas, but may be profitable elsewhere.

It can not be readily adapted to the farmer of limited means; but on the co-operative plan is almost sure to give good returns.

While the root continues to increase in tannic acid for some time (as shown by analyses given), it will pay best to gather when a year, or a season, old.

Cultivation increases the tannin.

BULLETIN No. 39. HORTICULTURAL SECTION. JULY, 1896.

THE PEACH.

R. H. PRICE, Horticulturist.

This bulletin contains notes on varieties tested at College Station for three years; some suggestions about varieties for different climates; rules of nomenclature; origin; and classification. There are also hints on orchard setting (see Bulletin No. 80 for more recent methods), a method of *dormant budding,* and brief notes on diseases and injurious insects, and a list of peaches recommended by horticulturists in the different parts of Texas.

Of the varieties tested, two belonged to the Peen-To race; five to South China; eleven to the Spanish; twenty-one to the North China; and eighty-six to the Persian; while forty-four were mixed.

The author recommends the following varieties for Middle and Northern Texas, arranged in the order of ripening.

Early Varieties.—Alexander, Mamie Ross, Amsden, Miss Lolo, Amalia, Rivers, Tillotson, Yellow St. John, and Family Favorite.

Medium Early Varieties.—Spottswood, Elberta, Thurber, Gen. Lee, Cobler and Curtis.

Late Varieties.—Mixon Free, Stonewall Jackson, Columbia, Texas, Bilyea and Victoria.

Varieties for Middle and Southern Texas.—Arranged in order of ripening.

Early Varieties.—Alexander (shy bearer), Mamie Ross, Early China, Coleman, Pallas, Mountain, Tillotson and Family Favorite.

Medium Early.—Spottswood, Elberta, Gen. Lee and Cobler.

Late Varieties.—Onderdonk, Stonewall Jackson, Columbia, Texas and Victoria.

A method of dormant budding, devised by Professor H. Ness, is given. The method consists of cutting a slip of bark, with some wood attached, down the tree about one inch, leaving it attached at the lower end. About half this slip is then cut off, leaving the other half still attached to the tree. Cut off a bud, leaving some wood attached to it, to prevent injury, and then carefully place it between the slip and the tree, so that it will fit nicely, and the cambium of the bud and tree come in contact Tie tight with some good material, such as raffia. In five or six days the bud will be found to have knit firmly. Treat it then as those budded in the usual way.

BULLETIN NO. 40. AGRICULTURAL SECTION. SEPTEMBER, 1894.

FIELD EXPERIMENTS AT COLLEGE STATION WITH CORN, COTTON AND FORAGE PLANTS.

J. H. CONNELL, Director.
JAMES CLAYTON, Agriculturist.

The experiments reported in this bulletin were made during two years—1894 and 1895—on sixty-two varieties of corn, thirty-four varieties of cotton, twenty-one varieties of grass, ten varieties of clover, two varieties of vetch and thirty-two other forage plants.

The soil was a black, sandy soil, deficient in phosphates, with a blue clay subsoil and very poor drainage.

The variety which made the largest yield of seed cotton in 1895, early planting, was Dickson Early Cluster; late planting, Welborn's Pet; in 1894, early planting, Sure Fruit; late planting, Peterkin Limbed Cluster.

Of corn, the varieties making the largest yields were Mosby's Prolific and Blount's Prolific.

The experience of all stations testing varieties now for many years seems to have been that any one variety making the best yield one year is likely to make the best yield any other year. No one variety has often, if ever, made the best yields for the same year at any two stations, however near together the stations may be. No variety has often made best yields at the same station in both late and early plantings. The whole question of variety tests, particularly for cotton, is very complex. The best that can be said is that certain types* of cotton, including many so-called varieties, have averaged a little more productive than other types, including many other so-called varieties.

The Peterkin or Rio Grande type has perhaps stood first at as many stations during as many years as any other. The Peerless type and the Fruit or Big Boll type have both averaged near the top. The former is earlier and the latter later than the Peterkin type. The Early Cluster or Dickson type of varieties and the King type have often stood first, and would average near the others named. These two types have averaged earlier than the others.

All experiments would indicate that the farmer who sends a long distance and pays a fancy price for extravagantly advertised seed generally throws away good money. Seed claimed to yield two to four bales per acre have seldom, if ever, surpassed well known and common kinds.

Of Forage Plants, Forage Sorghum and White African Millet produced most.

BULLETIN NO. 41. AGRICULTURAL SECTION. DECEMBER, 1896.

TWO STEER-FEEDING EXPERIMENTS.

J. H. CONNELL, Director.
J. W. CARSON, Assistant to Director.

The purpose of these experiments carried on in the winters of 1894-95 and 1895-96 was to determine:

*NOTE.—See Bulletins 75 and 79, pp. 66 and 73.

1. In what proportions should cotton seed meal and hulls be fed for cheapest gain in flesh for long and short fattening periods?

2. What combinations of meal with hulls fed to steers give the largest daily gain in live weight when fed for long and short periods?

3. Can sound meal and hulls be so proportioned or fed as to produce blindness or "fat sickness" in good cattle with healthful surroundings?

The cattle used were 100 head of threes and fours. They were fed for 70 days and 120 days.

The conclusions were:

1. At current or probable prices of meal and hulls, it pays best to feed some 5 or 6 pounds of hulls to every pound of meal eaten.

2. The *largest daily gain in live weight* can be secured by feeding meal and hulls in a very common proportion of 3 pounds of hulls to 1 pound of meal. The quicker gain, secured by increasing the amount of meal fed daily from 4 pounds to 6 pounds, increases the cost of feeding each steer $1.25 or $1.50 for every one hundred days.

3. Changing the amount of cotton seed meal from a light feed of meal for first fifty days to heavy meal for last seventy days gave results of no marked value, although the change of ration clearly added to the cost of maintenance.

4. We were totally unable to cause "fat sickness" in steers fed on *sound dry* cotton seed meal and hulls when combined in various proportions and fed for one hundred and fifty days, continuing into hot weather.

5. When less than 2½ pounds of hulls is fed to 1 pound of cotton seed meal, the appetite is disturbed and indigestion is produced, resulting in light feeding and slow gains.

6. From the trials here reported, we may safely conclude that when the price of a ton of cotton seed meal as compared with a ton of hulls is as 5 to 1, then a pound of meal should be accompanied by at least 5 pounds of hulls. When the difference in price widens, then the hulls should be correspondingly increased. Thus, if meal be worth $15 per ton and hulls $3.00, at least 5 pounds of hulls should be fed to 1 pound of meal; if meal be worth $15 and hulls $2.00 per ton, 7½ pounds of hulls should be fed to every pound of meal, provided the steers eat freely of the foods mixed in this proportion.

BULLETIN NO. 42. HORTICULTURAL SECTION. MARCH, 1897.

THE IRISH POTATO.

R. H. PRICE, Horticulturist.

This bulletin reports results of experiments begun in 1895 on some fifty varieties of *Irish Potatoes;* in keeping them; in preventing injury from disease; and in testing the effects of fertilizers on the yield.

Bliss Triumph was found to be the best keeping quality; Early Puritan and Early Ohio gave slightly greater yields in this test.

A fertilizer consisting of 300 pounds bone black and 200 pounds potassium sulphate was found to give greater yield in the soil of the

Station—a rather stiff clay. Nitrate of soda lowered the yield. It was found that a fertilizer that increased or decreased the yield of sweet potatoes would be apt to do the same for Irish potatoes.

Of various methods of keeping potatoes, none was found satisfactory. Best results were obtained from leaving them in the ground, covering them well with a turning plow. By this means the crop may be held four weeks.

The planting of second-crop potatoes is strongly recommended. This will save importing Northern seed. Mature tubers should be kept in the shade and sprouted and planted from July 20th to August 15th, when the ground is moist. Rows should be three feet apart and four to six inches deep. Large potatoes sliced were found to sprout quicker than small ones. They should be covered about three inches deep at first and more earth added when growth begins, with level culture afterwards. Second-crop tubers may be kept in the ground or stored in sand.

Early leaf blight (*Macrosporium solain*) and dry rot (*Fusarium solain*) were troublesome, and no effective remedy was found for either.

BULLETIN No. 43. APRIL, 1897.

REPORT FROM BEEVILLE STATION—NO. 1.

J. H. CONNELL, Director.
S. A. MCHENRY, Superintendent of Beeville Station.

I. Soils.
II. Climate.
III. Water Supply.
IV. Irrigation Equipment.

This is the first report of the Experiment Station in this part of Southern Texas, provided for by the State appropriation and established in 1894.

I. *Soils.*—A gently rolling prairie, covered with chaparral and treeless except along the streams, where post-oak, live-oak and elm form the timber. Mesquite and prickly pear and mesquite grass cover the prairie. The soil is a dark-brown, sandy loam, overlying a whitish marl which contains much lime. Bee county lies in that geological region known as the Fayette beds, which have a great deal of sulphur and gypsum, and in hot dry seasons these elements seem to burn out the organic matter in the soils. Broadcast sown forage crops and crops for green manure are, therefore, needed to maintain the fertility of these soils. Analyses of three samples of soil from different depths are given.

II. *Climate and Rainfall.*—The average annual rainfall of this region is twenty to thirty inches. During the coldest weather in 1896, when the thermometer registered 19° above zero, cabbages were not killed.

III. An account is given of the method of "Plow Irrigation" and the "Campbell system" of "subsoil packing," on which the experiments were planned for the following year, but the work was actually done with the aid of irrigation from the underground water supply. Fifty to one hundred and fifty feet below the surface a coarse water-bearing sand supplies bored wells with good water, usually abundant, but the flow decreases in long drouths.

Windmills were found to be insufficient for pumping these wells, since the winds were not constant, so a four-horse-power gasoline engine was installed. A reservoir was built, 8 feet deep and 28x48 at the bottom, 44x64 at the top. The highest available location was chosen for it, and the soil tested; it was found to hold water very badly; tar mastic* was, therefore, used to coat it, and the foundation laid in a furrow or ditch, which is called "reseating."

Different methods of irrigation—by furrows, on hillsides, by ditches and by basins—are described and discussed. At Beeville it was necessary to irrigate *every* furrow.

To counteract alkali in the soils and in waters, flooding irrigation with pure water and the growth of such crops as sorghum and beets are recommended.

BULLETIN No. 44. CHEMICAL SECTION. JULY, 1897.

PAINTS AND PAINTING MATERIALS AND MISCELLANEOUS ANALYSES.

H. H. HARRINGTON, Chemist.
P. S. TILSON, Associate Chemist.

Tests of drying properties of refined and crude *cotton seed oil* and analyses for thirteen samples of common paints are here reported.

Cotton seed oil treated with 3-10 of 1 per cent of manganese borate and heated at 170 degrees for one hour was found to dry rapidly and make good mixer for paints—more tenacious and less likely to crack than linseed oil. For outside work, cotton seed oil may be used without treatment, but it runs and is a poor dryer.

It is cheaper to buy paints and other materials and mix them than to buy ready-mixed paints.

Analyses of mineral waters and other miscellaneous articles are given.

Several samples of lignite were analyzed. One sample from Crockett was found of excellent quality.

A sample of iron ore from Buffalo was found to have 53 per cent oxide of iron, making it a very good quality.

Analyses were made of Satol for feeding. The heart of the plant is better than turnips as a feed, containing about twice as much dry nutritive matter in a given weight as turnips, but is probably not quite so digestible.

BULLETIN No. 45. AGRICULTURAL SECTION. DECEMBER, 1897.

COTTON AND CORN EXPERIMENTS.

B. C. PITTUCK, Agriculturist.

I. Bohemian, Welborn's Pet and Peterkin Limbed Cluster made largest yields when planted in three-foot rows and two feet in the drill; Texas Oak, in four-foot rows and two feet in the drill; Jones' Improved, in four-foot rows and three feet in the drill.

II. The largest individual yield (738.5 pounds seed cotton) in cot-

*See Bulletin No. 69, p. 62.

ton fertilizer test was given by a single application of phosphoric acid in the form of bone black, at the rate of 500 pounds per acre. Of the nitrogenous fertilizers, cotton seed meal, at the rate of 500 pounds per acre, gave the largest yield—711.6 pounds seed cotton. Of the potash fertilizers, cotton seed hull ashes, at the rate of 500 pounds per acre, gave the largest yield—670.1 pounds seed cotton. Of the complete fertilizers, acid phosphate, 200 pounds per acre, and stable manure, 4000 pounds per acre, gave the largest yield—665.5 pounds seed cotton.

[Note.—From the experience of many stations, it is probable that fertilizers were applied in too large amounts to give most profitable results. It is quite likely that one-third the amounts would have given almost as good yields. Much work has been done at several stations to test the best distances to thin cotton. The general trend of all results has been to show that it makes most when left rather thick—say fifteen to eighteen inches in three to four-foot rows. Thick cotton undoubtedly tends to mature earlier.]

The largest individual yield (37.2 bushels) in corn fertilizer test was given by a single application of acid phosphate, applied at the rate of 500 pounds per acre.

BULLETIN No. 46. AGRICULTURAL SECTION. 1898.

GRASSES AND FORAGE PLANTS.

B. C. PITTUCK, Agriculturist.

This bulletin contains an account of experiments tried at the Station in 1897, with seeds furnished by the United States Agricultural Department. Besides planting seeds at College Station, co-operative experiments were attempted with farmers in other parts of the State. Of the value of this latter work, the author says: "Although this phase of our experimental work is in its infancy, we feel sure that the community interests will continue the demands for such work." * * * "To make an experiment as to the adaptability of grasses and forage plants of general interest, the investigator finds himself contending with many variable conditions in the State. The climate, soil, and elevation above the sea level have a wonderful range. Along our Gulf coast a humid, semi-tropical climate is met, but on pushing on some 40 miles further north or west, we can perceive a marked change in temperature.

"Beginning on our southeastern border, the altitude increases to the west and north; our rainfall varies from forty to fifty inches on the eastern border, to four and five inches on the west; the soil changes gradually from sandy, through the different grades of loams and clays, and back again to sand, with surprising abruptness. With such conditions to combat, much study is necessary to properly adjust the plants most suitable to each locality, and it can only be accomplished by an extensive system of experimental investigation, carried on among and by the farmers themselves. * * * With our large number of grasses, ranging in growth from early spring to late winter, with proper care and selection, our farmers should be able to increase the feeding power of their native pastures twofold. The prairie regions of Texas are gen-

erally rich soils, and make an excellent growth of native grasses under ordinary circumstances, but in many cases they have been improved by seeding and light fertilizer application in the form of manure. A too heavy application has been found to be non-beneficial, owing to a tendency to thin the grasses, producing an uneven growth. We do not advocate changing native pastures, in every case, into new pastures of new grasses, but, by proper selection, new species can be introduced into these pastures, thereby greatly improving them."

Of forty-three grasses tested, ten are reported on favorably.

Agropyron repens—Couch Grass.
Agropyron Richardsonii.
Bouteloua oligostachya—Mesquite Grass.
Bouteloua Racemosa—Mesquite Grass.
Bromus uniloides—Rescue Grass.
Eragrostis Abyssinica.
Panicum crus-gali—Barnyard Grass.
Panicum Texanum—Colorado Bottom Grass.
Poa arachnifera—Texas Blue Grass.
Lycerus phleoides.

A part of the bulletin is devoted to some special experiments on methods of growing *Sorghum,* which is highly recommended for dairying and stock feeding; while even the farmer, for whose purpose it is not so essential, will find it more profitable than corn. He is advised to plant it as a crop to follow on corn land, and to plant oats after the sorghum, and peas the next spring to restore the nitrogen, which is soon exhausted by sorghum.

As a result of the experiments in methods tried at the Station, the following conclusions are given:

In each instance where sorghum was drilled in three feet, eight-inch rows, the yields resulted strongly in favor of seeding at the rate of one-half bushel per acre, against seeding at the rate of one bushel per acre, though a coarser quality of hay was produced from this seeding.

[Note.—Sorghum planted on land subsoiled fifteen inches deep yielded 5¼ tons per acres of hay; on land plowed five inches deep it yielded 5.85 tons per acre, and on land plowed three inches deep it yielded 5 tons per acre. In this trial, five-inch plowing gave better results than subsoiling, and three-inch plowing gave nearly as good results as subsoiling. Subsoiling has generally proved unprofitable at all the stations testing it.]

Descriptions and methods are given of *Alfalfa, Burr Clover, Teosinte,* and several *Vetches,* and other forage plants.

Of alfalfa, the author says: "It has been grown very successfully here, both from a spring and fall planting. Fall planting is preferred, provided the season is to be had which will allow the plant to establish a good root system before the frost. Planted in the early spring, with a thorough preparation of the soil, this plant will make a strong growth, and, unless drowned by heavy rains or injured by excessive heat previous to its firm establishment, will give one or two cuttings during the first season. Alfalfa is a deep-rooted perennial plant, often sending its feeders to a depth of twenty or twenty-five feet, in favorable soils. It pre-

fers a rich sandy soil underlaid by a permeable subsoil, and demands good drainage for best results.

"Alfalfa is difficult to cure properly. The large number of tender, succulent leaves renders the greatest care and best of weather necessary to save them. It is a very nutritious feed, both as hay and for soiling. Much care must be exercised in pasturing cattle on alfalfa. An overfeed, or injudicious feeding, is liable to result in bloat among cattle and 'founder' among horses. Wet alfalfa is injurious, and should be avoided."

[Note.—From later experience with alfalfa in Texas and elsewhere, it does not seem probable that it will succeed on any sandy land in East Texas. Its best success seems to be met with on the stiff, black prairies, or the buckshot lands of the river bottoms, where it is well drained, naturally or artificially, and on the arid and semi-arid lands of the West, under irrigation. These last named lands, although they may appear sandy, are quite rich in lime and other elements of plant food.]

