

University of Arizona  
Agricultural Experiment Station,

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# FOURTEENTH ANNUAL REPORT,

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For the Year Ending June 30, 1903.  
*(With subsequent items.)*

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Consisting of the Reports of the Departments of

Administration,  
Agriculture and Horticulture,  
Animal Husbandry,  
Botany and  
Chemistry.

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Tucson, Arizona, December 30, 1903.

UNIVERSITY OF ARIZONA  
AGRICULTURAL EXPERIMENT STATION

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(Regents of the University.)

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S. M. WOODWARD, A. M., . . . . . Consulting Meteorologist  
E. G. LEE, . . . . . Clerk

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The Experiment Station office and the botanical and chemical laboratories are located in the University main building at Tucson. The range reserve is suitably situated adjacent to and southeast of Tucson. The departments of agriculture and horticulture and of animal husbandry conduct operations on the Experiment Station farm, 8 miles northwest of Phoenix, Arizona. The date-palm orchard is 3 miles south of Tempe, Arizona.

Visitors are cordially invited, and correspondence receives careful attention.

Samples of water, fertilizers, etc., which are of agricultural interest, and which are sent with full information, are analyzed free of charge as time permits.

The Bulletins, Timely Hints, and Reports of this Station will be sent free to all who apply. Kindly notify us of errors or changes in address, and send in the names of your neighbors, especially recent arrivals, who may find our publications useful.

Address,

THE EXPERIMENT STATION,  
Tucson, Arizona.

LETTER OF TRANSMITTAL.

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*To His Excellency, Alexander O. Brodie, Governor of Arizona :*

SIR : In accordance with the Congressional act of March 2, 1887, I submit, herewith, the Fourteenth Annual Report of the Arizona Agricultural Experiment Station, for the fiscal year ending June 30, 1903.