Of *Burr Clover,* the author says: "This clover makes a wonderful growth in this section, remaining green and succulent during winter, and up to May, when its seeds mature. In connection with rescue grass and Bermuda, it makes almost continuous green pasturage. Our objection to the burr clover is that, although green and succulent, stock are not very fond of it, but will pick out other grasses in preference. At this Station, parts of the campus are covered with this plant, mixed with rescue grass and Bermuda.

BULLETIN No. 47. AGRICULTURAL SECTION. 1898.

THE EFFECT OF FOOD ON ECONOMIC DAIRY PRODUCTIONS.

A. M. SOULE, Assistant Agriculturist.

This bulletin reports results of experiments in 1897, with eighteen Jersey and Holstein grades, to study some of the principles of feeding for dairy production. Different proportions of cotton seed hulls and cotton seed meal, and sorghum hay with cotton seed meal, were fed against several combinations of silage and cotton seed hulls, with cotton seed meal and bran, corn meal and oats, to determine:

1. What ration produced milk and butter most economically?
2. The effect of changes in the feed, on cost, yield, and nutrition.
3. Whether cotton seed meal alone, or combined with bran or corn meal or oats, gave best results?
4. Whether Jersey or Holstein blood is best in dairy cows?
5. How far other factors than food affect milk and butter yields?

The results reached were:

1. A "narrow" ration (one rich in protein, lacking in fats) proved best for milk and butter production. A nutritive ratio of 1:5 or 1:6 is recommended.

2. Changes in the elements of the rations affected yield and nutrition and cost, even when the nutritive ratio was kept unchanged. Some feeds are more appetizing; and an excess of one nutrient could take the place, to some extent, of another.

3. A combination of bran, corn meal, or oats, with cotton seed meal prevented the waste of protein, which was evident when the nitrogenous meal was fed alone with roughage.

4. Both Jersey and Holstein sires with native cows produce excellent grades for dairy stock. The Jersey is best for butter purposes; the Holstein for milk production.

5. Many other factors besides food and breed affect the yield of milk and butter. Weather may do it; a sudden cold spell reduced the amounts for several days. The cow's state of health, her surroundings, the period of lactation, also affect it. But the character of the cow—her "individuality"—is the most important influence of all. Each cow has a maximum ability to produce milk and butter, which depends partly, but not wholly, on her ancestry, and is determined by various causes. Some cows can digest and assimilate more food than they can render into milk, so that a fat cow may be a good milker; but, as a rule, a cow which fattens rapidly is not. The cost of keeping a cow depends on the use she makes of the food. A record should be kept of each cow, and only the profitable ones kept in the herd.

Besides these results, two other things were evident:

1. That it paid better—at prices then prevailing in that section—to sell milk than butter.

2. That the fertilizing value of the manure was enough to cover the cost of caring for the cows, milking, and handling of the products.

A description is given of a good type of dairy cow: She should possess a well-developed wedge shape, and indications of great nervous energy. A clean-cut contour, with a well-fleshed body—not fat, but not mere skin-and-bones. A wide, deep chest, and narrow withers, with great depth and breadth through the pelvic regions. Tremendous digestive and udder capacity, and every indication of a great circulation of the blood, as shown by the skin and milk veins. A good milch cow need not be sleek, smooth, and well-rounded out.

Improved dairy practice should be based on the use of foods that will increase both the quantity and the circulation of the blood, maintain the animal system in a state of equilibrium, and keep it in a healthy and vigorous condition at all times.

Cotton seed meal failed to increase the percentage of fats in milk more than other meals. The feed cost of milk ranged from 50 cents to 68 cents a hundred pounds in these experiments, or about 5 cents a gallon. Feed cost for butter ranged from 11 to 14 cents per pound. A part succulent ration—containing silage—proved superior to an entirely dry ration. The cows receiving the greatest variety in their rations also made the most profit.

Cotton seed meal and hulls alone, fed to dairy cows, tend to produce fat, and are not the best feed without mixing with some other feed.

BULLETIN No. 48. HORTICULTURAL SECTION. 1898.

THE GRAPE.

R. H. PRICE, Horticulturist.
H. NESS, Assistant Horticulturist.

This bulletin is in two parts:

I. *Experimental Work,* and

II. *Care and Management of the Grape.*

The experiments at the Station were made on 205 varieties, from vines of each variety, set in December, 1893.

The conclusions reached were:

1. No variety with any great amount of *Labrusca* or *Vinifera* blood withstood the climate. Varieties with *Lincecumii* and *Bourquiniana* blood did excellently.

2. The varieties which were found best for table grapes were: Brilliant, Bailey, Delaware, Dracut, Duchess, Golden Gem, Gold Coin, Green Mountain, Herbert. For wine: America, Catawba, Herbemont, Herman, LeNoir, Mrs. Munson.

II. *Care and Management of the Grape.*—This treats of propagation, pruning and training grapes; setting, cultivating, and trellising a vineyard; diseases, insect enemies, and how to treat them.

BULLETIN No. 49. AGRICULTURAL SECTION. DECEMBER, 1898.

CORN EXPERIMENTS AND VARIETIES.

B. C. PITTUCK, Agriculturist.
J. H. CONNELL, Director.

I.

The following experiment with *Corn* was carried on at College Station during the season of 1898:

1. Variety Test—Embracing forty-two varieties.

The following field experiments with *Corn* were carried on at the Beeville Station during the season of 1898:

1. Variety Test—Embracing twenty-five varieties; distance between rows four feet, and twenty inches in the drill.

2. Variety and Distance Test—Embracing five varieties, the distance varying between rows from three feet to five feet, and two and one-half to three feet in the drill.

SUMMARY OF RESULTS.

COLLEGE STATION.

Varieties—With the varieties tested at College Station, Blount's Prolific, a Southern-grown (Virginia) seed corn, gave the largest yield (40.7 bushels) per acre.

Second best yield (39.5 bushels) was made by St. Charles White, a Northern (Illinois) grown seed corn.

Third best yield (37.2 bushels) was made by a Delaware grown seed corn.

By a comparison of yields during the past three and four years, we find Blount's Prolific made the largest average yield over all other varieties. This indicates to us the pressing need of more distinct varieties of Southern-grown seed corn.

BEEVILLE SUB-STATION.

1. *Varieties*—The three varieties making largest yields at College Station also made largest yields at the Beeville Station, notwithstanding the difference in soil and seasons.

2. *Distance Test*—With corn planted at varying distances, three out of the five varieties gave largest yields when planted in rows four feet apart and two and one-half feet in the drill. With varying methods of preparation, this distance gave largest yields in each case. These results indicate that with all varieties and methods of preparation used in these two *soil sections* that the best average distance to be given corn is four feet by two and one-half feet, for seasons such as that experienced in 1898. This conclusion is also confirmed by the results of our previous experiments and observations.

Best Yields—Of the five varieties planted three feet by two and one-half feet, Golden Beauty gave the largest yield. Of the five varieties planted four feet by two and one-half feet, the 100-Day Bristol gave the largest yield. Of the five varieties planted four and one-half feet by three feet, Forsyth's Favorite gave the largest yield. Of the five varieties planted five feet by three feet, Thomas gave the largest yield.

II.

BEST VARIETIES OF CORN.

The subject of varieties of corn best suited to different sections of Texas is discussed. Late and medium early varieties are briefly described, and the number of days required to mature them, when tested, is given. The conditions of soil and climate in relation to corn culture in different parts of the State are considered, and the rainfall and daily mean temperature for the year are recorded.

For milling and feeding purposes, the authors recommend: Welborn Conscience, Mosby Prolific, White Southern Bread, and Mexican June Corn.

In East Texas, where forty inches and more rain falls in a season, and in the moist bottom soil of Rainbelt No. 2, where less than forty inches of rain may be expected, late varieties of corn are recommended, since they are more prolific than the early-maturing kinds. On the uplands of Rainbelt No. 2, medium early corns are recommended. For Rainbelt No. 3, where less than thirty inches of rain may be expected, Kaffir corn, milo maize, and sorghum are recommended, instead of corn.

BULLETIN No. 50. FEBRUARY, 1899.

AGRICULTURAL SECTION—FIELD CROPS AND LIVE STOCK.

COTTON EXPERIMENTS.

I. EXPERIMENTS WITH COTTON AT COLLEGE STATION.

B. C. PITTUCK, Agriculturist.

In 1898, the *Cotton* experiments at the Station were:

1. A continuation of test with varieties—twelve varieties.

2. A continuation of test with fertilizers—fertilizers applied during January, 1897. [First year's work published in Bulletin No. 45.]

The varieties making the *largest yield* in 1898 were Dixon's Improved and Beck's Big Boll. *Largest money value,* Beck's Big Boll.

Of the fertilizers, cotton seed meal gave largest yield and largest net gain, making 1357 pounds seed cotton.

Of the phosphate fertilizers, bone black, at the rate of 500 pounds per acre, gave a yield of 1315 pounds seed cotton. Of the potash fertilizers, wood ashes, at the rate of 2000 pounds per acre, gave a yield of 1060 pounds seed cotton. A mixture of 200 pounds acid phosphate and 2000 pounds stable manure gave a yield of 1162 pounds seed cotton. The two acres having no manure yielded an average of 817 pounds seed cotton.

[Note.—Later experience suggests that cotton seed meal to furnish nitrogen, and acid phosphate or bone black to furnish phosphoric acid, should be mixed and used to get best results. One and a half parts acid phosphate and one part cotton seed meal mixed, and used at the rate of 300 pounds per acre, would probably give profitable results on any rather thin sandy, loamy, or clay land in East Texas. On the black waxy or lime lands, such fertilizers have not given good results. On these latter soils, cotton seed, coarse manures, growing restorative crops, such as peas, beans, alfalfa, melilotus, vetch, etc., would seem to be the best means of enrichment.]

II. EXPERIMENTS AT BEEVILLE STATION.

B. C. PITTUCK, Agriculturist.
S. A. MCHENRY, Superintendent of Beeville Station.

In 1898, the experiments with cotton at Beeville were:

1. A variety test of twelve varieties.

A variety and distance test of five varieties; the distance varying from three-foot rows and two feet in the drill to five-foot rows and three feet in the drill.

The varieties making largest yield were Nancy Hanks and Gilbert's Lamb Wool; largest money value, Hawkins' Extra Prolific and Griffin's Drouth Proof.

2. Humphrey's Dailkeith and Strickland's Improved gave best results when planted in three-foot rows, two feet in the drill.

Beck's Improved and Lowry's Improved, in four-foot rows, two feet in the drill.

Texas Oak, in four-foot rows, three feet in the drill.

Beck's Improved gave largest yield at each distance. The distance, three feet by two feet, gave a little better result than greater distances, on an average.

BULLETIN No. 51. CHEMICAL SECTION. 1899.

FERTILIZERS AND FERTILIZER ANALYSES.

H. H. HARRINGTON, Chemist.

The text of the law providing for the inspection of fertilizer and commercial poisons recently passed by the Legislature of Texas, and discussions of the nature, function, valuation, and use of fertilizers, and analyses of fifteen samples of fertilizing materials, including bat guano and bat guano ash, mineral phosphates, acid phosphates, bone meal, tankage, cotton hull ashes, sulphate of ammonia, kainit, and barnyard manure. A sample of barnyard manure showed a chemical value of $3.97 per ton.

BULLETIN No. 52. JULY, 1899.

AGRICULTURAL SECTION—HORTICULTURE.
(BEEVILLE, No. 3.)

CABBAGE AND CAULIFLOWER.

B. C. PITTUCK, Agriculturist.
S. A. MCHENRY, Superintendent of Beeville Station.

This bulletin contains notes on the germination, growth, yield, and character of thirty-five varieties of *Cabbage* and eight of *Cauliflower*.

The cabbage most highly recommended are Early Jersey, Wakefield, Improved Early Summer, Lauderback All Year. The cauliflower: Le Normand, Short Stem, Henderson's Early Snowball, Late Italian Giant.

(See Bulletins Nos. 57 and 69.)

BULLETIN No. 53. VETERINARY SECTION. OCTOBER, 1899.

TEXAS FEVER.

M. FRANCIS, Veterinarian.
J. W. CONNAWAY, Veterinarian, Missouri Experiment Station.

This bulletin contains a description of experiments made to ascertain whether immunity to Texas fever can be brought about in any one of three ways:

1. By the subcutaneous injection of the blood serum of immune animals in such quantities as to produce a passive immunity until the

danger of death from an attack of fever contracted in the usual way will have passed.

2. By the production of actual immunity by infecting the animals gradually by means of ticks.

3. By the production of actual immunity, in a degree of tolerance that will amount to a practical immunity, by simply infecting suitable animals by subcutaneous inoculation of infected cattle blood: and by giving the animals proper care, succeed in saving a large per cent of them.

The conclusions reached at the time were (1) that the blood serum of Southern cattle, which are practically immune to Texas fever, can not be used in a practical way to produce a temporary immunity to Texas fever; (2) the production of immunity by gradual tick infection is entirely successful, but is somewhat hard to manage on account of the danger of other cattle becoming infected and causing much mischief; (3) that the production of immunity by simply infecting suitable cattle by subcutaneous injections of the blood of Southern cattle is the most practical method of meeting this problem. It is shown that the most suitable subjects are young cattle from ten to sixteen months of age; that they should be inoculated during the winter months; that the result is an attack of genuine Texas fever, which appears about ten days after inoculation; that a second fever period occurs about thirty days after inoculation; that the death rate is about 3 per cent from inoculation fever; that about 5 per cent more die of relapse, due to actual tick infestation during the summer; that, of the 432 animals reported at this time, the total death rate is about 8 per cent; that we have no medicinal remedy for this disease which will abate, or cure it.

(See Bulletin No. 63, which contains further work along this line.)

BULLETIN No. 54. HORTICULTURAL SECTION. NOVEMBER, 1899.

THE IRISH POTATO (SECOND REPORT).

R. H. PRICE, Horticulturist.
H. NESS, Professor of Botany.

This is a continuation of Bulletin No. 42, and covers, with that bulletin, the work of four years. The results already given in Bulletin No. 42 are repeated, with the following conclusions:

1. Plant early varieties and ship the crop just as early as it will do to harvest.

2. If the season be dry and the market crowded, let the crop stay in the ground about four weeks after maturing, when the markets in Texas are somewhat empty, and then harvest and market at once. If a heavy soaking rain should come after the tubers mature, there is risk of losing the crop.

3. Grow a second crop whenever it can be grown. Irrigation is a great help in growing the late crop. Seed of second-crop potatoes planted next spring have made much better yields than Northern-grown seed. They come up later, but make about as early, and seem freer from blight.

4. By spreading the tubers out on the floor of a cellar, or even under a house, where some light covering of leaves or straw could be placed over them, enough can be stored for family use till after Christmas or later.

5. Potatoes grown on well-drained, sandy loam soils will keep better than those grown on stiff, heavy, clay soils.

6. Make sweet potatoes more largely take the place of the Irish potato for family use, since they are not difficult to keep, and may be grown anywhere in the State.

(See Bulletin No. 71 for later work on this subject. A bulletin is in preparation, treating of cultural methods and fertilizers for potatoes, the result of recent careful experiments.)

BULLETIN NO. 55. DECEMBER, 1899.

AGRICULTURAL SECTION—LIVE STOCK.

I. FEEDING STEERS.

J. H. CONNELL, Director.
H. C. KYLE, Foreman of Farm.

II. FEED VALUE OF COTTON SEED AND ITS PRODUCTS.

1. *Feeding Steers.*—The experiments described in this bulletin were instituted at the request of the Texas Live Stock Association, using the "hull and meal" ration as a basis, to answer the following questions:

1. Can corn meal, or hay, be added profitably to a cotton seed meal and hull ration?

2. In what proportion should corn meal, cotton seed meal, and hulls be fed for best results?

3. Can oats be profitably used as companion food for meal and hulls?

4. What is the best proportion of oats, meal and hulls to be fed in fattening steers?

5. Which of the three groups that are fed different rations will give the best finish in 100 to 140 days?

6. What profit may be expected in feeding well-bred Texas cattle until they are thoroughly ripe?

Forty-eight head of short two-year olds were fed 100 days, and the results checked up; then they were fed 40 days longer, and the results for both the 100-day and the 140-day periods were compared; the cattle were shipped to St. Louis and sold at a good price, and the bulletin gives the dressed weights, live weights at St. Louis, and other data.

From which the following conclusions are drawn:

1. Sorghum hay is more than equal to cotton seed hulls, when fed with hulls and cotton seed meal.

2. The common practice of "topping out" the hull and meal ration with corn chops is not so profitable, as to feed the same amount of corn chops from the beginning.

3. Steers fed 100 days only will make rapid gains on the several rations used.

4. When corn chops is combined with hulls and meal, a feed of 2 pounds of chops made more gain at less cost than when 4 pounds of chops were used.

5. Equal parts of oats, corn chops, and cotton seed meal, combined with hulls, make an excellent ration.

6. Corn chops and shelled oats are of equal value for fattening steers when fed with hulls and meal.

7. Steers eating corn chops shrink largely in live weight, when shipped, if the chops is combined with hulls and meal.

A statement of cost of sorghum hay is given as $2.05 a ton, exclusive of land rent.

II. *Feed Value of Cotton Seed and Its Products.*—This section contains: (1) *Experience of feeders and farmers,* and (2) Station experiments on the results of feeding cotton seed meal to (a) beef; (b) hogs; (c) sheep; (d) milk cattle and young stock; (e) horses; (f) poultry; and (3) some guesses as to the reasons why cotton seed meal may affect the health of animals injuriously.

The results arrived at may be summarized as follows:

1. Cotton seed meal and its products, used judiciously, form a cheap and valuable feed for cattle.

2. About half the feeders report that cotton seed, even when cooked, will kill hogs. The results of experiments at the Texas and Mississippi Stations, and elsewhere, seem to show that hogs, when fed on cotton seed, will begin to die about the fortieth day. Attention is called to the fact that cotton seed, when rotted, seems to agree with the hogs better than when boiled, crushed, or roasted. An analysis made by Professor H. H. Harrington, Texas Experiment Station, is given, which shows that partially rotted seed contains 30 per cent crude protein and 30 per cent water, in place of 23.48 per cent crude protein and only 7.64 per cent water in the sound seed. One of the feeders recommends thoroughly wetting the seed, because he thinks it is the lint which chokes and kills the hogs; but the Texas Experiment Station expressly advises against feeding wet seed, unless it is allowed to rot. It declares also that roasting produces no better effect than boiling.

3. It is recommended that cotton seed be more largely used for fattening sheep, as well as for carrying them through the winter.

4. As a dairy feed, it is recommended for its cheapness; it makes butter firmer but whiter, and lowers the quality.

5. For horses, the reports vary. Some consider it a useful feed for horses and mules; others do not, and report that it is hard to make them eat it.

6. For poultry, it seems to have been little used; it makes the flesh and eggs darker, and gives a peculiar flavor, when used with wheat and bran.

7. Four possible reasons for injurious effects are offered:

(1) The possible presence of an active poison in the seed or the meal.

(2) The development of "ptomaines" during the process of digestion.

(3) The development of microscopic germs (bacteria) in damaged cotton seed meal, and parts of fermented rations left in troughs and about feeding places.

(4) The trouble arising from feeding the entire seed, or cotton seed

hulls, has been attributed to the indigestibility of the hull, because of its tough and impervious nature, together with the harmful effect of lint lodged in the lungs of the animal.

A report by the German mycologist, Zopf, on certain microscopic fungi, *bacterium vermicosum,* found in cotton seed meal, shows nothing that would indicate that these fungi caused the death of the animals, though they are similar to bacteria found in the blood of the animals dying after eating the meal.

BULLETIN No. 56. HORTICULTURAL SECTION. NOVEMBER, 1899.

INVESTIGATION AND IMPROVEMENT OF AMERICAN GRAPES AT THE MUNSON EXPERIMENT GROUNDS, NEAR DENISON, TEXAS, FROM 1870 TO 1900.

T. V. MUNSON, Denison, Texas.

From this most valuable and interesting bulletin, only a few brief practical points may here be reproduced, as of special use to the grower of grapes. The conclusion drawn by Mr. Munson from his twenty-five years' work in vine-breeding (of which this bulletin gives a short account) are:

1. That the native or wild grapes of America, which have learned to resist heat, drouth, mildew, rot, and insects, must form the foundation of American vine-breeding.

2. That by selecting the best of these, crossing their seedlings, and hybridizing with foreign or cultivated species, or with other native sorts, a series of varieties may be produced which will supply a succession of desirable table and wine grapes, marketable from July 1st till October.

3. That seventeen species of grapes—all but two, native—can supply a basis for breeding for all parts of this country, from Puget Sound and Dakota to Puerto Rico.

He recommends:

(1) For graft-stocks (a) in temperate regions (Northern California), V. Vulpina, V. Rupestris, V. Doaniana, V. Champini; the two last for limy soils; (b) in hot, dry regions (Southwest Texas), V. Champini, V. Doaniana, V. Berlandieri.

(2) For breeding, for market and table use (a) for the north, V. Vulpina, V. Lincecumii, V. Bicolor, V. Rupestris, V. Doaniana, using V. Vinifera in alteration of one-fourth to one-eighth or less; for example, such hybrids as Brighton, Brilliant, etc.; (b) for the South, all these, with V. Champini, V. Bourquiniana, V. Berlandieri, V. Rotundifolia, and others.

(3) For breeding grapes for wine, the small-berried species, V. Rupestris, V. Bourquiniana, V. Lincecumii, V. Berlandieri, etc.

4. That in addition to vines bearing perfect flowers—with both pistils and stamens—the grower should cultivate male (or pollen-bearing) and female (or fruit-bearing vines), because these produce more vigorous, productive, and long-lived seedlings; and allow cross-fertilization by a much easier and quicker method—which he describes in detail—than the ordinary one. Careful directions are given for hybridizing and cross-

ing, for saving of pollen, and for testing, growing and selecting varieties; and for breeding for special qualities, such as earliness, size, flavor, etc.

5. That the vine is apt to inherit its *constitution* from its mother; therefore, a hardy, vigorous, disease-resisting female should be chosen. This law, however, has many exceptions.

6. That the ideal vine should possess these qualities:

(1) Great vigor, hardiness, long life, in the climate for which it is desired.

(2) Greatest possible resistance to Phylloxera, Downy Mildew, Black Rot, and Leaf Folder.

(3) Easily grown from cuttings.

(4) Perfect flowers, so that the vine will bear well standing alone.

(5) Prolific bearing.

(6) Large, full, handsome clusters.

(7) Berries persistent to the pedicles, with thin, delicate, yet tough, non-cracking skin, without astringency or bitterness; color bright; pulp meaty, yet tender, juicy, readily freeing the seeds, of pure fine quality, rich in sugar and agreeably sprightly with acid, having a pleasing characteristic flavor; seeds few and small; if for table or market, berry large; or good keeping quality.

7. That not more than one out of a thousand carefully selected and hybridized seedlings may be expected to prove worthy. Out of 75,000 seedlings, in his own experience, not more than one hundred are recommended as equal or superior to such a grape as the Concord, for example, and, therefore, worthy to be introduced into general use. From this list of one hundred excellent varieties, he selects the following to make a series that comes nearest to filling the needs spoken of in Section 2:

Translucent Red, as good or better than Brighton.	Bright Black, as good as Concord, or better.	White or Yellowish, as good or better than Niagara.
1. Headlight and Presly.		
2. Pontotoc. Onyx. Tuskahoma.	Manito. Washita, Blackwood.	Marvina. Bell.
3. Brilliant. Yomaga.	Lukfata.	Wapanuka.
4. Amethyst. Tonkawa.	Delmerlie, Modena.	Rommel, Hidalgo.
5. Waneta.	Beacon, R. W. Munson. American. Bailey. Captain. Carman, Xlnta, La. Reine.	Estella, Tamala. Wetumka. Hopeon.
6. Big Hope.	Hopkins, Universal. Muench. Wine King.	Albania. Gold Coin.
7. Fern and Laussel.	Kiowa, Husmann. Profusion, I a Salle.	Onderdonk.
8. Marguerite.	Waubeck. San Jacinto.	Dixie.
9.	Winter Wine.	

BULLETIN NO. 57. AGRICULTURAL SECTION. JULY, 1900.
(BEEVILLE NO. 4.)

CABBAGE AND CAULIFLOWER.

B. C. PITTUCK, Agriculturist.
S. A. MCHENRY, Superintendent of Beeville Station.

General directions (which are to be found in greater detail in Bulletin No. 69) are given for growing and marketing *Cabbage* and *Cauliflower.*

In the variety tests with cabbage, Stein Early Flat Dutch gave the largest yield. Danish Ball Head, when young, would not withstand cold better than the average variety, but when two-thirds grown was the most hardy variety tested. Frotscher's Superior Late Flat Dutch was the most hardy at all stages.

The coldest weather in this section generally comes February 15th to 25th. By planting early-maturing varieties about August 1st and using fertilizers freely, the crop may be matured before the February freeze.

Barnyard manure produced the best and quickest results.

The cauliflower test was a failure because damaged by cold. If the crop had been properly fertilized, it would have escaped injury by earlier maturity. "Early Snowball" proved to be the surest header and earliest variety of the five tested. Late Italian Giant was found valuable.

BULLETIN NO. 58. HORTICULTURAL SECTION. DECEMBER, 1900.

PRUNING AND TRAINING PEACH ORCHARDS.

R. H. PRICE, Horticulturist.

The subject of this bulletin is treated in Bulletin No. 80, which gives more recent views on the subject.

BULLETIN NO. 59. MARCH, 1901.

AGRICULTURAL SECTION—FIELD CROPS AND LIVE STOCK.

FORAGE CROPS.

REPORTS OF CO-OPERATING STOCKMEN AND FARMERS FROM SEVENTY-ONE COUNTIES.

The crops which were tested in these co-operative experiments were *Alfalfa, Japan Clover, Melilotus, Crimson Clover, White Clover, Velvet Bean, Beggar-weed, Cow-peas, Rescue Grass, Kaffir Corn, Field Corn* and *Chufas.*

Brief cultural directions for each crop are given. The average annual precipitation for the different regions of the State, and the location of the co-operative tests, are shown on maps, and the plans of other forage crop work pursued by the Station briefly outlined.

BULLETIN No. 60. JUNE, 1901.

AGRICULTURAL SECTION—HORTICULTURE.

TWO METHODS OF GROWING ONIONS.

B. C. PITTUCK, Agriculturist.
S. A. MCHENRY, Superintendent of Beeville Station.

This bulletin gives an account of duplicate experiments tried with horse, and hand culture on two varieties of *onions*—Creole and Red Bermuda—in 1898, to determine the difference in yield and cost of growing according to the two methods, and also to find out if planting in the beds and transplanting were more profitable than field planting. Methods of onion culture are also given. [See Bulletin No. 77.]

The results showed little difference in the cost of growing either variety to maturity, by horse cultivation, whether the seed is sown in beds or in the field; but the yield was nearly double, and the profits more than double with the Red Bermuda when transplanted; while with the Creole there was a somewhat greater yield and profit.

In horse cultivation the rows were thirty inches apart, and only fourteen inches in hand cultivation. The cost of hand cultivation was only 75 cents more than the other, while the yield was increased from 36 per cent in the case of the Creole variety to 188 per cent with the Red Bermuda onions. This shows that it pays to give onions the hand cultivation and transplanting, especially the Bermuda onions.

Good seed is important. Creole seed are grown in Louisiana, and may be grown in Texas equally well. But the best Bermuda seed come from Teneriffe. Of twenty-three varieties tested at Beeville, only these two are recommended for South Texas.

These crops are grown without irrigation.

A study of the markets shows that the best market for Texas onions is just before the Southern crop moves (May) and again after the Southern crop is marketed (July and August). The Red Bermuda onions are suitable for the early market; the Creole for the later.

BULLETIN No. 61. OCTOBER, 1901.

CHEMICAL SECTION—FIELD CROPS AND HORTICULTURE.

WILLIS AND HUNTSVILLE TOBACCO SOILS.

H. H. HARRINGTON, Chemist.
P. S. TILSON, Associate Chemist.

Chemical and mechanical analyses of eighteen samples of soil from Willis and six from Huntsville are reported, and compared with analyses of Connecticut Valley soils, with the result that it is stated that "with the same care and expense that is devoted to tobacco culture in other localities, Willis, Texas, could soon acquire a national reputation as a tobacco district."

Recommendations are given as to fertilizers for the different soils,

based upon analyses of samples of tobacco ash. The amount of nicotine was small—1.75 per cent in the wrapper to 2.50 per cent in the filler.

The authors conclude:

1. That tobacco soils of Willis and Huntsville are admirably adapted to the growth of a high-grade filler or wrapper.
2. Willis is perhaps the southern limit, along the I. & G. N. R. R., of the typical tobacco land.
3. The tobacco area extends north and almost certainly east.
4. A comparison of Connecticut and Willis soils shows a difference in favor of Willis for high-grade Havana filler or wrapper.
5. Under present conditions, it may be more profitable to grow the Havana filler. But with greater outlay of capital, by means of shade, irrigation, and fertilizers, a most satisfactory wrapper can be produced.

BULLETIN No. 62. HORTICULTURAL SECTION. DECEMBER, 1901.

THE FIG.

R. H. PRICE, Horticulturist.

A brief discussion of fig culture in Texas; directions for propagation, fertilizing, planting and pruning. Figs are easily grown, yield abundantly, and are very wholesome.

Three classes of figs—Capri figs, Smyrna figs and Adriatic figs—are known. The Smyrna figs produce only female flowers, and can not fruit unless the Capri fig and a small insect, called the blastophaga, are present to pollenize them. It is not known if the blastophaga will live in Texas. Capri figs have been grown at Del Rio. Adriatic figs are grown all over the South. Twenty varieties are described in this bulletin. The most productive at College Station were Brown Turkey, Black Marseilles, White Marseilles, and Brunswick. This latter is identified as the same as Dr. Hogg's Clare and Barnisotte, and is known in Texas as the "Magnolia Fig."

BULLETIN No. 63. VETERINARY SECTION. JANUARY, 1902.

TEXAS FEVER.

M. FRANCIS, Veterinarian.

This is really a continuation of the work reported in Bulletin No. 53, and presents the results of further experiments in which the conclusions there given are abundantly confirmed. The data on more than 1250 animals are given, and show that the most practical way to import Northern cattle into the Southern States is to:

1. Select young cattle from twelve to eighteen months of age.
2. Bring them South during the winter months.
3. Inoculate each with one cubic-centimeter of the blood of Southern cattle immediately on arrival.

4. Keep them separated from the Southern cattle and in a tick-free enclosure for sixty days.
5. Run them on green stuff—say, green oats, rye, wheat.
6. No "fever medicines" are effective.
7. After sixty days turn them among Southern cattle.
8. Inoculated cattle should be well fed and cared for the entire first summer.

This bulletin also contains a map of Texas showing the distribution of the animals inoculated.

A graphic record showing the regular and irregular type of the fever.

Some fever records taken at short intervals, day and night, during the reaction, with data on the age, breed, and gain of loss in flesh, etc.

A record of some fifteen cases that died with inoculation fever.

A record of forty cases in detail, compiled to ascertain if there be any difference in susceptibility due to breed.

A temperature of ten young suckling calves ranging in age from forty to seventy days.

A record of forty-nine heifers which were given a second inoculation sixty-seven days after the first one.

A list of the owners of 1251 cattle, their present location, and death rate of the cattle.

Other technical matters of interest only to specialists in this subject.

[Since Bulletins Nos. 53 and 63 were published this work has been continued by the Station until now (1907) about three thousand animals have passed through its hands. Of these we have saved from 90 to 92 per cent.]

BULLETIN No. 64. APRIL, 1902.

INSECT PESTS ATTACKING TRUCK CROPS.

FREDERICK W. MALLY, Professor of Entomology.

This bulletin briefly describes the transformations of insects from egg to adult. The second stage of an insect is the larva, and it is during this stage that it does its growing. Some insects pass through three stages, viz., egg, larva and adult. The larva generally resembles the adult. Other insects pass through four stages, viz., egg, larva, pupa and adult. The larva is a worm or caterpillar, and does not resemble the adult. Some insects chew and swallow certain parts of the plant, while others merely insert their beaks and suck the sap. Against the former poisons may be used effectively, while against those that suck, contact insecticides are recommended.

The hotbed is the first battleground. The author believes that greater losses are suffered from excessive moisture and heat than from insects. To obviate this, subirrigation of the hotbed is recommended, as follows:

"Three or four-inch tiling is used and laid on a dead level in forty to fifty-foot beds. For four-foot beds only one series of tiling is laid along the center; for six-foot beds two series are used. Water is introduced into the tile, from which it diffuses in the soil through the joints of the drain. The temperature of the water may be regulated to suit weather conditions.

"Hotbeds for winter or seed beds for mid-summer or autumn should be well prepared fully a month ahead of seed-sowing. The soil should be well dug up, watered thoroughly, then pulverized and leveled off. This done, treat with carbon bisulphide (high life) as follows: Take any ordinary garden dibble and punch holes six inches deep two feet apart all over the surface of the bed. Then pour an ounce of carbon bisulphide in each hole, immediately fill it up with earth, giving it a slight pressure. Do this as quickly as possible and then cover with hotbed sash or cloth. In case of autumn seed beds, cover the surface with wet gunny sacks. Allow the beds to remain in this condition for a couple of weeks and then uncover and air well. This fumigation process destroys any insect eggs or lower animal life in the soil and at the same time most of the fungus spores. In addition, it stimulates a healthy vigorous plant growth afterwards.

"As the season progresses, save and gather up plenty of wood ashes.

"Pile them so as to leach well and rot thoroughly by the time fumigation is completed. At sowing time, spade the seed bed over thoroughly, and level off as before. Sow the seed, cover well (about an inch deep) and tamp the surface lightly. If it be an autumn seed bed, give a liberal top dressing of tobacco dust at the rate of 500 pounds per acre and rake in lightly. Then apply a dressing of well-leached wood ashes to a depth of about one-sixteenth inch. This is done by taking a coarse sieve and sifting the ashes evenly over the entire surface. If for a hotbed, sift the wood ashes on first and then apply a dusting of a mixture of one ounce of sulphur to three ounces of air-slaked lime. Use a finer meshed sieve than for the ashes and sift on enough to make the surface look like a frosty morning. Then take the coarser sieve again and give an evenly distributed application of tobacco dust at the rate of about 300 pounds to the acre or until the whitishness of the lime application is hidden. The lime and sulphur prevent damping off and the tobacco dust destroys or drives out all insect or animal life. The ordinary heat of the bed generates vapor enough from the moisture to set free the fumes of tobacco to such an extent that the odor is very noticeable when the sash is opened for airing the beds. For this reason, if no other, hotbed sashes are preferred to cloth covers. With subirrigation, keeping the surface dry and with the dressings of fungicide and insecticide materials above indicated, the author has yet to experience his first loss of plants in seed beds or hotbeds, due to insect ravages or fungus diseases. Root maggots in autumn seed beds especially are easily prevented by the fumigation and anti-pest dressing manipulation just outlined. This kind of management is also especially advisable in those localities where onions are grown extensively, in order that the various root troubles may be avoided. The above outlined treatment and preventive measures apply equally well to all locations or for any season of the year, and should, therefore, have a much wider application among gardeners than has heretofore been given the system.