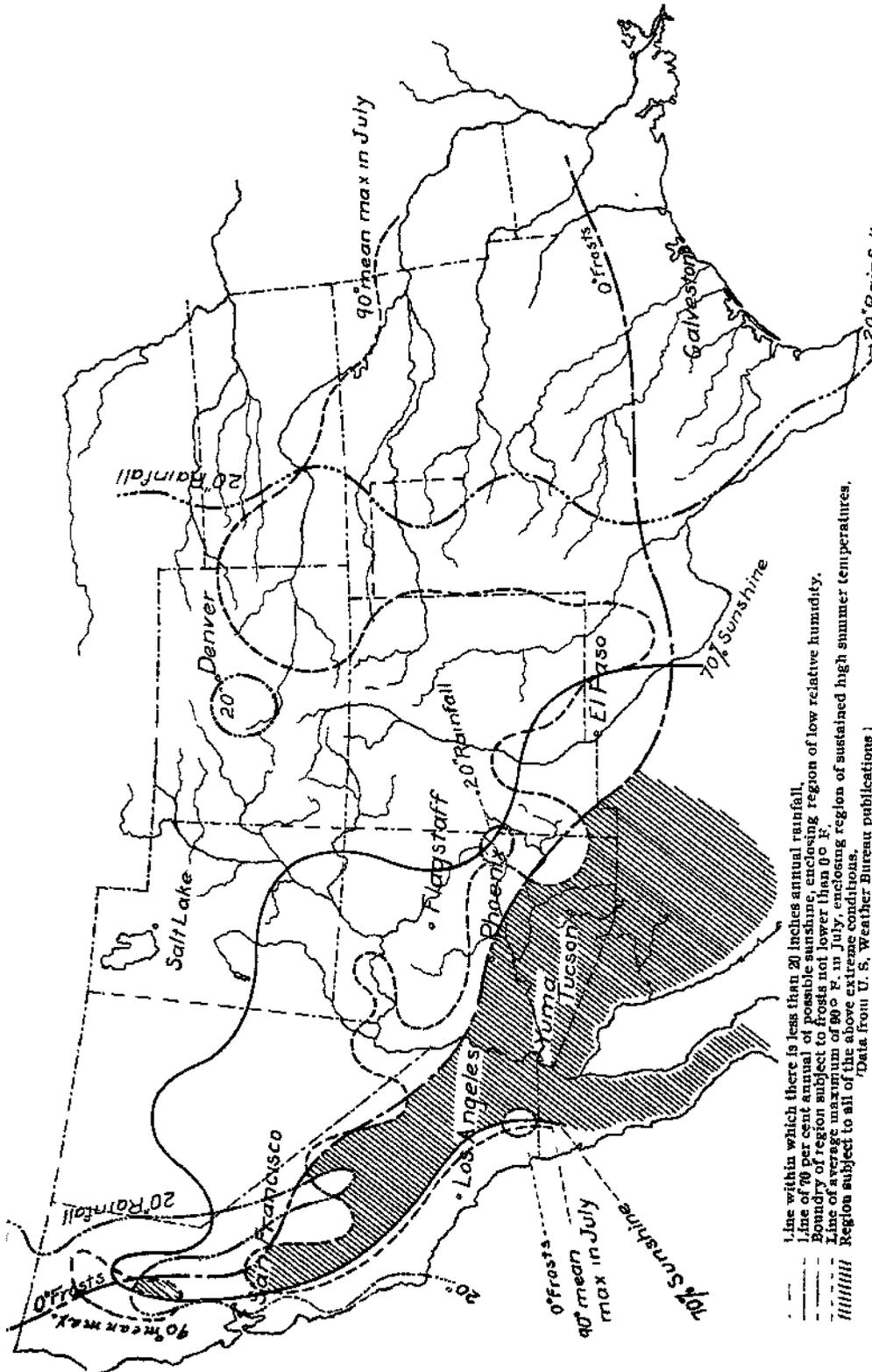
Very respectfully,

R. H. FORBES,

*Director.*

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- Line within which there is less than 20 inches annual rainfall.  
 - Line of 70 per cent annual of possible sunshine, enclosing region of low relative humidity.  
 - Boundary of region subject to frost not lower than 0° F.  
 - Line of average maximum of 90° F. in July, enclosing region of sustained high summer temperatures.  
 - Region subject to all of the above extreme conditions.  
 (Data from U. S. Weather Bureau publications)

# FOURTEENTH ANNUAL REPORT.

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## ADMINISTRATIVE.

It has become more than ever evident during the past year that the work devolving upon the Arizona Station is a separate and peculiar one, being concerned with a field which combines the most unusual conditions of rainfall, humidity, sunshine, and temperature to be found in the United States, with the interesting agricultural methods of an irrigated region. This zone may be roughly defined as the one which combines less than twenty inches, annually, of rainfall, more than seventy per cent of possible sunshine, sharp frosts (down to 0 degrees F.) in winter, long periods of hot weather (average maximum of ninety degrees P. in July) in summer, and very low atmospheric humidity. The rough outlines of this zone are shown in the accompanying frontispiece, which is constructed from the iso-3ine charts for rainfall, sunshine, frosts and maximum summer temperatures published by the Weather Bureau. The shaded portion, combining all extreme conditions, is seen to include southern Arizona, parts of central and southern California and adjacent areas in Mexico. This zone of *combined extreme conditions* corresponds generally with the western part of the Lower Sonoran life zone of Merriam, so called because within its boundaries are found certain characteristic plants and animals. Agriculturally, this region may be described as semi-arid and sub-tropical, combining heat and frost, climatic dryness and occasional rainfall, and an unusual variety of crop plants, with the well regulated soil and moisture conditions possible in an irrigated country.

Under such a combination of conditions it is not remarkable that ordinary, humid-region crop plants modify their behavior, and must be studied anew with reference to these conditions. Time and again the accepted usages of other agricultural regions are found at fault here; and familiar farm practice often requires revision.

Experiment station work in this agricultural zone, therefore, is necessarily of pioneering character, as has been evidenced by the California Station publications for many years past, which, in part, apply to regions of similar though less extreme conditions. Incidentally this calls attention to the fact that for a rapidly settling region of vast extent, the Station staff is too small to accomplish all the work so insistently at hand. Especial credit is due those of our investigators, who, often lacking facilities, working in isolation, and with limited resources, have courageously and ingeniously taken things as they have found them and have given the semi-arid Southwest a real experiment station under circumstances which seemingly forbade. Additions to the staff, however, seem almost imperative. A competent irrigation and pumping engineer and a plant physiologist and pathologist would be powerful factors in the development of this region at this time of agricultural awakening and activity.