"COLD-FRAME MANAGEMENT.

"It has been my practice to give these almost the same management, as to preparation, that is given the hotbed. There is, of course, no bottom heat; water is used more freely and, except in permanently located cold

frames, the watering is done from the surface. Where the cold frames have a permanent location it is well to provide for subirrigation. Cold frames should be given the carbon bisulphide treatment some two weeks in advance of transplanting time. After the plants have been transferred to the cold frames, then a liberal top dressing of about 1 pound of tobacco dust per one hundred square feet is sifted evenly over the surface. The next day after transplanting they are thoroughly sprayed with a solution of arsenate of lead in proportion of 1 pound to twenty-five gallons of water. This should be done as a general precautionary measure to guard against the sudden appearance of some voracious leaf-feeding insect which would cause sad havoc before treatment could otherwise be given. Just before the plants are taken from the cold frames to the field for transplanting they should be well sprayed with the arsenate of lead solution already indicated.

"FIELD MANAGEMENT.

"For such crops as are taken from the cold frame to the field with a small block of the cold-frame earth, it is to be urged that a small handful of tobacco dust be applied as a fertilizer at the time of transplanting, followed with a liberal application as a top dressing around the plants.

In case of onions which are transferred direct from the original seed bed to the field, the rows should be first marked off lightly with a bull tongue and tobacco dust applied at the rate of about 500 pounds per acre. Mix with earth well by running a bull tongue through it. Bed lightly so as to fill up the furrow, and smooth down the rows to a level. A good fertilizer drill will answer the purpose as well and is more expeditious. After the onions are transplanted, give another liberal top dressing of tobacco dust alongside of the rows and in between the plants. This treatment applies equally well to all crops or seeds to be planted or sown directly in the fields. Such operation should always be accompanied with the intelligent and liberal use of tobacco dust. The author believes that the value of tobacco dust is underestimated; that it is worth, as a fertilizer, practically all it costs."

BULLETIN No. 65. HORTICULTURAL SECTION. JANUARY, 1903.

THE TOMATO.

E. J. KYLE, Horticulturist.
E. C. GREEN, Assistant Horticulturist.

This contains a very complete account of practical tomato culture; discusses seed and soils, planting, pruning and staking, cultivation, insects, and diseases, harvesting, marketing, yield and value of crop, relative success of large and small plantations, and overproduction.

For specific experiments on tomato fertilizers, see Bulletin No. 84.

BULLETIN NO. 66. AGRICULTURAL SECTION. MAY, 1903.

FORAGE CROPS.

B. C. PITTUCK, Agriculturist.

Alfalfa, Peanuts, Velvet Beans, Millet and *Rape* are discussed in this bulletin.

ALFALFA ON BRAZOS BOTTOM SOILS.

The soil of this section is deep, fertile, warm, and well drained—an ideal soil for alfalfa. It produces the finest alfalfa in the world. But a large part of this section is subject to overflows of from one to eight days' duration; and twenty-four to thirty-six hours under water will, it has been asserted, kill alfalfa. The experience of several Brazos bottom planters, however, given at length in this bulletin, leads the author to conclude (1) that, where the soil is favorable, alfalfa will often recuperate wonderfully even after it has been flooded for six or eight days; (2) that winter overflows do it little harm, and that late summer overflows are rare; (3) that the damage is due chiefly to the smothering by deposits of sediment, so that only near the river front, and in poorly drained spots, will there be much damage done.

An experiment with some drought-resisting alfalfa seed from Utah gave no advantage the first year, but the second season showed a difference of 2071 pounds in favor of the Utah seed.

PEANUTS.

The peanut as a forage and pasture plant is rapidly, and deservedly, becoming popular with the Texas farmer. Being a legume, it exercises a highly beneficial effect on the soil and at the same time furnishes a highly nitrogenous feed stuff, greatly relished by stock as green feed or as hay. Peanuts are partial to loose soils of a light color. The land should be well drained and not too rich in vegetable matter. Barnyard manure should be used only in small quantities. Phosphoric acid and potash are the main elements of plant food required by the peanut for best results.

BULLETIN NO. 67. CHEMICAL SECTION. JULY, 1903.

COMMERCIAL FERTILIZERS AND COMMERCIAL POISONOUS INSECTICIDES.

H. H. HARRINGTON, Chemist.

This bulletin contains a discussion of some of the fundamental principles underlying the use of fertilizer and insecticides; an account of their chemical composition, and a list of the dealers and agents handling commercial fertilizers, and manufacturers of poisonous insecticides in the State. Most of the analyses were made by Dr. N. Fraenkel, Mr. O. D. Hargis and Professor P. S. Tilson. The amount of fertilizer used in

the State was only 10,000 tons, but that was twice as much as the year before.

It is explained that the statement at the top of the fertilizer tag, "Not good after such and such a date," refers to the tag, not to the fertilizer; that the purchaser should judge of the fertilizer by its amount of available phosphoric acid, of nitrogen, and of potash. By using cotton seed meal—which contains about 3 per cent of phosphoric acid (worth 7 cents per pound), 1.5 per cent of potash (5 cents per pound), and 7 per cent of nitrogen (5 cents per pound) or a total value of $25 per ton—as a standard, the farmer can judge from the analysis of any given fertilizer of its value for any given soil and crop. Cotton seed meal, with its excess of nitrogen, is not a perfectly balanced fertilizer, and, for most soils and crops, acid phosphate and kainit (or better, sulphate or muriate of potash) should be added.

Suppose the farmer makes a mixture as follows:

Tankage	1,200 pounds.
Acid phosphate	300 pounds.
Kainit	500 pounds.

Assuming that the tankage carries 6 per cent of nitrogen and 8.5 per cent of available phosphoric acid; that acid phosphate had 14 per cent of available phosphoric acid, and the kainit 12 per cent of actual potash, the above mixture would show about

3.6 per cent nitrogen.
7.2 per cent available phosphoric acid.
3.0 per cent potash.

It should be noted, however, that the composition of tankage varies quite widely, according to the relative amounts of dried blood or dried meat to that of crushed bones; the nitrogen, of course, being derived mainly from the former, and the phosphoric acid from the latter.

Using Bat Guano Compost, with a guaranteed composition of 4 per cent of nitrogen, 6 per cent available phosphoric acid, and ¾ of 1 per cent of potash, we may supplement its acid phosphate and potash as follows:

1,400 pounds of bat guano compost.
400 pounds of acid phosphate.
200 pounds of high-grade muriate of potash.

This would give us a mixture of about the following proportion of plant food:

9.0 per cent available phosphoric acid.
2.8 per cent nitrogen.
5.5 per cent potash.

This makes a highly concentrated and quick-acting fertilizer. Bat guano compost is nothing but a mixture of bat guano and bat guano ash. The bat guano itself varies quite widely in composition, owing to the varying amount of dirt and foreign material mixed with it. The following analysis shows the results of a recent sample:

Moisture	12.18 per cent.
Ash	17.93 per cent.
Organic matter	69.89 per cent.

Total nitrogen . . . . . 9.94 per cent.
Total phosphoric acid . . . . . 5.00 per cent.
No nitrate present.

If we desire the quick effects of nitrate of soda, we may use this mixture:

300 pounds nitrate of soda.
1,200 pounds acid phosphate.
500 pounds kainit.

The above combinations are, in composition, very much like the fertilizers usually recommended for truck crops. Average fertilizers used for cotton contain about 2 per cent nitrogen, 8 or 9 per cent available phosphoric acid and 1.5 to 2 per cent potash.

Tobacco Waste, used as an insecticide, is stated to be worth about $12 a ton as a fertilizer also.

Goat and sheep manure, barnyard manure, spent bone black from sugar refineries are analyzed and their fertilizing value explained.

The insecticides discussed are *Arsenate of Lead*—which is recommended for the cotton-leaf worm—*Paris Green, London Purple, White Arsenic.*

BULLETIN No. 68. CHEMICAL SECTION. JULY, 1903.

THE MANUFACTURE OF CANE SYRUP.

H. H. HARRINGTON, Chemist.

The object of this bulletin is to encourage the small farmer to raise sugar cane and make syrup for his own use and for the local market. It contains instructions for planting the cane and making the syrup, a plan for a syrup mill, and analyses of various syrups on the market.

Its conclusions are:

1. That cane syrup, even when made in small quantity, is a paying crop for the farmer.

2. A very simple and inexpensive outfit, consisting merely of a three-roller horse mill for grinding the cane, and one single-horse evaporating pan, is all that is absolutely necessary for making a fair grade of the syrup.

3. That this simple apparatus can be much improved, at very little increased cost, by the addition of the following:

(a) A simple hydrometer, as described, for taking the specific gravity of the syrup, and thus getting it all of a proper density.

(b) Gray moss, when it can be obtained, for filtering the juice as it comes from the mill.

(c) Upright settling tanks, for the finished syrup. This is very important.

4. That if moss can not be had, or if more than a few hundred gallons of syrup is to be made, a sulphur box, and lime, should be used.

5. That if the syrup is properly made it can be kept for one year or more, even in barrels, if these are agitated very little, and the syrup exposed to the air as seldom as possible. But that in small vessels that are tightly corked, not even sealed, the syrup will keep indefinitely.

6. That pure cane syrups, or even "open kettle syrups," are seldom found on the market; and that most of the table syrup which we use is only a mixture of glucose, starch, or corn syrup, with lowest grade of refuse cane molasses.

7. That we very rarely get pure maple syrup in the open market.

[Note.—In Louisiana, Mississippi, Alabama, Georgia and Florida, large quantities of pure cane syrup are now put up in cans, jugs and bottles and sealed; the syrup being put into the receptacle hot to insure perfect sterilization. In this way the syrup keeps fresh indefinitely. An average yield of syrup on the pine woodlands of these States, by the use of some fertilizers, appears to be about 300 gallons to 400 gallons per acre. Prices for the last year or two have been about 50 cents a gallon.]

BULLETIN No. 69. AGRICULTURAL SECTION. JULY, 1903.
(BEEVILLE No. 6.)

CABBAGE.

VARIETIES—FERTILIZERS.

B. C. PITTUCK, Agriculturist.
S. A. MCHENRY, Superintendent of Beeville Station.

This bulletin contains summaries of results of experiments at Beeville on eighteen varieties of *Cabbage* tested in 1901-1902 and twelve varieties tested in 1902-1903; fertilizer experiments begun in 1902 by a co-operative method at five other points in the coast country besides Beeville; and instructions for cultivation of cabbage.

1. The varieties making largest yield were Premium Late Flat Dutch, Early Flat Dutch, and Autumn King. The varieties maturing largest per cent heads from transplanted plants were Lauderback's All Year, Reedland's Early Drumhead, Early Flat Dutch, and Autumn King.

2. The fertilizer experiments giving the best results were at:

Beeville.—Acid Phosphate, 600 pounds per acre, yield, 18,020 pounds.

Edna.—Bat Guano, 500 pounds, and Nitrate Soda, 200 pounds per acre; yield, 27,040 pounds.

Runge.—Ground Tankage, 800 pounds, and Muriate Potash, 500 pounds per acre; yield, 9920 pounds.

Skidmore.—Stable Manure, 1000 pounds, and Wood Ashes, 3000 pounds per acre; yield, 20,280 pounds.

Richmond.—Bat Guano, 1000 pounds per acre; yield, 19,120 pounds.

Cuero.—Bat Guano, 600 pounds, and Wood Ashes, 3000 pounds per acre; yield, 10,560 pounds.

3. *Cultivation.*—Land should be carefully prepared. If seasons permit, plowing should be done during the summer, rebreaking early in the fall, thoroughly pulverizing and harrowing before transplanting. When irrigation is to be used, the land should be carefully leveled. In South Texas seeds are planted in cold frames during the early part of August, and transplanted in September or October. Cultivate the crop from six to nine times a season, and hoe once. The Planet, Jr., cultivator with pulverizing attachments, and the Iron Age five-tooth cultivator are rec-

ommended; the twelve-tooth for level culture and the five-tooth to throw dirt up, and protect against freezes.

4. *Irrigation—Reservoirs.*—The method of irrigation is by furrows; 20,000 to 40,000 gallons per acre applied before transplanting, 35,000 gallons at each succeeding irrigation, at from 60 cents to $2.40 per acre. To prevent leakage, the reservoir is lined with *Tar Mastic,* prepared as follows: Use by weight 25 per cent coal tar, 2 per cent lime, 73 per cent sand. Weigh lime and sand dry. Weigh tar after boiling. Mix air-slaked lime and sand dry, pour in boiling tar, and mix with hoe. Apply to bottom and sides of reservoir, while hot, using about 53 pounds per square yard. To close small crevices left by cooling, go over the entire surface with *flashed tar paint,* made by boiling tar twenty minutes, and "flashing" (setting on fire), while boiling, until all grease is burned out. Apply with a paint brush. Before lining a reservoir, the sides should be allowed to settle, and they should not be steeper than 45°. Put in no fish for a year or two, for the tar will kill them.

5. *Insecticides.*—Paris green is recommended for the cabbage worm; the blow-torch and kerosene emulsion for the Harlequin bug. The resin-lime mixture was found to be fatal to the cabbage worm, but only drove away the Harlequin bug.

6. *Cutting, Packing and Shipping.*—To judge when to cut the heads, the testing by touch is advised. Cutting and loading should take place the same day. Care should be taken not to market immature heads; nor to bruise the heads. They should be crated in standard crates, 20x20x28 inches, holding 150 pounds, and made of poplar, sweet gum or cotton-wood. Packing should be tight with tops turned toward the center. Medium-sized heads—2 to 5 pounds—sell best. If shipped in bulk (which is not advised), they should be well ventilated.

7. *Cost of Growing.*—At $1.00 a day for labor, and $1.50 for team, the cost of an acre of cabbage is estimated to be $12.85, exclusive of fertilizers, irrigation, handling, crating, and shipping.

BULLETIN No. 70. CHEMICAL SECTION. MARCH, 1904.

THE COMPOSITION OF TEXAS COTTON SEED MEAL.

H. H. HARRINGTON, Chemist.
G. S. FRAPS, Associate Chemist.

This bulletin shows results of analyses of forty-six samples of Texas cotton seed meal, representing forty-three mills in thirty-four counties. It contains a discussion of the value of cotton seed products, of the food elements they contain, and a list of Texas mills.

The following conclusions are drawn:

1. The feeding value of cotton seed meal depends chiefly upon the amount of nitrogen and fat which it contains, nitrogen in protein being a flesh-forming food, and fat serving for fuel and to be stored up as fat.

2. The fertilizing value of cotton seed meal depends chiefly upon the amount of nitrogen which it contains.

3. Of forty-six samples of Texas meal tested, thirty-three contained

over 7.5 per cent of nitrogen, while of 151 samples of meal examined in nine other States, only eight contained over 7.5 per cent nitrogen.

4. Texas cotton seed meals on the average are richer in nitrogen than meal from other sections, and, therefore, should have a higher commercial value.

5. The meals richest in nitrogen come from the western part of the State; those lowest in nitrogen from the east, and the medium grades from the central cotton-growing region.

A map shows the distribution of the meals.

6. There is very possibly a relation between the rainfall and the nitrogen content of cotton seed, the seed being richer in more arid sections. This difference may, however, be due to other causes.

BULLETIN No. 71. HORTICULTURAL SECTION. APRIL, 1904.

IRISH POTATOES.

EDWARD C. GREEN, Assistant Horticulturist.

This bulletin describes a single season's work with early *Irish Potatoes* at Troupe, Smith county. The conclusions of the author were:

1. Potatoes planted three inches deep matured earlier and produced a larger crop than those planted four and one-half and six inches deep.

2. Level culture proved more profitable than bedding and "hilling up" the rows.

3. The gray, sandy clay soil, with red subsoil, at Troupe Station, responded more profitably to application of acid phosphate than to any other single fertilizer.

4. In a complete fertilizer, potash over 6 per cent was unprofitable, while unusually large percentages (8 per cent and 10 per cent) of phosphoric acid greatly increased the yield.

5. Cotton seed meal applied only a few days before planting was too slowly available to prove a desirable fertilizer for early potatoes.

6. Northern-grown seed potatoes produced their crop at least one week in advance of second-crop Texas-grown seed.

7. Some of the white sorts, Thorburn, and Irish Cobbler, produced much more abundantly than the red Triumph and were equally early. It is suggested that these varieties be planted experimentally by truckers.

BULLETIN No. 72. HORTICULTURAL SECTION. JULY, 1907.

STRAWBERRIES AT TROUPE STATION.

EDWARD C. GREEN, Assistant Horticulturist.

This bulletin deals with the results of experiments tried at Troupe, in Smith county, by Dr. E. P. Stiles, Mr. W. S. Hotchkiss and Professor Green. A variety test and a shipping test are described, and sugges-

tions for culture given, from which were drawn the following conclusions:

1. For distant market Excelsior and Lady Thompson for early, and Aroma and Haverland for mid-season are the varieties of proven value.

2. For distant market the Klondyke for early offers great promise and is worthy of extensive trial by commercial growers. For late the Barton's Eclipse is a promising variety, but should be tested further before given extensive trial.