The support granted to Station work by the Twenty-second Territorial Legislature was most acceptable evidence of public appreciation. A bond issue of \$11,000.00, which will bring in about \$12,000.00 when approved and sold, was voted for the maintenance and improvement of the date orchard and the Station farm, for publications, and for farmers' institutes throughout the Territory. This action of the Legislature in bonding the Territory for funds with which to carry on experimental work in agriculture, is expressive of intelligent confidence on the part of our people in the future of this commonwealth; and, in itself considered, this appropriation, indicates an intention by our public to foster our most stable and permanent industry,

#### CO-OPERATIVE WORK.

During the year various lines of co-operative work have yielded results fully justifying this plan of operation. The complexity of many agricultural problems, indeed, and the necessity, in frequent instances, for the services of a group of specialists for their proper solution, makes co-operative effort a necessity. If this cannot be secured within the membership of the Station staff,

then, if possible, it should be gained by outside co-operation. The co-operations with the United States Department of Agriculture, continued during the year, have been date palm culture at Tempe, and grazing range investigations near Tucson. With the Geological Survey a partnership has been maintained for the study of the Colorado river.

### RANGE RECLAMATION

This important line of study, which has largely occupied the attention of Station botanists for three years past, has been continued under existing co-operative arrangements with the agronomists of the Department. Pursuant to these agreements 26.38 miles of barbed wire fence have been constructed, enclosing 49.2 square miles of range country north and west of the Santa Rita mountains and 25 miles southeast of Tucson. It is proposed to administer this large and somewhat varied area as to gain knowledge of its grazing capacity, demonstrate feasible methods of improvement, and arrive at the proper principles of range management in a semi-arid region.

One object of this line of study, at a time when much effort is being directed towards the revision of existing land laws, is to ascertain the income or homestead value of different classes of grazing lands. While it is true that 160 acres will usually afford a fair living to the humid-region farmer, and while forty acres (with water) are in most cases ample for the irrigator, a vastly greater area of range country is required to sustain the income producing herd of a small stock grower. What this area is can only be guessed at now; but, ultimately, the *stockman's leasehold or homestead* in a purely grazing country will, logically, be a necessary provision in any adequate and comprehensive system of land laws.

With suitable tenure of sufficient range, incentive will be created for its maintenance and improvement where now the public domain, belonging to all but the care of none, is too often the object of unregulated devastation.



Arechti, have produced fruit. Rhars, which comprised the bulk of the crop, began to ripen August 30th, but matured mostly between October 1st and 10th. This variety is of excellent flavor, but being a very soft date, requires to be dried to about 85 per cent of its fresh weight in order to keep and handle well. This can be done artificially or in dry, quiet weather will take place on the tree.

It is probable that Deglet Noor, supposedly the most valuable of all the imported varieties, will not ripen in the Salt River valley. Several of the young trees have borne large bunches of fruit the past season, but have not properly matured them. Amari proves to be a small, dark date, drier than Rhars but of very ordinary quality.

The two consignments from Egypt received May and October, 1901, remain essentially the same, a few weak trees having slowly perished, the remainder, including nearly all varieties, growing thriftily.

The last importation, that from Arabia and Beluchistan, received in June, 1902, has made the least satisfactory showing of any of the foreign palms. The suckers, which averaged about five pounds in weight, were planted June 13th and 14th, 1902, were most carefully watered, and appeared well at the end of the summer. They were wrapped in sacking to protect them from cold during the winter, but the next spring many of them were weak and subsequently died. On July 4th, but 40 per cent were living and growing, with a further loss of 10 per cent probable. The reason for this result undoubtedly is the small size of the suckers. Small suckers have been observed not only in this but in several other cases to give a very high death rate. It appears unwise, therefore, for importers to cut down freight bills at the expense of necessary size in the offshoots. Thirty pounds, judging from the experiments thus far, is about the weight best suited for importation, combining economy in freight with a high growing percentage.

The following is a summary statement of the present condition of the five importations received through the United States Department of Agriculture at the orchard:

Importation.			Present condition, July 4, 1903.				
Date received.	No. of varieties.	No. of trees.	Varieties living.	Trees living.	Young suckers.	Bloomed, 1903.	Dead trees.
August 1, 1899.....	5	6	.....	.....	.....	.....	6
July 17, 1900.....	24	405	21	282	422	60	123
May 20, 1901.....	5	18	3	6	10	.....	12
October 21, 1901.....	6	35	6	25	63	.....	10
June 11 and 12, '02.....	46	212	39	86	7	.....	126
Totals.....	86	676	69	399	502	60	277
Duplications.....	4	.....	1	.....	.....	.....	.....
Net.....	82	.....	68	.....	.....	.....	.....



Fig. 2. View in date-palm orchard at time of planting, July 25, 1900.

From this it appears that while 41 per cent of all trees have been lost, the remaining 59 per cent living include 68 out of 82 varieties, or 83 per cent. Taken as whole, therefore, the work thus far has been fairly successful in the establishment of varieties; but from a commercial point of view the loss has been heavy.

Estimating upon available data, and allowing a loss of 40 per cent, it costs, under favorable circumstances, not less than \$4.00 each to deliver 25-pound suckers from Africa in this region.

Because of such a cost of importation and the desirable character of many of the native seedlings, many would prefer to plant seeds in the expectation of obtaining a small percentage of good, fruit-bearing palms therefrom. We have observed that the seeds may be made to grow promptly by first stratifying them for three or four months. This consists in burying them under about 20 inches of well-drained moist sand or sandy soil and keeping them moist for the time stated. They will then be well softened, and, being planted, will sprout promptly instead of waiting weeks or months before appearing above ground. Very alkaline ground

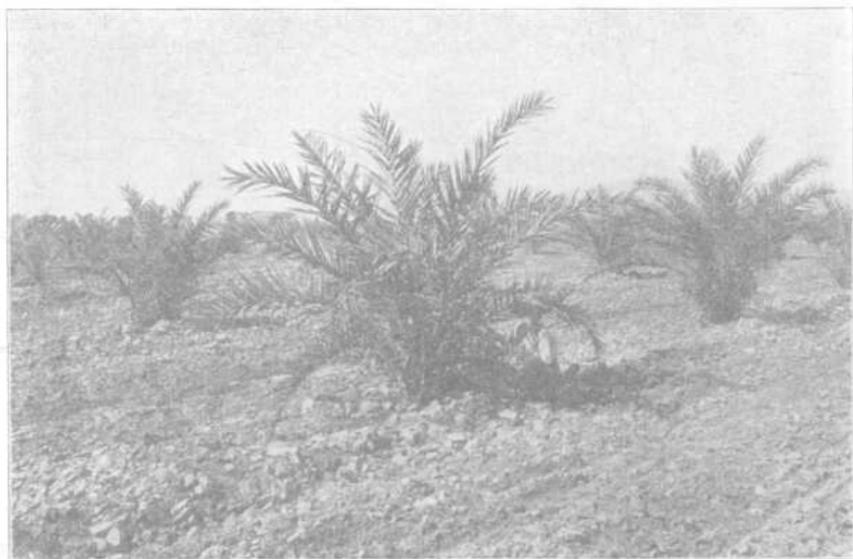


Fig. 3. The same view three years later, Aug. 27, 1903.

should not be used to start seedlings, which are much less resistant to salts than mature trees.

The date palm scale has not yet appeared in the Tempe orchard, indicating the extermination of this menace to the palms by the hydrocyanic acid gas fumigation employed when the palms

were received. A new enemy has been noted during the year in the burrowing "gophers" so common about irrigated fields. These creatures, encountering the succulent roots of the palm underground, follow them clear into the tree, often-times eating out the center with fatal results. These depredations have been noticed only in sandy ground which these animals most inhabit. The date orchard being on heavy soil has thus far escaped.