3. For the home table Johnson's Early and Darling for early, Haverland, Aroma and Wm. Belt for medium to late.

4. The results indicate that Haverland is a perfect shipper, and that Aroma, Barton's Eclipse and Mexican, are satisfactory.

SUGGESTIONS FOR STRAWBERRY CULTURE.

Strawberries do well on nearly every kind of soil, but the location should be carefully chosen. Land subject to drought, wet soil, cold or quicksand, very light or very stiff soil should be avoided. Low places totally surrounded by higher land should be avoided on account of probability of spring frost. Chocolate, sandy loam, and light clay soils have proven best for strawberries, while rolling land with ample air drainage is safest from frost. Bottom land is often satisfactory when not too wet in spring, or subject to untimely frost.

The best preparation for the strawberry field is to turn under deeply in fall a heavy crop of cow-peas. Barnyard manure and wood ashes may be applied any time during the winter and harrowed in. Plow again in early spring and harrow again until perfectly mellow. Continue work with the harrow once a week until planting. Early in March the plants should be set about eighteen inches apart in three and one-half-foot rows.

None but young plants which have never borne a crop should be used in the new field. All dry stems and old leaves should be removed, leaving only two or three young leaves about the center.

In case plants obtained from a distance are received in a poor condition, they should be taken from the bundles and heeled in with roots well spread in long shallow trenches and sprinkled lightly once a day; in a short time it will be seen which will be likely to endure field planting, and no time will be lost in setting worthless plants.

A full stand depends much on the setting. The plants must not be put over a quarter of an inch deeper than they were in their original situation, or the terminal buds, covered with earth, will be killed. Plants set too high suffer when the ground settles, as this leaves their roots and crowns exposed and dried, and death of plants quickly follows. Another apparently small but essentially important point is care in spreading the roots out thinly so that their entire surface may be against the soil, which should be opened for them by the use of a spade or a flat dibble.

The cultivation throughout the summer should be shallow and thorough, and the rows must be kept free from grass and weeds by means of hand labor. When the runners form, let them fill any vacant places; the other runners then should be kept down by cutting off with a hoe or a rolling cutter attached to a cultivator.

Late in the fall after all growth has stopped cover the rows with a

mulch of clean straw or pine needles. This should be left in place until the middles can be cultivated in February, after which the mulch may be raked off the rows to cover the middles and more straw added, if necessary, to make a blanket deep enough to retain moisture and prevent weed growth.

If the soil is reasonably rich and has been prepared in the manner as suggested, no further fertilization is necessary; but, failing in this, it is desirable to work in 500 pounds of acid phosphate and fifty bushels of ashes between the rows during the February cultivation before the mulch is raked from the rows.

In harvesting, the berries should be picked by passing the thumb and forefinger over the berry and snapping off the stem about half an inch from the fruit.

Of the diseases attacking the strawberry, the leaf-spot (Sphoerella fragariae) is the most serious. It is almost impossible to grow certain varieties on account of this fungus, as it attacks both leaves and fruit stalks, girdling the latter and causing the spray of young fruit to wither. In setting new beds, remove from plants all spotted leaves and dry stems, and if convenient spray with Bordeaux mixture once or twice within a few weeks after planting. In renovating old beds, the practice of burning over is recommended. Choose a time when the soil is damp and leaves and mulch dry enough to burn slowly. When the young leaves push forth, thoroughly spray with Bordeaux mixture.

BULLETIN NO. 73. CHEMICAL SECTION. JULY, 1904.

THE COMPOSITION OF RICE BY-PRODUCTS.

G. S. FRAPS, Associate Chemist.

The object of this bulletin is to give an account of rice bran, rice polish, and rice hulls. The samples are compared with samples analyzed the year before by Dr. N. Fraenkel, and with analyses made at other stations. Three samples of hulls, five of polish, and six of bran, were analyzed.

The conclusions drawn were:

1. Rice hulls have a low feeding value; their composition approximates that of wheat straw, but the hulls have less value.
2. Rice polish has a slightly higher feeding value than corn, and is about equal to oats or wheat.
3. Three classes of so-called rice bran are sold in Texas: Pure rice bran, consisting of the cuticle of the grain mixed with a small amount of hulls incidental to the process of milling; rice bran mixed with rice hulls; rice bran, rice polish, and rice hulls mixed. This confusion will eventually damage the trade.
4. Pure rice bran should contain not less than 10 per cent protein and 6 per cent fat, nor more than 20 per cent crude fiber.
5. Pure rice bran is slightly superior in composition to corn meal.
6. Any addition of rice hulls lowers the feeding value of the mixture.
7. Commercial rice bran may contain as low as 4 per cent protein, and as high as 50 per cent crude fiber.

8. The mixture of rice, bran, and hulls in the proportion in which they come from the grain will contain about 7.5 per cent protein and 25 per cent crude fiber, and has a little over half the value of pure bran.

9. Mixtures of rice bran with rice hulls, or with hulls and polish, should be sold under their true names, and on their own merits, and not under the name and on the merits of a superior article.

BULLETIN No. 74. SEPTEMBER, 1904.

INSECTS MISTAKEN FOR THE MEXICAN COTTON BOLL WEEVIL.

E. DWIGHT SANDERSON, Entomologist.

In this bulletin the author illustrates and describes the insects frequently found in and around the cotton field which are commonly mistaken for the *Boll Weevil*. While many snout beetles have spines on the thick portion of the front legs near the knee joint, the cotton boll weevil may be readily distinguished by the presence of a swelling, bearing two teeth, one larger than the other, and located immediately above the knee joint of the front legs.

BULLETIN No. 75. AGRICULTURAL DEPARTMENT. OCTOBER, 1904.

COTTON INVESTIGATIONS OF THE BUREAU OF PLANT INDUSTRY, U. S. DEPARTMENT OF AGRICULTURE AND THE TEXAS EXPERIMENT STATION.

EARLY COTTONS.

R. L. BENNETT, Cotton Specialist.

This bulletin describes one year's work, carried on at College Station and at San Angelo on sandy loam soil, and at Waxahachie, Ellis county, on black waxy soil, to produce early varieties of cotton, which would make a crop before the boll weevils became very prevalent.

The first half of the bulletin treats of seed selection, and describes the type of cotton which should be chosen for early yields; the second treats of fertilizing as a means of producing an early crop.

Seeds of early and of late varieties, seeds from the northern edge of the cotton belt, and local seeds were planted. The intention was to study early and late varieties, and cotton from north and south edges of cotton region, and local seeds in their relations of growth and earliness. The varieties are listed herewith: King, Shine, Toole, Welborn, Herlong, Doughty, Drake, Boyd, Peerless, Peterkin, Hawkins Excelsion, Russell, Truitt, Allen, Berry Big Boll, Rowdan, Jones' Storm-Proof, Bohemian, Jones, Little Boll, Owens, Meyer, and three Texas big boll cottons.

The conclusions reached were:

1. The type of cotton that makes an early crop has a short-jointed main stem, with short jointed long fruit limbs (not wood limbs) at each

joint on the main stem; the relative length of fruit limbs decreasing with age from base of stalk upward; the first fruit limbs should be at the first joints on the main stem; the first fruit in the first axil or joint of the first fruit limb, and successively at each joint on all fruit limbs to the close of the season. The larger the bolls, the greater will be the yield. Such a plant fruits earliest, most rapidly, is earliest in maturing fruit, and is most productive. The highest development of such a plant is a matter of seed selection, and, with the type defined, stalks nearest approaching the type can be recognized in the field when picking; it is not necessary to watch and mark the plants that open the first boll.

2. From the time the square first appears in the leaf axil to the full-grown boll is practically the same in both the early and late cottons and in both large and small-boll cottons. Though the large boll takes a few days longer to dry out and open, it is not exposed to the weevils' attacks when mature.

3. A rapid rate of growth is desirable, and this may be obtained by selecting seeds from the *largest stalks* of the right type.

4. It is a mistake to suppose that early cotton necessarily has small bolls and short fiber, or that long staple cotton can be grown only in the lowlands.

5. To increase the yield of cotton, the grower has two means within the plant: increasing the number of bolls and increasing the size. By taking the type which will produce an early, abundant crop of large bolls as a guide, and carefully selecting seed from the plants conforming most nearly to that type, he may fix these features each year more perfectly, and proper cultivation and plant food will enable him to produce a maximum crop.

6. Imported small-boll short-staple Carolina seed, and seed from Northern Arkansas and the Panhandle, gave results no better than native Texas seed.

7. The large, thick hulls of the native big-boll cottons were found to protect the lint from storms.

II. On fertilizing cotton for earliness, experiments were tried at College Station, in the Brazos bottom, and at Waxahachie:

First—To get information as to the effect of the three fertilizing elements of the earliness of the cotton plant.

Second—To get some data as to the relative yield of cotton in a short fruiting season when fertilized and not fertilized.

Third—To learn the way that fertilizers cause an early maturity of the cotton crop. Phosphoric acid, nitrogen, and potash, the elements of plant food applied to soils, were used in this work as acid phosphate, sulphate of ammonia and kainit. Each was applied in small, medium and excessive amounts, and also the three were mixed in like amounts, as follows:

Acid phosphate, 100, 200 and 500 pounds per acre.

Potash or kainit, 100, 200 and 500 pounds per acre.

Nitrogen or sulphate of ammonia, 250 and 500 pounds per acre.

The mixture was made of one part kainit, one and one-half parts cotton seed meal for nitrogen and two parts of acid phosphate. This combination was applied at the rate of 225 and 600 pounds per acre.

Kainit contained 12 per cent potash; acid phosphate, 14 per cent available phosphoric acid; sulphate of ammonia contained 20½ per cent of nitrogen—as analyzed by Dr. Fraps of the College. Nitrate of soda was used in the place of sulphate of ammonia in the Brazos bottoms and at Waxahachie.

The results observed were these:

(1) Neither potash nor nitrogen seemed to hasten or delay maturity; but (2) at College the use of phosphoric acid made a very rapid growth and greatly increased the yield.

The conclusion drawn is that, when the soil is deficient in one element, there will be a decided increase in yield due to rapid growth, if that element is added. The important thing is to find out which element the soil lacks. Few Texas soils need potash for cotton. Some sandy or dormant soils may need nitrogen, which may be supplied by applying cotton seed meal at the rate of 100 to 150 pounds per acre. Most soils, except the black waxy, need phosphoric acid, which may be applied in the form of acid phosphate at the rate of 100 to 200 pounds per acre, when the phosphoric acid is 14 to 15 per cent. The black waxy soil did not respond to any of the fertilizers applied, yet the yield showed that some stimulus was needed. Deep breaking is suggested.

A few suggestions are added, telling:

WHEN AND HOW TO APPLY FERTILIZERS TO SOIL.

The land should be broken flat in winter, December or earlier, or if cotton stubble it may be bedded in the old middles. About the last of January, or a sufficient period before planting for the seed bed to become firm, furrows for rows are run off on the flat broken land and fertilizers distributed in these furrows. On the rebedded cotton stubble land, the fertilizers may be applied in the middle furrow, which was the old row before breaking. The fertilizers in the furrow are bedded on and the cotton planted in the usual manner. The cotton seed should be planted directly over the fertilizer and not in the furrow with the fertilizer, or at least not in contact, as their vitality may be destroyed.

Fertilizers may be distributed in the bed without rebreaking by seed planters, or by one-horse fertilizer distributors, or by hand. If they are distributed by hand, a tin bugle or horn is necessary to prevent the wind interfering. This device is made of tin, with a diameter of about two inches, and about three feet in length, with an enlarged funnel-like shape at the top, and to one side of the top a handle is soldered. The laborer takes the fertilizer in a sack on his right side and holds the bugle in his left hand with the lower end of the bugle in the furrow, and while walking rapidly along works the fingers of his right hand for an even distribution of the fertilizer. After a few hours' practice, a good man can put it down uniformly and at a rapid walk.

BULLETIN NO. 76. NOVEMBER, 1904.

ANIMAL HUSBANDRY SECTION.

EXPERIMENTS IN STEER FEEDING.

JOHN A. CRAIG, Dean and Director.
F. R. MARSHALL, Professor of Animal Husbandry.

This bulletin covers two years' work, 1903-1904, and five lines of experiments:

I. Rice By-Products for Steer Feeding.
II. Fodders for Feeding Steers With Cotton Seed Meal.
III. Molasses for Steer Feeding.
IV. Comparison of Yearlings With Two-Year-Olds for Fattening.
V. Corn vs. Corn and Cotton Seed Meal for Steers on Pasture.

The object was to study materials of special interest to Southern feeders.

The experiments reported under I and III were begun in 1903 by W. D. Gibbs, then Director, and J. W. Carson, Superintendent of the Farm Department. Forty steers were used; ten were two-year-olds, thirty yearlings; they were fed 100 days.

In January, 1904, Professors Craig and Marshall continued these experiments with thirty head of yearlings fed for seventy days. Besides these, ten Northern-bred cattle, previously inoculated at the Station to render them immune to Texas fever, were fed for sixty days. The following summer thirty-eight yearling steers were pastured, with corn and cotton seed meal added, for 196 days:

Their conclusions were:

1. Rice bran added to a ration of cotton seed meal and hulls in two out of three trials gave an increased rate of gain at a lower cost.

2. Rice polish added to a ration of cotton seed meal and hulls slightly increased the rate of gain at the same cost.

3. Rice hulls were not satisfactory as a substitute for cotton seed hulls, as the steers did not relish them.

4. Rice hulls fed with cotton seed meal, rice bran and molasses were unsatisfactory, as the steers could not be induced to eat a fair ration.

5. Sorghum hay in a ration of cotton seed meal and rice bran gave about equal results to cotton seed hulls, as 1 in the former results equal to 1.02 pounds of cotton seed hulls. The daily rate of gain per head was slightly in favor of the hulls, being 2.98 pounds as against 2.35 pounds in the instance of the sorghum.

6. Cow pea hay was not found as satisfactory as cotton seed hulls in a ration of rice bran and cotton seed meal, as the daily rate of gain per head was 2.98 pounds in the instance of the lot receiving hulls and 2.3 pounds in the trial with cow pea hay. A pound of cow pea hay was equaled by .94 of a pound of hulls.

7. Peanut hay was very unsatisfactory fed with rice bran and cotton seed meal, owing to the fact that it was a very nutritive food, being too similar to cotton seed meal in composition to mix well with it.

8. Alfalfa hay was a very unsatisfactory addition to rice bran and cotton seed meal ration, for the reason that it was also rich in those con-

stituents which are abundant in cotton seed meal, making the ration too nitrogenous.

Cotton seed meal and hulls make the most generally used ration in the cotton belt, while corn and alfalfa hay are most highly thought of as a ration in the corn belt. A comparison of these rations becomes interesting from these facts.

The steers receiving the ration of cotton seed meal and hulls ate daily per head 5.7 pounds of cotton seed meal and 22.4 pounds of hulls, and gained 2.21 pounds. With the cotton seed meal at $20 per ton and the hulls at $4.00 per ton, the cost of 1 pound of gain was 4 cents.

9. The steers receiving the alfalfa and corn and cob meal ate daily per head 11 pounds of corn and cob meal and 16.9 pounds of alfalfa, and gained 2.53 pounds. With the corn and cob meal at 40 cents per bushel, and the alfalfa at $5 per ton, the cost of 1 pound of gain was 4.1 cents. It will be seen from this that the cost of fattening steers under the very best circumstances for securing the most economical rations is very similar.

10. Molasses added to a ration consisting of cotton seed meal and hulls resulted in a gereater and cheaper gain from those receiving it, as they gained 3.11 pounds per head daily, while those not receiving it gained 2.59 pounds.

11. Yearling steers in comparison with two-year-old steers on rations of cotton seed meal and hulls made about the same gain at a little cheaper cost. The two-year-old steers gained 2.59 pounds per head daily and the yearlings 2.21 pounds.

12. In feeding steers on pasture it was found that a corn and cotton seed meal ration gave better returns than corn alone. The substitution of 3267 pounds of cotton seed meal for 3438 pounds of corn gave an increased gain of 831 pounds on the total lot of nineteen head.

BULLETIN NO. 77. HORTICULTURAL SECTION. DECEMBER, 1904.

ONIONS AND BUNCH CROPS AT BEEVILLE.

J. K. ROBERTSON, Superintendent Beeville Station.
EDWARD C. GREEN, Assistant Horticulturist.

This bulletin treats of the cost, culture, and yields of irrigated and unirrigated plats of *Onions, Beets, Radishes, Lettuce, Carrots and Turnips,* at the Station grounds, in 1904. Variety tests were also made.

Onions.—The seed were sown in beds—a rich sandy loam broken with a plow and worked over with a spading fork to the depth of four or five inches. Seeds were drilled in half an inch deep; the rows spaced about three inches. Six ounces planted a 4x50-foot bed; and five or six such beds will set an acre, four feet apart in fifteen-foot rows. The beds were watered by sprinkling when they needed it, *in the middle of the day* by preference.

Thrips appeared in the seed beds in December, and were promptly destroyed by an application of 2 pounds of whale oil soap dissolved in six gallons of water. The solution was sprayed over the bed thoroughly, and no further trouble was experienced.

Preparatory to the removal of seedlings to the field, the seed beds were soaked by flooding, and the plants drawn by hand. The tops were trimmed to about five inches, and the roots were cut to about three-fourths of an inch long.