#### PUBLICATIONS.

Publications have been continued on the usual plan. "Timely Hints for Farmers" are, as formerly, the most popular and effective method of bringing our Station work before our farmers. The results of investigation, they are yet so untechnical in form that any man of common education can make use of them. The longer and more technical bulletins serve the needs of more studious readers.

Following are the titles for the year ending June 30th, 1903: Bulletin 43, July 28, 1902. Utilizing Our Water Supply.—By A. J. McClatchie.

Bulletin 44, September 30, 1902. The River Irrigating-Waters of Arizona—Their Character and Effects.—By R. H. Forbes.

Bulletin 45, November 20, 1902. Timely Hints for Farmers, collected, edited and illustrated edition for 1901-1902.—By the Station Staff.

Thirteenth Annual Report, December 20, 1902. — By the Station Staff.

Index to Vol. III of Station Publications.—By W. O. Hayes.

#### Timely Hints for Farmers:

No. 42, Oct. 20, 1902. Strawberry Culture.—By A. J. McClatchie.

No. 43, Dec. 15, 1902. Skimmilk for Pigs.—By G. H. True.

No. 44, Jan. 25, 1903. Watermelon Growing.—By A. J. McClatchie.

No. 45, Mar. 1, 1903. Combating the Flat-headed Borer.—By A. J. McClatchie,

No. 46, Apr. 15, 1903. The Melon Plant-louse and the "Manteca" Disease.—By J. J. Thornber.

No. 47, May 1, 1903. The Use of Branding Fluid.—By G. H. True.

The mailing list, excluding official names, is now about 4000, necessitating a publication issue of 5200 copies. The increasing expense for publications will be largely defrayed in the immediate future by the legislative appropriation of March, 1903, setting aside \$1500.00 for this purpose.

#### EDUCATIONAL.

While the Station, through its publications, is at all times exerting itself in an educational way, we more commonly think of "agricultural education" as applying to institute or classroom work. Such work is essential to an early and well proportioned knowledge of subjects presented and has the infinite advantage of the personal teacher over the printed page. The effort to devise an effective method of agricultural education for the scattered population of this region was therefore renewed. The experiment was tried of giving a short course of instruction in subjects of immediate interest in the academy at Thatcher, Arizona, which is situated in the midst of a rich, irrigated district. The course was for three weeks, one week each being occupied by Professors Thornber, McConnell, and Forbes. Professor Thornber lectured on topics relating to crop production; Professor McConnell took up livestock and dairying; and Professor Forbes discussed soils and alkali, with related subjects. The course ended with a field day during which the class constructed a drain in an alkaline field for the purpose of reclamation.

This work was apparently so fruitful of good results that a clause in the Experiment Station appropriation bill of March, 1903, was secured providing \$2,700.00 for the extension of this kind of instruction.

#### FINANCIAL.

With an allowance of \$741.89 by the Board of Regents from the University Territorial fund, and with unusually large sales of livestock from the farm, the Station has had fairly adequate means for current lines of work.

The income of the Station for the year has been :

Receipts from the Treasurer of the United States	\$15,000.00	
Receipts from the Territorial fund	741.89	
Farm sales, livestock and milk	1,586.26	
Farm sales, fruit and plants	107.20	
Greenhouse sales	41 05	
Miscellaneous receipts	22 76	\$17,499.16
Less balance on hand carried to 19034904		<u>262.66</u>
		\$17,236.50

By the following statement of expenditures it is seen that out of a total disbursement of \$17,236.50, \$8,820.44, or about half, is expended upon the Station farm; \$625.01 upon the date orchard; and \$7.791.05 upon laboratories and office.

R. H. FORBES,  
*Director.*

EXPENDITURES BY SCHEDULES AND DEPARTMENTS FOR THE YEAR ENDING JUNE 30, 1903

	Administration	Agriculture and Horticulture	Animal Husbandry	General Farm Expenses	Botany	Chemistry	Entomology and Meteorology	Date Palm Orchard	Miscellaneous	Totals
\$15,000 00 U. S. appropriation.	Salaries	1688.31	1800.00	1682.20		1017.96	2050.17			8259.64
	Labor	40.20	445.16	346.91		679.95	40.80	321.13		1874.15
	Publications	89.71	436.40	92.06		74.25	444.27	8.00	2.46	1147.18
	Postage and stationery	108.61	5.55	3.92		8.82	6.00	3.30	.40	136.60
	Freight and express	34.35	18.46	44.71		18.40	62.80	1.00	6.00	188.06
	Heat, light and water			1.75		79.85	54.35			135.95
	Chemical supplies	.75					154.49			163.99
	Seeds, plants and sundries		70.81	82.61	405.00	61.93			8.75	223.75
	Fertilizers								8.40	223.75
	Feeding stuffs		142.35	312.23					24.04	454.58
	Library	5.99					1.34			7.33
	Tools, implements and mach'y	8.60	55.92	515.48	40.25	26.10	6.65	.40	26.55	679.95
	Furniture and fixtures	75.25	2.10	6.36			12.95			96.66
	Scientific apparatus			.75		4.25	39.85		4.25	80.60
	Live stock			682.45						582.45
	Traveling expenses	91.73	12.25	74.80		31.10	17.60		116.70	344.18
	Contingent		77.05	78.62					9.59	195.94
	Building and repairs		827.69	591.67		80.68				1419.86
	Sales fund.								55.25	75.25
	Contingent	20.00								8.85
Territorial fund.			8.85						595.89	
Offices work	595.89			41.50					137.15	
Telephone service	9.55	25.95	18.05					41.60	741.89	
Total cost of departments	2769.94	3919.68	4414.01	486.75	2033.29	2691.27	62.70	625.01	33.86	17236.50

## DEPARTMENT OF AGRICULTURE AND HORTICULTURE.

The increased water supply during the past year has made it possible to conduct experiments more satisfactorily than during the previous year, yet considerable of the farm could not be utilized during the summer because of a shortage of water. Experiments have been continued in the relation of temperatures to crops, in irrigation and evaporation, and in the culture of dates, strawberries, potatoes, cotton and dhourra. The best methods of combating the injurious insects that are gradually finding their way into the region have been studied and tested.

### RELATION OF TEMPERATURES TO CROPS.

The study of the relation of temperatures to crops has been continued through the year, the importance of the observations extending over as long a period as practicable becoming more apparent as the study progresses. Records are being kept of temperatures at various distances above and below the surface of the ground, and notes upon the effect of high and of low temperatures upon various crops are being continued. In connection with this an evaporation record is being kept. The results of the observations are being incorporated into a bulletin upon the subject.

### IRRIGATION AND LOSS OF WATER FROM SOIL.

Experiments upon the best methods of irrigating various crops, and the amounts of water needed by different crops have been continued. Many points seem to be pretty definitely settled, and experiments along those particular lines have been discontinued for the present. In the future, especial attention will be confined to a few phases of the subject \*

The study of the influence of temperature and relative humidity and of cultivation upon the loss of water from the soil was continued throughout the year, and the difference noted between the loss from soil and from a water surface, under different conditions of the weather.

## STRAWBERRIES.

Especial attention has been given to experiments with strawberries, in the hope of finding varieties and determining methods of culture that will prevent the threatened extinction of the strawberry industry here. About a dozen varieties were grown on a large enough scale to determine quite definitely their endurance of such climatic conditions as prevailed the past season, and more than as many more were grown on a smaller scale. Of the thirty varieties tested, the most promising one is the Texas, making a good growth during the cool part of the year, and enduring the heat of the summer well. As it is a prolific bearer and produces berries of excellent quality, it will probably come to be a standard variety in the valley. It endures our climatic conditions better than the two varieties that have been grown here almost exclusively heretofore—the Michel and the Arizona Everbearing. Two other promising varieties are the Lady Thompson and the Excelsior, both enduring the summer well, and both producing berries of excellent quality.

Various methods of culture and irrigation have been tried. Judging from present results, the best method is to set in single rows twenty to twenty-four inches apart, irrigate between each two rows, and cultivate and keep free from weeds. The intention is to continue investigations along this line, using in the experiments a few of the most promising varieties and growing them in sufficient quantities to give practical results, and at the end of the year to incorporate the results in a bulletin.