The soil used for the onion field was a rich, black loam containing some sand, and, though naturally rich, it was not especially fertile at the time of experiment, owing to the continuous cropping of previous years. During September the land was plowed seven inches deep with a single disk, and harrowed thoroughly, and on December 17th it was again broken with a turning plow set six inches deep and harrowed. On January 30th furrows were laid off two and a half feet from center to center, using a twenty-four-inch sweep, and water applied at the rate of 40,000 gallons per acre. February 2d the field was leveled with an Acme pulverizer, cultivated three inches deep with a five-tooth cultivator, and planked to smooth the surface for planting, and on the following day the onions were set for both experiments. Eight cultivations were given. In addition, the unirrigated plat received one hoeing. Level cultivation, to preserve a dust mulch, stirring the soil after each rain or irrigation, was at no time deeper than 1.5 inches.

The irrigated plat received four irrigations in addition to the preparatory one given to both plats. A mixed fertilizer containing 5 per cent nitrogen, 6 per cent phosphoric acid, and 9 per cent potash was applied at the rate of 500 pounds per acre and worked in at each side of the row, in March.

On one-twentieth of an acre the irrigated plat yielded 1928 pounds, of which only 2 pounds were unmarketable. The unirrigated plat of the same area yielded 987.4 pounds, of which 12 pounds were unmarketable. The difference in yield would have been greater if the irrigation equipment had not been old and inefficient. As it was, selling the onions at 2 cents per pound in Beeville, the profits were $33.45 on the irrigated plat against $15.19 on the check plat. The variety which, in the variety test, proved the best was the Red Bermuda. The variety test was carried on with nineteen varieties, planted and cultivated just as described in the irrigated plat.

Beets.—This is the favorite bunch crop of South Texas; it requires eighty to ninety days, and two crops may be grown from October to May; and a net profit of $1500 per acre on one crop is possible.

In the Station experiment, the land was plowed deep in November, thoroughly harrowed and pulverized, and later furrows were laid off with a twelve-inch sweep and the land irrigated. Bat guano, at the rate of 500 pounds per acre, was sown broadcast and worked into the soil with a five-tooth cultivator. On December 15th the seed was drilled a half inch deep in rows seventeen inches apart, at the rate of 5 pounds per acre, and the packed track made by the planter was covered by running a wheel hoe around the rows. Six irrigations and nine cultivations were given. The beets in the variety tests were thinned to one plant every two or three inches, and so they matured evenly and were soon harvested, while it took sixty days to harvest the others. As soon as the beets were about three inches in diameter they were gathered for market, washed and trimmed and tied in bunches of three to five, and packed in ventilated barrels, nineteen to twenty-five dozen bunches to

the barrel, with their tops toward the center, and shipped without ice; covering the top of the barrel with burlaps was found sufficient. The crop was marketed in Kansas City and St. Joseph, Mo., bringing 40 cents a dozen bunches in March and April; 25 cents in May; profit $54.23 on one-tenth of an acre.

The Electric is recommended as the safest commercial variety; but in the test of twelve kinds the Crimson Globe and the New Meteor showed great promise.

Radishes.—This crops takes only thirty-five days to grow, so that three crops may be planted in a season. A one-tenth-acre yield test was conducted, and twenty-eight varieties tested.

The soil was prepared as for beets, but without fertilizer. Cultivation was given with wheel hoes, and one irrigation was sufficient. Eight pounds of seed were planted to the acre. Harvesting was the same as for beets except that the tops were not cut.

The barrels are not ventilated but iced, four half-inch holes being bored in the bottom for the water to run out. Like beets, the radishes are laid in concentric circles with tops to the center, with three layers of ice, 50 pounds in all, in lumps.the size of an egg, and heaped up on the top layer so as to have the barrel full on arrival.

The turnip-rotted varieties were most profitable, when marketed in Kansas City and St. Louis, and of these the Scarlet White Tipped is recommended. Of the long varieties the Market Gardener's Long Scarlet was found the best for home use; the Round Scarlet Chinese and Icicle are recommended.

A profit of $33.67 on each one-tenth acre is reported. About a barrel and a half were lost by a severe January freeze.

Lettuce, Carrots and Turnips.—The cultural tests with these crops failed; but, of twenty-one varieties of lettuce tested, Big Boston, Hanson, and California Cream Butter gave good results. Of sixteen varieties of turnips the Purple Top, White Globe and the White Dutch Strap Leaf proved most valuable for market purposes.

Lettuce should be planted in land that has had clean culture for two years, as white grubs injure it severely. It should have plenty of water and well-rotted barnyard manure.

BULLETIN No. 78. OCTOBER, 1905.

ANIMAL HUSBANDRY SECTION.

FEEDING COTTON SEED MEAL TO HOGS.

F. R. MARSHALL, Professor of Animal Husbandry.

This bulletin contains an account of an experiment tried on forty hogs, to determine whether or not hogs can safely consume *fermented* cotton seed meal in larger quantities or for longer periods than they can unfermented seed. The experiment was carried on in the spring and early summer, and was a very severe test of the method, which is known as the "Allison method" of feeding cotton seed.

The first part of the bulletin contains a summary of the investiga-

tions in feeding cotton seed meal by other investigators, including two experiments at this Station in 1891 and 1892 (see Bulletin No. 21); an account of the "Allison method" of the experiences of the feeders who have used it, and of the slaughter test on the hogs in this experiment.

The results reached are thus stated:

1. A comparison of the results of this experiment with those of other stations at which cotton seed meal was fed in the ordinary way indicates that cotton seed meal may be used in larger quantities and for longer periods when fermented and fed in a slop than when fed without being fermented.

2. The reports of feeders who have used cotton seed meal for hogs indicate that a light feed of cotton seed meal may be continued indefinitely, and that the consumption of green feed lessens the danger of death from feeding cotton seed meal.

3. In this trial the hogs were yard-fed during the hot summer season, consequently they were under conditions which made the trial as severe as possible. Under such conditions *fermenting cotton seed meal does not entirely remove its injurious effects* when fed to hogs.

4. The results of this experiment show that for the first forty-three days of the feeding the mixture containing the cotton seed meal and the corn gave larger and cheaper gains than the straight corn ration, while the second period of forty days the results were reversed. This leads to the suggestion that, to improve a corn ration, it would be advisable to add cotton seed meal to it for about forty days, preferably, for other reasons also, during the last forty days of the feeding instead of the first.

5. The hogs that received cotton seed meal as part of their ration in this trial showed less fat and more lean meat in the carcass.

6. The carcasses of the hogs that received cotton seed meal, contrary to the previously expressed opinion of the packers, were firmer and therefore more acceptable to them than those of the corn-fed hogs.

BULLETIN No. 79. OCTOBER, 1905.

BUREAU OF PLANT INDUSTRY OF THE U. S. DEPARTMENT OF AGRICULTURE, AND THE AGRICULTURAL SECTION, TEXAS EXPERIMENT STATION.

BREEDING AN EARLY, RAPID FRUITING, AND PRODUCTIVE COTTON.

R. L. BENNETT, In Charge Cotton Breeding.

This bulletin presents results of two years' work in breeding a cotton that will produce a crop in spite of the boll weevil, and shows how the farmer may, from the native Texas big-boll cotton on his own farm, by careful seed selection produce an early and productive variety of good staple cotton which will mature before the boll weevils have become very numerous.

The experiments showed:

1. That seed from the northern edge of the cotton belt, from Arkan-

sas or Oklahoma, or from the East, did not produce an early ripening kind of cotton.

2. That large-boll cotton was as likely to be early as small-boll cotton; and was better because it produced more cotton and was injured less by storms.

3. That it is easily possible, by careful selection of the seed, to produce an early cotton, and also, by the same means, to increase the proportion of lint to seed.

4. The type of cotton to be chosen for these ends is described as follows:

FOR EARLY FRUITING.

The first fruit limbs must be low—not higher than the fifth joint above the seed leaf joint.

Primary or wood limbs must be low—the first not above the fifth or sixth joint, and not exceeding four in number is desirable.

FOR RAPID FRUITING.

The joints on the main stem, fruit limbs and primary limbs must be short; not to exceed two to three inches is desirable.

Fruit limbs should grow in succession at each joint of the main stem and primary limbs and should be continuous in growth for continuous fruiting.

FOR PRODUCTIVENESS.

The bolls should not be less than one and one-half inches in diameter.

The per cent of lint to seed cotton should not be less than 33⅓.

The rate of growth is very important, and, therefore, the larger the plant, of the type, the greater is its inherent rate of growth, its earliness, rapidity of fruiting, and yield.

Early opening of bolls, or maturity, is not important in escaping weevils. In States further north, it is important in escaping early fall frosts. It is not invariably a measure of the early setting of fruit.

[A third bulletin will be issued, containing an account of the complete series of experiments; amplifying the description given, of the desirable type; and giving the results of other experiments which relate to factors that may aid in the productiveness and improve the quality of the product.]

BULLETIN NO. 80. HORTICULTURAL SECTION. DECEMBER, 1905.

PEACH-GROWING IN TEXAS.

E. J. KYLE, Horticulturist.

This bulletin gives methods of cultivation to insure a uniform production each season. "It is the crop in the off-year that brings the most money." To prevent the frequent failure of this crop, due to too early blossoming, or to scanty growth, the grower is advised to plant fewer trees and to keep them in vigorous condition by frequent and thorough cultivation.

The land should be completely cleared and very deeply plowed. If the land has been impoverished, Irish potatoes or some other quick-maturing crop may precede the orchard, so that cow peas can be planted and plowed under in the fall.

The hexagonal method of setting out is preferred, as it gives 126 trees to the acre, set twenty feet apart, instead of 108, and allows cultivation in six directions. Take a fence as base line, and run rows parallel, every seventeen feet and four inches. Cross these every ten feet, and put a tree at every other crossing; at the odd crossings on the first rows, and at the even crossings on the second and other even rows.

Plant in December; trim the roots, but not too severely, and cut the top so that when set it is about eighteen inches above ground. At least twice during the summer all buds that are not desired should be rubbed off. Three to five branches, from ten to fifteen inches from the ground, may be left. It should be severely pruned till the end of the third year, and moderately pruned each year afterward.

Clean cultivation is recommended; plowing with a turning plow as soon as growth begins in the spring, and harrowing just after. Then a spike-tooth harrow every two weeks may be used till September to keep a "dust mulch" over the roots. In case of rain and consequent growth of weeds, a disc may be used instead of the harrow.

If, however, the grower decides to crop his orchard, an early crop like Irish potatoes may be followed by cow peas, peanuts, or sweet potatoes. Thus the soil is kept stirred and fertilized. Corn and cotton are not recommended as orchard crops. When the trees begin to bear, clean cultivation, after growth begins in the spring, continuing at ten-day intervals, should be practiced.

The fruit should be thinned, to a distance of six or eight inches, by hand.

For the "crown gall," a fungus growth on peach roots, no complete remedy has been found. It is very contagious. A paste made one part of copperas, two of copper sulphate, and three of lime, applied to the roots after pulling the earth back with a hoe, is recommended.

For the borer, cutting the larva out with a knife in the spring and fall is advised. The tree may be painted to about a foot from the ground with seven gallons of Beaumont oil to one pint of carbolic acid. Clean cultivation is the best preventive of borers.

BULLETIN NO. 81. BOTANICAL SECTION. DECEMBER, 1905.

ALFALFA SEED TESTING.

O. M. BALL, Botanist.

This bulletin gives results of tests of thirty-two samples of *Alfalfa Seed*, made, in 1905, for purity and vitality.

Out of these, thirty different kinds of weed-seeds were taken; only four samples were free from weed-seeds. Many of the weeds were harmless, but some were noxious, like hemlock and Russian thistle. Draw-

ings showing appearance of alfalfa seed and of the seeds of other plants commonly found in alfalfa seed are given.

The vitality of the thirty-two samples was found to vary between 49.5 and 96.5. It is shown that seed at 16 cents, which germinates well, is cheaper than seed at 11 cents which germinates badly.

Seed will be tested for purity and vitality free of charge at the College Experiment Station if an ounce or more is sent with name of sender, price per pound, and date and place of growth. Directions are given for testing vitality at home, by means of the simple apparatus described in Bulletin No. 81.

BULLETIN NO. 82. CHEMICAL SECTION. JANUARY, 1906.

MAINTAINING THE FERTILITY OF RICE SOILS—A CHEMICAL STUDY.

G. S. FRAPS, Acting Chemist.

This bulletin is a study of the chemical composition and properties of some rice soils, rice irrigation waters, and the rice plant, with a view to find ways of maintaining the fertility of rice soils. It determined the following points:

1. *Food Requirements of Rice.*—An average Texas crop consumes 16 pounds phosphoric acid, 42 pounds nitrogen, and 53 pounds potash per acre. Rice straw carries with it, when removed, 3 pounds phosphoric acid, 14 pounds nitrogen, 31 pounds potash per acre. In burning rice stubble, nearly 5 pounds nitrogen is lost; in burning rice straw, 14 pounds nitrogen, per acre. The ashes contain 3 pounds phosphoric acid and 37 pounds potash per acre.

An average crop of rice consumes more nitrogen than one of cotton, oats, or corn. If the *rice straw* is taken away, four times as much potash is removed as by a crop of cotton, oats, or corn. If the ashes are scattered over the field after burning rice straw, only about half as much potash is withdrawn as by crops of oats, corn, or cotton.

2. *Irrigation Waters.*—Deducting losses from seepage and off-flow, the irrigation water adds about 3.1 pounds phosphoric acid and 20 pounds potash, but removes some nitrogen; as much as 20 pounds per acre in winter may seep through and be lost.

3. *Total Loss.*—If the straw is removed and the stubble burned, the total loss per acre may be estimated at 12 pounds phosphoric acid, 60 pounds nitrogen, 22 pounds potash. This may be reduced to 9 pounds phosphoric acid, 57 pounds nitrogen, if the stubble is plowed under and the straw-ashes returned; and there will be *gain* of 15 pounds of potash.

4. *Composition of Certain Rice Soils.*—The soil samples from Jefferson, Orange, De Witt, Victoria and the black lands of Brazoria contain small quantities of phosphoric acid. Those from Harris county, the Rio Grande valley and the red bottom lands of Brazoria contain an abundance of phosphoric acid. The Orange county soil is low in potash and in lime. The Rio Grande Valley is rich in potash.

The Brownsville and De Witt soils have an unfavorable ratio of lime and magnesia. A Japanese investigator seems to have shown that lime

and magnesia should be present in soil in equal quantities. The Brazos river carries enough carbonate of lime to neutralize the acidity of Brazoria soil in a year, but the Neches river, and Cow Bayou, would require eight and sixteen years respectively. Rice is probably not as much affected by acidity as other crops.

Tests showed that the amount of phosphoric acid and potash available for use in the Orange and Brazoria soils was not enough.

5. *Treatment of Soils.*—Burning the straw is wasteful; but, if burned, the ashes should be scattered on the field. The stubble should be plowed under. The nitrogen content of the soil should be kept up by growing leguminous crops—cow peas, vetch, etc. These may be grown in rotation with rice during a season, thus destroying water-weeds and "red rice." Or a winter growing plant may be planted in the fall and plowed under in the spring.

One hundred pounds per acre of acid phosphate may be used to add phosphoric acid to the Orange, Jefferson, Brazoria, and Victoria soils.

Potash fertilizers may improve the Orange soil.

Lime, tried on a small scale at first, and always in small amounts, may be of advantage east of Houston.

Magnesia sulphate or magnesite may help the De Witt and Brownsville soils.

BULLETIN No. 83. BOTANICAL SECTION. JANUARY, 1906.

NITRO-CULTURE.

O. M. BALL, Mycologist.

This bulletin records results of experiments in 1904 and 1905 to test the claims that:

1. The presence of nitrogen-fixing bacteria on the roots of legumes is requisite for the production of good crops, especially where the soil is lacking in nitrates.

2. The various legumes are affected by a species of bacterium which has so adapted itself to its host plant that each legume has its own variety of that species.

3. If soils are naturally deficient in nitrogen-fixing bacteria, these may be introduced by inoculation of the soil, or of the seed to be sown.

4. In order to obtain the best results, it is necessary to inoculate a given legume with its own variety of bacterium.

5. By cultivation of these bacteria under suitable conditions,—for example, in solutions of food stuff in which no nitrogen is present—their "virility" or greed for nitrogen may be greatly increased.

6. After having been inoculated with these greedy bacteria, the crop of a given legume will be vastly enlarged, because the bacteria will fix a quantity of nitrates corresponding to their enhanced appetites, thus affording a greatly enlarged food supply for the legume.

The experiments were by means of pot-cultures, and were planned to determine:

1. (a) Whether nodules will appear on the roots of alfalfa when it is grown in the soil which had grown burr clover but no alfalfa before.

(b) Whether alfalfa in sterilized soil could be inoculated with germs from burr-clover nodules.

2. Whether "nitro-culture" produced any good results.

The results proved:

1. (a) That alfalfa will grow nodules when grown in soil producing burr clover, or (b) after being watered with water containing such soil, or in which nodules from burr clover had been.

2. That inoculation with "nitro-culture" produced fewer tubercles than those growing on the plant in natural conditions; and that these few seemed to do the plant no good. A parallel series of experiments with burr clover produced similar results.

The conclusions drawn from these and similar experiments at other stations are, with reference to the claims tested:

1. This is to some extent true, though in a soil where nitrates are abundant the legumes seem to get along just as well without nodules.

2. It is certain that the bacteria growing on alfalfa will also grow on burr clover, and vice versa. Alfalfa and mellilotus bacteria seem also to be the same, judging by results gotten in Illinois and Oklahoma.

3. It would be hard to find a soil entirely free from these bacteria, unless artificially sterilized.

4. This is shown to be untrue by the experiments described.

5. Not proven.

6. The experiments disproved this.

BULLETIN No. 84. HORTICULTURAL SECTION. JANUARY, 1906.

TOMATO FERTILIZERS AT TROUPE.

W. S. HOTCHKISS, Superintendent Troupe Station.
EDWARD C. GREEN, Assistant Horticulturist.

An account of the fertilizer experiments and variety tests with *Tomatoes* at the Troupe Station during 1904 and 1905.

The fertilizer ingredients used included cotton seed meal, muriate of potash, acid phosphate, wood ashes, cow manure, nitrate of soda, lime and tankage, either alone or in combinations.

Beauty, Acme, Earliana were the varieties tested. Acme was used as the standard. The soil is a fine gray sand, from eight to eighteen inches deep, underlaid with a red clay.

The conclusions were:

1. Acid phosphate produced more constant beneficial results than any other single fertilizer.

2. On new land an application of 300 pounds of acid phosphate per acre gave best results.

3. On old land, which had never been fertilized, an application of 300 pounds of acid phosphate and 200 pounds of cotton seed meal per acre gave the most satisfactory returns.

(Note.—The literature of agriculture, even down to the present time, almost universally recommends very large percentages of potash in fertilizers for truck crops. The writer has never seen any record of any

experiments to justify the high percentages of potash commonly recommended and actually put into fertilizers and used for truck crops. These experiments and others made in Louisiana, Mississippi and other States indicate very clearly that potash is not needed for most trucking crops and on most trucking soils. Where needed at all, there is no proof that the writer has seen that would support the belief that it is needed in larger proportionate amount than for cotton.

4. Potash, either alone or in combination, was at least unsatisfactory.
5. Lime was injurious.
6. Wood ashes were valueless.
7. The Earliana was earlier than Acme or Beauty, and commends itself as a profitable variety for early express shipments. It is not recommended for the general crop.

BULLETIN No. 85. CHEMICAL SECTION. JUNE, 1906.

COMMERCIAL FERTILIZERS IN 1905-1906.

G. S. FRAPS, Acting Chemist.

This bulletin gives the test of the State fertilizer law, together with information regarding the taking of samples; form of tag, terms used reporting analyses; valuation of fertilizers; fertilizers for cotton, corn, rice, and potatoes; home mixtures, fertilizer recipes, and bat guano.

The valuation put on the ingredients of fertilizers is for nitrogen 16 cents a pound, available phosphoric acid 6 cents, and potash 5 cents. Cotton seed meal, nitrate of soda, tankage and bat guano are our best sources of nitrogen. Texas cotton seed meal contains 7 to 8 per cent of nitrogen, 3 per cent of phosphoric acid, and 1½ per cent of potash. The average selling price of mixed fertilizers on the Texas market during the season 1905-1906 was $26.15, or $5.35 higher than the valuations for nitrogen, phosphoric acid and potash used in this bulletin. Moderate amounts of fertilizers are recommended, because, while large amounts may give more increase in crops, the increase will not be proportionate to the increase in cost of fertilizer.

Two hundred pounds of cotton seed meal per acre are recommended for certain old, worn, sandy land. Two hundred pounds of acid phosphate are suited to certain bottom and black prairie lands. Two hundred pounds acid phosphate per acre have been known to increase the yield of rice two to three sacks. Mixed fertilizers containing about 2 per cent nitrogen, 8 per cent available phosphoric acid and 2 per cent potash are commonly used for cotton, and even on uplands other than black prairie with good effect.

Some Texas potato soils need potash and some do not. These soils need further study. Where no potash is needed, equal parts cotton seed meal and acid phosphate are recommended.

BULLETIN NO. 86. ANIMAL HUSBANDRY SECTION. SEPTEMBER, 1906.

CATTLE FEEDING EXPERIMENTS.

JOHN A. CRAIG, Director.
F. R. MARSHALL, Professor of Animal Husbandry.

This bulletin contains results of experiments carried on in 1905 on:

I. Molasses for fattening cattle.
II. Rough rice as a steer feed.
III. Profit from different systems of feeding cattle.

It contains also a discussion of cane molasses, of molasses as a feed for horses and swine, and of different methods of feeding molasses; and accounts of early experiments tried with it at this Station. (See Bulletin No. 76 and Bulletin No. 10.)

Cane molasses is shown to be so different in its composition from beet molasses that the German experiments with the latter are of no use to the feeder of "Black strap molasses," which may be fed quite freely without giving diarrhea to cattle or horses, if the rest of the ration contains the proper elements.

The experiments in detail were:

I. *Feeding Molasses to Two-Year-Old Steers Being Finished for Market.*—Eighteen steers in three equal lots being fed for eighty days on cotton seed meal, corn chops, and molasses, with cotton seed hulls as roughage. The cattle that were fed the largest ration of molasses made greatest and cheapest gains; and fifteen head selected from these cattle won first prize at the Fort Worth Fat Stock Show, March, 1905, were reserve champion carload, and sold for $5.50 a hundred.

II. *Feeding Different Amounts of Molasses to Yearling Steers.*—Eighteen steers in three equal lots fed for 100 days, on cotton seed meal, hulls, and varying amounts of molasses, with the addition of corn chops and alfalfa hay during the latter part of the test. The cattle receiving the most molasses made the greatest gains.

III. *Feeding Molasses from Trough to Cattle on Grass.*—In this experiment the same cattle fed in test II were used, dividing them into two lots, of which one was allowed to eat as much molasses as they would—a gallon a day for each steer—while the others had none for sixty days. When sold in Chicago, December, 1905, at $6.00 a hundred, the molasses-fed lot averaged 31 pounds more.

IV. *Feeding Rough Rice to Steers.*—Fifteen yearling steers in three lots were fed for seventy days on cotton seed meal and cotton seed hulls; on cotton seed meal, rough rice, and hulls; and on rough rice and hulls. It was found desirable to grind the rice. It required 2.3 pounds rice to equal 1 pound cotton seed meal. It was believed that with the alfalfa, cow pea, or peanut hay, better results would have been obtained.

Conclusions:

I. In our experiments the addition of molasses to a fattening ration has always produced an increased gain.

II. Addition of molasses to a ration of cotton seed meal and hulls lowered the cost of gains.

III. When molasses was added to a balanced ration it gave larger

gains and improved the appearance of the cattle but did not lower the cost of gain.

IV. There was no undesirable result from feeding yearling steers one gallon of molasses each per day, and there is good reason to believe that larger amounts might be used.

V. In experiment II the cheapest gains in each month were made by the lot receiving most nearly a balanced ration.

VI. Molasses returned from 3 to 30 cents per gallon. The lower value was obtained when molasses was added to a ration already balanced and when, in the early part of the feeding period, an unbalanced ration was fed the higher value was obtained.

VII. When cotton seed hulls were used as roughage, a ton of rough rice was equal to one-half a ton of cotton seed meal.

Yearling steers proved much more profitable to feed than older cattle. In fact, they made a profit where the older cattle were fed at a financial loss.

BULLETIN NO. 87. ENTOMOLOGICAL SECTION. NOVEMBER, 1906.

SAN JOSÉ SCALE.

ALBERT F. CONRADI, Entomologist.

This bulletin discusses one of the most serious problems of the fruit grower. The San José scale is known to occur in a number of places in Texas east of the 98th meridian, and there has been one case farther west. It is spreading rapidly. An account is given of its history from its introduction into California from China, a description of the pest, its life history, a list of its food plants; and an account of remedies used against it follows, with a resume of work done in combating it in Texas.

DESCRIPTION OF THE SCALE.

The full grown scale is circular in shape, of an ashy-gray color, with a small protuberance called nipple at the center. Around the nipple are two more concentric rings, the general shape being conical except when crowded, when all kinds of shapes may be found. When the scale is raised with a knife blade, the small orange-yellow body of the insect may be seen below it.

The male scale is more elongated, smaller, and frequently darker. The nipple is not at the center, but is nearer the anterior end of the scale. When young, the scale of both sexes is nearly jet black and often very difficult to see with the naked eye.

LIFE HISTORY.

The females never leave their scales; under them they live and die. The male, however, molts in early spring and leaves the scales as a minute active insect with two wings. It dies after mating. The female gives birth to living young. The newly-born scales are very minute and oval in shape, but their bright orange-yellow color makes them conspicuous on the bark. After wandering about from twelve hours to a

day, they settle down to feed. The insect then inserts its beak into the tissues and sucks the sap. Here it remains during the feeding period. The male becomes full grown in about twenty-five days, but the female requires a little longer time. In from ten to eighteen days the young of the next generation appear. During the season of activity, each female may give birth to from three hundred to four hundred young. The over-wintering females produce about one hundred young, which become full grown in about thirty days. As from five to six broods occur in a single season, calculation will show that one pair of insects can theoretically give rise to over 3,000,000,000 young in a single season.

HOW TO DETECT SCALE.

When a shipment of nursery stock has been received, even fumigation should not be depended on. The orchardist should keep close watch over such shipments as they arrive. The plants should be carefully gone over with the reading glass, paying special attention to the crotches and anything on the bark that may suggest an appearance like the description given above should be removed without touching it directly, packed securely in a regulation mailing case and sent to the office of the State Entomologist for identification.

In light infestations the leaves and fruit are but sparsely attacked, but on badly infested trees the insects settle anywhere on the plants where the tissues are exposed. They become so crowded as to overlap, creating an ashy-gray scurvy incrustation on the bark.

They may occur on both sides of the leaf, causing purplish, grayish, or reddish discolorations on the young wood of peach. The bark turns red and when cut the coloration may be seen to extend to the wood. Individual scales cause reddish spots with a diameter several times that of the scale. The winter is passed in all stages of growth from half-grown to mature insects. Many of the adult females die; these dead and dried-up scales are always in evidence. When a knife handle or some other hard object, or thumb nail is rubbed over the surface of a badly infested twig, the insects are crushed under the scales and a yellowish fluid appears.

HOW THE SCALE SPREADS.

The scale was introduced into the United States from a few nurseries spread over the country. The fact that it has thus spread shows the extreme importance of using the most scrupulous precautions in handling trees to keep it from being disseminated.

The young can crawl the first day after birth. As the broods are not defined, these crawling specimens are in evidence on all infested trees during the entire growing season. They may be carried by birds, bees and other insects. They may be blown by the wind, and frequently, while spraying an infested orchard, careless operators carry them on their hands and clothing. After they have become stationary, they may be carried by the plowman when cultivating the orchard. Correspondents often wrap infested twigs carelessly when transmitting them through the mails for identification.

The results of all experiments tried by the Department in Texas show that the best remedy yet applied is the

LIME SULPHUR WASH.

This is today the standard spray used in commercial orchards. It is the cheapest, and superior to all others in point of safety, as it does not injure the trees. It is not only effective in killing the scale, but it is also valuable in controlling fungi, notably the peach-leaf curl. In view of the efficiency of the spray as compared with others in Texas during the past year, no commercial fruit grower is justified in substituting other sprays simply because the Lime Sulphur Wash is more difficult to prepare and has a corrosive effect on the apparatus.

In the original California wash, salt was used. It also formed a part of the mixture in the East until recently it was found that the salt was of little benefit, if any, except that in rainy seasons it adheres better. The washes in this State were as effective without any salt as those containing it.

FUMIGATION.

Upon receipt of nursery stock, unless the grower has undoubted evidence that it was fumigated according to law, it is always best to fumigate immediately. The gas is made as follows: Potassium cyanide (98 per cent) 1 ounce, commercial sulphuric acid, 1 ounce, water 3 ounces for every one hundred cubic feet of space. The fumigation should be continued for forty-five minutes. The room or box should be gas tight and provided with ventilators and doors so that gas can be removed rapidly at the end of the fumigation period. It must never be forgotten that the gas is deadly poisonous, and that under no circumstances must the least amount be inhaled.

BULLETIN NO. 88. HORTICULTURAL SECTION. JUNE, 1906.

LENGTH OF LIFE OF VINES OF VARIOUS SPECIES AND VARIETIES OF GRAPES; PROFITABLENESS; AND BY WHAT DISEASES SERIOUSLY AFFECTED.

T. V. MUNSON, D. Sc., Denison, Texas.

This bulletin, prepared at the suggestion of Professor E. J. Kyle. gives the results of Mr. Munson's nineteen years' experimenting with grapes on light sandy land, with red subsoil, near Denison.

His conclusions are:

"All species and varieties grow well in sandy soils where carbonate of lime does not exceed 25 per cent of the soil. Some varieties can not well endure more than 25 or 30 per cent of lime, while others will flourish in 50 and even 60 per cent of lime.

"The species naturally found in limy soils are: Berlandieri, Blancoii, Bourquiniana, Candicans, Champini, Cinerea, Cordifolia, Coriacea, Doaniana, Monticola, Rubra, Rupestris, Vinifera. And varieties of such species generally succeed well in limy soils.

"Varieties much subject to rot and mildew should not be planted in regions such as the forest area of East Texas, unless thoroughly treated

with spray of sulphate, or carbonate of copper solution, but they may do well in Central or Western Texas, if set in proper soil, without spraying.

"No grape will succeed in boggy or seepy soil, and a high location surrounded by lower grounds, is preferable to the reverse location, on account of late frosts, and fungus diseases prevailing much more in low than in high localities."

Two tables are given: No. 1 shows relative longevity of vines of various species of native and other grapes in sandy soil. No. 2 shows longevity, profitableness, and pedigree of varieties of cultivated grapes.

The most valuable wild grape for hybridizing in sandy soil, he found to be the Post Oak Grape—*Vitis Lincecumii.*

The most profitable varieties were:

"America" (black)—Lincecumii×Rupestris.
"Bailey" (black)—Lincecumii×Triumph.
"Fern Munson" (black)—Lincecumii×Catawba.
"Gold Coin" (yellow)—Norton Virginia×Martha.
"Herbmont" (red-purple)—Bourquiniana.
"Jaeger No. 43" (black)—Lincecumii.
"Laussel" (black)—Lincecumii×Gold Coin.
"Muench" (black)—Lincecumii×Herbmont.
"Neva" (black)—Lincecumii×Herbmont.
"Niagara" (white)—Labrusca×Vinifera.
"Presly" (red)—Elvira×Champion.
"R. W. Munson" (black)—Lincecumii×Triumph.
"Scuppernong" (yellow)—Rotundifolia
"Triumph" (white)—Concord×Muscat.

BULLETIN No. 89. ENTOMOLOGICAL DEPARTMENT. DECEMBER, 1906.

INSECTS OF THE GARDEN.

ALBERT F. CONRADI, Entomologist.

This bulletin treats of thirty different species of insects injurious to garden crops. It gives the distribution, seasonal occurrence, life history, habits, host plants, and remedial and preventive measures, with forty-four figures, including two full-page illustrations.

Carbon bisulphide, "high life," is recommended for the different bean and pea weevils. It is used at the rate of 1 pound to 100 bushels for forty-eight hours. On a small scale a coal oil barrel may be employed. The barrel may be covered with a heavy canvas which was previously saturated in linseed oil or painted. Three ounces of CS_2 is sufficient for each barrel, which contains approximately five bushels.

Carbon bisulphide is also recommended against the cabbage maggot. It is employed by burying in the soils, near the base of the plant, a small wad of the cotton saturated with carbon bisulphide. The liquid should never touch any portion of the plant. Carbolic acid emulsion, when properly used, is also effective.

Bordeaux mixture is used successfully against the striped beetle and flea beetles. The plants should be kept thoroughly covered. Bordeaux

is also recommended against the twelve-spotted beetle and is more effective when poison is added. Planting an excessive amount of seed is recommended.

Paris green ordinarily used at the rate of 1 pound to 150 gallons of water is recommended for cabbage worms, grasshoppers, cut worms, June bugs and potato beetles. In case of the striped beetle it is dusted, either undiluted or diluted with a cheap diluent like lime, land plaster, road dust, etc., at the rate of one poison to seventy-five of diluent by weight. Pyrethrum powder may be employed against the cabbage worms where poisons are undesirable. It should be dusted on the plants heavily.

Harlequin bugs are controlled by timely hand-picking; also by use of the plumber's torch with which they are scorched off the plants.

Squash bugs are destroyed by placing boards between the rows, and every morning the insects that have collected under them are destroyed.

Cultural methods are depended upon for destroying cut worms, grasshoppers, corn ear worms, June bugs and white grubs. Poisoned bran mash and poisoned grass distributed over infested territory is effective against cut worms.

Great stress is laid upon the destruction of the remains of crops after harvest. This is of prime importance against the potato stalk weevil.

The onion maggot may appear in Texas at any time. Frequent changes of seed bud, keeping the bulbs well covered with soil and liberal applications of carbolic acid emulsions are the principal measures recommended to be used against it.

The maggots frequently appearing in onions above the ground are seed-corn maggots. Onion sets should be immersed in carbolic acid emulsion before they are transplanted. Infested plants should be dug up (not pulled up) and thrown into a pail containing either carbolic emulsion, crude oil or kerosene.

There are three lines of operations recommended against plant lice, viz., fumigation, sprays and the propagation and retention of parasites and predaceous insects. This last may be brought about by the use of trap plants like rape. Artificial hibernation experiments for the purpose of determining the best methods for retaining these natural enemies are in progress, but not yet completed. This method is intended to control the insects on large plantations where other recommendations are inapplicable.

Fumigation with gases is more effective than sprays. While carbon bisulphide can be effectively used in the hands of intelligent operators, it is not recommended where cheap labor is employed. Nicotine preparations are preferred. For plant covers a cheap muslin that has been saturated in linseed oil and dried in a mild sunlight is recommended. A covering less porous prevents the circulation of the fumes and causes an accumulation of heat that is injurious. The fumigation tent consists of a rectangular folding frame 4x6 feet, with the canvas tacked over it, leaving the sides unfastened in order to make the tent adjustable for different plants.

A spray of whale oil soap, 1 pound to six gallons of water, is used against plant lice, other than the melon louse, in emergencies; while against the onion thrips the same is used at the rate of 1 to 2 pounds.

BULLETIN NO. 90. CHEMICAL SECTION. SEPTEMBER, 1906.

THE FEED CONTROL IN 1905-1906.

J. W. CARSON, Vice-Director.
G. S. FRAPS, Chemist.

The Legislature of 1905 passed a law governing the sale of concentrated feeding stuffs in Texas. This bulletin reports the work done under this law for the season of 1905-1906.

It contains a copy of the Feeding Stuff Law; directions for registration under it; a definition of such terms as "protein," "fat," "crude fiber," and an explanation of the required guarantees; of what is meant by "adulteration" and "purity" under the law as enacted (it has since been amended—see Bulletin No. 95); a description of various feeding stuffs and their average composition; and a discussion of feed control analyses, showing that for the most part the feeds on the Texas market are of excellent quality.

A list of the registered feeds, the name and manufacturer of each, with the guarantee of protein and fat, and the analysis, follows.

BULLETIN NO. 91. CHEMICAL SECTION. OCTOBER, 1906.

FOOD ADULTERATION IN TEXAS.

G. S. FRAPS, PH. D., Chemist.

This bulletin contains analyses of 211 samples of sausage, dried fruit, condiments, syrups, canned goods, lard, etc., of which 101 were found to be "illegal" under the Texas law; a definition of "adulteration" and "misbranding"; the Texas Food Law, and the Federal Food Law; an account of chemical preservatives and other adulterants; and conclusions as follows:

That there is a good deal of adulteration in certain classes of foods; some harmless, but all calculated to impose on the purchaser an inferior article; that the Federal law will prevent adulteration of goods shipped in from other States; but not of sausage, dried fruit, molasses, soda water, lard and other products made in Texas. A State law, with an appropriation to enforce it, is recommended.

BULLETIN NO. 92. DECEMBER, 1906.

A TEST OF THE PRODUCING POWER OF SOME TEXAS SEED CORN.

R. L. BENNETT, In Charge of Cotton Investigation and Breeding.

This describes a test made in 1906 of seed corn obtained from some two dozen growers, in different parts of the State, to determine the relative productiveness of individual ears. It is known that growers who shell their corn into a bin, and plant seed drawn at random, can expect

only an *average yield* under the best weather and soil conditions, since the productiveness of different ears varies greatly. Some ears produce a progeny which will almost uniformly grow a good ear to each stalk, while others will have many barren stalks, and a low yield. If, therefore, a maximum yield is desired, the farmer should plant seeds from each ear in a different row, and the next year select seed from the row producing the largest yield.

In the test described, as carried on at the Station by Mr. W. A. Price, this was done. Of 108 ears planted, one produced *twelve bushels* more than the average of all the yields. This twelve bushels represents approximately the loss of farmers who do not select their seed; but by careful selection, even this maximum may be increased.

The conclusions drawn are:

1. That a very large part of the corn grown in Texas does not yield what would be produced if the seed came from an ear that was highly productive.

2. That Texas farmers need not import seed for increased yields; they need only select their own best ears. Seed from the same locality is apt to be more productive than imported seed, if it is equally well chosen.

3. That the farmer should select the best ears on the stalks, plant each ear to a row; compare yields of each row, and select the best producer for the next year's seed. The best type depends on what use is to be made of the ears and stalks. For general use on the farm it is desirable to have the stalk not extra tall, but with a large diameter and fairly short joints. This type of stalk will have vigor and resistance to the winds and the weather. The ear should be at a height comfortable to husk and not so high as to overbalance the stalk.

The ear should have a medium diameter of cob, of good length and filled with grains, which should be of good length, not too tapering and with as little space as possible between the rows of grain.

Select seed ears on the stalk and store in a dry place.

BULLETIN No. 93. 1907.

THE SWEET POTATO ROOT-BORER.

A. F. CONRADI.

This is a 16-page bulletin with four figures and one folding map of Texas, showing the present distribution of the insect as well as the territory over which it will become most destructive.

Since the middle of the last century Texas has been one of the most important States growing sweet potatoes, but the industry is seriously threatened by the *Sweet Potato Root-Borer*, also known as the *Sweet Potato Weevil.*

The insect being of a tropical original is most destructive in South Texas, less so in Central Texas, while sporadic outbreaks are possible during the growing season in any section of North Texas.

The insect has been on record since 1798. It was reported on sweet potato as early as 1857. It was probably introduced from the West

Indies. It was first reported in the United States from New Orleans in 1875, the first report from Texas being 1890. It is present in South Texas west as far as Comal and Cameron counties, and north as far as Milam county.

Early varieties as well as potatoes planted early are more seriously injured than late varieties and those planted late.

Shallow planted tubers are more infested than those planted deep.

The weevils reach the tubers chiefly by burrowing along the vines.

The full grown insect is an elongated glossy snout beetle with a black head, middle part of body and legs red, hind part dark steel blue, and about one-fourth inch long. It lays its eggs on tubers and vines. The larva, which is a white footless grub about one-fifth inch long, tunnels in the tuber. It pupates at the end of its tunnel. The entire life cycle is completed in the potato in about thirty-five days.

The beetles can subsist on other plants besides sweet potatoes, principally on those plants that are closely related to the sweet potato vines, such as morning glory plants.

The insect has never been observed in flight in this country. It has well-developed wings which makes it appear that migration on the wing is possible.

Rotation of sweet potato fields, combined with other methods, is of value not only from an insect standpoint but from an agricultural point of view as well. Plant as remote from last field as possible.

We have not found any variety of sweet potato that is immune.

Raw tubers should never be thrown out nor fed to stock without having been boiled.

Harrow the ground after the crop has been gathered. In spring by means of volunteer plants the over-wintering weevils may be destroyed on them.

As a rule stock will eat the tubers with the exception of those badly riddled and dried up. Remnants left by stock should always be gathered and destroyed by burning.

Burying infested tubers is discouraged.

A totally infested crop should be gathered clean, and vines and all thrown into a hot fire and burned.

Tuber traps may be used to advantage if carefully manipulated.

Gathering volunteer slips from tubers left in the ground from the last crop as well as selecting home-grown seed from infested farms is dangerous.

Adults can be easily killed when exposed to the fumes of carbon bisulphide (high life) at the rate of 1 pound to 1000 cubic feet of space for twenty-four hours.

To kill the stages in the tubers carbon bisulphide should be used at the rate of 3 pounds to 100 bushels or 1000 cubic feet of space for thirty hours. The bin should be tightly closed.

All seed should be imported from non-infected sections, carefully packed to avoid danger of infestation en route.

Tie vines, such as morning glories, should be kept down by grazing or otherwise, as much as possible. When this is impossible they might be poisoned in and about a potato field.

Farmers should co-operate in controlling the pest.

BULLETIN NO. 94. HORTICULTURAL SECTION. MARCH, 1907.

HORTICULTURAL SURVEY OF THE GULF COAST.

EDWARD C. GREEN, Assistant Horticulturist.

This is an account of visits to seven towns in South Texas, describing the new truck industry in the region recently opened up by new railroads.

The newcomer is advised to lay aside all preconceived ideas as to crops and methods, and to follow the local custom. He is informed, too, that it is not wise to attempt special truck crops on the new land, but rather to plant cotton and corn or sorghum the first season, and in this manner subdue the wild land by plenty of culture with team tools. Land from the brush can seldom be prepared for truck crops the first season, and disappointment is likely to result from the attempt. On the other hand, cotton will flourish on new soil and produce returns which, labor considered, are fairly proportionate to those obtained from truck. Corn with favorable rains or timely irrigation will make two crops a year, while the nature of the plant allows a system of culture which is most beneficial to the new land.

As to the crops for the various localities visited, the successful truckers list them, in order of profitableness and certainty, about as follows:

Corpus Christi.—First, cabbage; second, cucumbers; third, onions; fourth, beets.

Kingsville.—First, carrots; second, beets; third, onions.

Sarita.—First, Irish potatoes; second, watermelons; third, cucumbers.

Raymondsville.—First, watermelons; second, onions; third, Irish potatoes; fourth, cucumbers.

Harlingen.—First, watermelons; second, onions.

Brownsville.—First, cabbage; second, onions; third, Irish potatoes; fourth, cucumbers.

Santa Maria.—First, onions; second, cucumbers; third, beans; fourth, cabbage.

Detailed accounts follow, of conditions in each of these towns; followed by brief suggestions on insects and diseases attacking the crop. The tomato worm, found to attack the Irish potato at Sarita, was destroyed with a Paris green spray. The cantaloupe is attacked by the melon louse; no other remedy but the fumigation described in Bulletin No. 89, has yet been found.

The potato scab and black rot of cauliflower are to be stamped out by the use of corrosive sublimate—four ounces to thirty gallons of soft water. Seed potatoes should be immersed in this for one and one-half hours; cabbage and cauliflower seed for fifteen minutes.

Uniform methods of assorting, packing and marketing vegetables are recommended.

METEOROLOGICAL REPORT.

Below is a summary of the data concerning the weather at College Station more or less complete for fifteen whole years. It is regretted that no records are available for the years 1899, 1900 and 1901.

For the fifteen years available the average rainfall was 37.50 inches.

MONTHLY PRECIPITATION FOR SEVEN YEARS—1889 TO 1898.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.
January	.....	.....	8.67	3.04	0.50	3.54	2.37	10.96	3.85	.....
February	.....	.....	2.05	1.96	1.24	2.07	1.13	4.38	0.15	.....
March	.....	.....	0.98	2.50	2.17	2.56	1.91	2.32	2.87	.....
April	.....	.....	7.01	2.44	1.41	3.24	1.71	1.46	1.57	.....
May	.....	.....	1.99	3.54	9.10	1.66	12 94	3.20	2.70	.....
June	.....	.....	1.60	3.84	3.50	1.88	5.26	0.10	3.35	.....
July	.....	.....	1.36	4.20	0.45	1.64	1.51	0.48	4.68	.....
August	.....	.....	0.09	2.13	1.85	4.71	2.81	0.60	4.68	.....
September	.....	.....	4.93	2.32	1.75	1.52	1.22	9.59	2.41	.....
October	.....	.....	0.00	2.47	0.17	1.10	3.35	2.00	5.07	.....
November	.....	.....	4.46	4.37	5.59	0.30	4.67	1.30	1.28	.....
December	.....	.....	9.24	11.03	1.73	0.26	2.18	1.87	3.61	.....
Total	50.58	40.44	42.38	43.86	29.46	24.48	41.06	38.26	36.22	41.47

METEOROLOGICAL RECORD FOR 1902.

Months of—	Mean maximum. Degrees.	Mean minimum. Degrees.	Mean temperature for month. Degrees.	Highest temperature and date. Degrees.	Lowest temperature and date. Degrees.	Total precipitation. Inches.	Greatest precipitation in 24 hours. Inches.
January	51	36	40	56 on 3d	24 on 27th	9	.4
February	*	35	.....	.....	25 on 4th	1.1	.3
March	*	46	.....	.....	34 on 4th	1.1	.6
April	*	62	.....	.....	55 on 18th	3.2	1.3
May	*	75	.....	.....	68 on 12th	3.8	2
June	92	80	86	97 on 2d	68 on 22d	1.4	1.3
July	94	73	84	102 on 20th	68 on 25th	9.3	2.83
August	98	77	87	104 on 27th	70 on 25th	.....	.....
September	92	65	75	101 on 2 & 3	51 on 13th	3.78	1
October	84	58	71	95 on 13th	48 on 5th	4.81	2.5
November	72	53	62	83 on 6th	45 on 26th	9.45	3.9
December	63	41	52	78 on 12th	26 on 4th	1.15	.55
Total precipitation for year						39.99	

* Not taken.

METEOROLOGICAL RECORD FOR 1903.

Months of	Mean maximum. Degrees.	Mean minimum. Degrees.	Mean temperature for month. Degrees.	Highest temperature and date. Degrees.	Lowest temperature and date. Degrees.	Total precipitation. Inches.	Greatest precipitation in 24 hours. Inches.
January	59	40	49	82 on 29th	24 on 17th	2.71	1.36
February	58	34	46	80 on 2nd	17 on 17th	5.44	.98
March	69	51	59	78 on 9th	41 on 1st	2.06	1.02
April	73	68	70	88 on 19th	44 on 4th	1.25	1.16
May	81	66	74	94 on 9th	53 on 4th	1.75	.77
June	90	64	77	101 on 26th	53 on 1st	1.81	.78
July	94	70	82	110 on 24th	52 on 16th	6.58	1.83
August	94	72	83	110 on 17th	65 on 11th	1.28	.39
September	91	64	77	102 on 12th	49 on 17th	.37	.27
October	83	57	70	93 on 3d, 7th	42 on 24th	4.74	1.35
November	68	47	57	85 on 15th	27 on 18th	.44	.32
December	65	41	53	75 on 23d	29 on 13th	3.17	2.27
Total precipitation for year						31.60	

METEOROLOGICAL RECORD FOR 1904.

Months of	Mean maximum. Degrees.	Mean minimum. Degrees.	Mean temperature for month. Degrees.	Highest temperature and date. Degrees.	Lowest temperature and date. Degrees.	Total precipitation. Inches.	Greatest precipitation in 24 hours. Inches.
January	63	37	50	77 on 20th	16 on 26th	1.25	1
February	70	47	58	84 on 29th	28 on 11th	1.75	.79
March	78	54	66	91 on 12th	31 on 4th	.41	.27
April	78	55	67	88 on 20th	39 on 10th	3.03	.82
May	88	60	74	97 on 26th	50 on 9th	5.99	2.67
June	*	71			65 on 10th, 11th, 13th	2.51	1.55
July	92	72	82	98 on 12th	65 on 3rd	1.6	.51
August	94	70	82	102 on 26th	66 on 1st	3.61	1.61
September	89	69	79	98 on 9th, 20th	65 on 8th	.75	.42
October	86	59	67	100 on 2nd, 4th	46 on 20th	3.07	1.25
November	72	47	57	88 on 24th	31 on 12th	1.10	.75
December	65	37	51	82 on 2nd, 24th	19 on 16th	3.95	2.5
Total precipitation for year						29.02	

* Not taken.

METEOROLOGICAL RECORD FOR 1905.

Months of	Mean maximum. Degrees.	Mean minimum. Degrees.	Mean temperature for month. Degrees.	Highest temperature and date. Degrees.	Lowest temperature and date. Degrees.	Total precipitation. Inches.	Greatest precipitation in 24 hours Inches.
January	59	37	48	76 on 11th...	20 on 14th, 15th and 26th.	.22	.2
February	53	34	44	78 on 26th....	14 on 14th....	1.67	1
March	69	53	61	87 on 2d.....	39 on 8th.....	3.29	2
April	77	61	69	85 on 26-27th	44 on 16th....	4.31	2
May	81	71	76	95 on 31st....	57 on 1st.....	3.10	1.5
June	90	71	81	98 on 19th....	68 on 3-10-22	15.03	6.7
July	92	72	81	100 on 31st....	64 on 10th....	1.15	.92
August	98	74	81	102 on 1-15th	63 on 29th....	1.61	1.05
September	94	70	82	100 on 12-22d	65 on 23-26th	.965	.52
October	82	59	68	97 on 2d.....	42 on 20th....	4.48	2.15
November	69	49	59	98 on 7th.....	38 on 29th....	1.8	.8
December	56	37	47	72 on 22d.....	31 on 2d-4th	4.49	1.5
Total precipitation for year						42.065	

METEOROLOGICAL RECORD FOR 1906.

Months of	Mean maximum. Degrees.	Mean minimum. Degrees.	Mean temperature for month. Degrees.	Highest temperature and date. Degrees.	Lowest temperature and date. Degrees.	Total precipitation. Inches.	Greatest precipitation in 24 hours. Inches.
January	61	44	52	80 on 20th	23 on 22nd	.95	.48
February	63	44	54	79 on 26th	28 on 5th	1.79	.92
March	69	49	59	85 on 27th	29 on 20th	1.09	.58
April	83	62	72	90 on 23d	53 on 17th	1.24	.40
May	89	67	78	101 on 27th	54 on 10th	2.02	.72
June	94	76	85	101 on 10th, 16th, 18th	62 on 14th	1.89	.82
July	96	75	85	**102 on 2nd, 14th**	68 on 5th	5.5	1.8
August	93	71	82	99 on 2nd	61 on 28th	4.72	1.6
September	90	70	80	99 on 9th, 18th	65 on 28th	2.93	1.08
October	80	54	62	88 on3d	45 on 28th	4.65	3.5
November						1.21	.65
December	69	50	58	81 on 3d	36 on 18th	3.66	2.45
Total precipitation						31.65	

Average precipitation for 15 years, 37.50 inches.

METEOROLOGICAL RECORD FOR 1907.

Months of	Mean maximum. Degrees.	Mean minimum. Degrees.	Mean temperature for month. Degrees.	Highest temperature and date. Degrees.	Lowest temperature and date. Degrees.	Total precipitation. Inches.	Greatest precipitation in 24 hours. Inches.
January	68	53	61	80 on 16-18th	37 on 26th...	1.15	.5
February	65	48	56	77 on 17th...	30 on 4th.....	2 65	1.6
March	74	59	66	78 on 8th.....	41 on 15th...	2.96	1.6
April	67	54	59	82 on 16th...	43 on 23d.....	3.73	1.62
May	68	60	64	86 on 26th...	43 on 1st-4th	6.50	1.72
June	82	70	76	97 on 12th...	60 on 18th...	.4	.4
July	90	72	81	101 on 31st..	68 on 9th.....	2.93	.9
August							
September							
October							
November							
December							
Total precipitation for above months						20.32	

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INDEX.