## POTATOES.

Many farmers experience so many difficulties in attempting to grow potatoes that it has been considered important to continue their culture. The best methods for obtaining satisfactory results seem to be fairly well established now, and will be set forth in a "Timely Hint". During the past season the writer grew 11,000 pounds upon two acres, on land adjacent to the Station farm, following the methods outlined in previous reports. This is probably about as heavily as potatoes will produce under the trying conditions of our climate, in most soils.

## EGYPTIAN COTTON.

Experiments upon Egyptian cotton are not being continued during the present season. Growing upon a sufficiently large scale for the results to be practical requires a large amount of labor, and it was thought that for the present its culture had been continued long enough to establish the main facts as to methods and varieties.

The cotton was picked from the two varieties grown during 1902—Abbassi and Mit-afifi—September 20th and December 15th. It has not been ginned yet, the average yield of seed cotton per acre from the several plats planted being: Abbassi 1120 pounds, and Mit-afifi 927 pounds. The indications are that this cotton requires in our climate a very large amount of water in order to produce a full yield, one portion that had been heavily irrigated producing 2200 pounds of seed cotton per acre.

## COMBATING HARMFUL INSECTS.

Harmful insects are gradually finding their way into the valley, a few species already being sufficiently abundant to do serious injury. As their presence is manifested, methods of combating them are tested. By following the method outlined in Timely Hints No. 45, borers were kept out of most of the young trees set out last spring. A few entered above the wrappers, but were dug out before they did much injury. Melons that were attacked and seriously injured by cucumber beetles were powdered with Paris green, the insects destroyed, and the crop thus saved. For destroying lice, scale insects, and other forms that injure plants by sucking the juice, the distillate that is now being used so successfully in California has been found to be effective.

A. J. McCLATCHIE,  
*Agriculturist and Horticulturist.*

## DEPARTMENT OF ANIMAL HUSBANDRY.

The work in steer feeding in progress at the time of the last Annual Report was concluded with sale and slaughter of twenty-two head of steers, then two years old. These cattle had been on experiment since August of the year before when they were divided into two lots of ten each (two were fed and weighed separately) and one lot given nothing but alfalfa, pasture or hay or both, while the other had a combination of alfalfa and sorghum.

The results do not seem to indicate that the combination of feeds gave any better results than alfalfa fed alone. The difference in gross gain between the two lots of ten steers each for a feeding period of nearly sixteen months was but six pounds.

The animals were in prime condition for this market when sold and brought the highest price paid for beef cattle in Arizona during the residence of the writer in the Territory.

The details of this feeding work and that referred to in the last Annual Report where two-year-old steers in three lots were fed alfalfa hay, alfalfa hay and sorghum, and alfalfa hay, sorghum and barley will be reported later. This report will include figures on shrinkage and the slaughter weights.

GORDON H. TRUE,  
*Animal Husbandman.*  
(until Jan. 15th, 1903).

## THE DAIRY HERD.

In the following pages is given a tabular statement of the amount of milk and the average percentages of fat, together with the amount of fat and butter produced by each cow in the herd for the past three years. A careful record is kept of the individual performance of the cows at the pail throughout the year by weighing the milk from each cow at every milking and making a test, by the Babcock method, for the fat percentages once a week.

The amount of butter produced is calculated on the theory that butter is composed of six parts pure fat and one part water, salt, casein, etc. This proportion is conceded by most authorities to be practically correct.

The herd remains the same as last year with the exception that cow No, 6 died with hoven, or bloat as it is generally termed. A grade Shorthorn heifer, coming three years old, that had just freshened was put in her place and given the title of No. 7. This substitution was made, both with the object of keeping the dairy herd up to its original number and to see if it is possible to educate the milking function of a young heifer with marked beef characteristics to a higher point.

The education of the milking function in the young heifer is of great importance and consists chiefly in the persistent clean milking of the young animal twice a day as long as it is possible to obtain any milk. The heifer should be bred the second time so as to freshen within at least a year of her first calving. This treatment is supposed to apply particularly to young animals with pronounced beef characteristics although all young heifers intended for the dairy should be milked clean twice a day up to within six weeks of their second calving if they will give milk that long. It is not best to condemn a heifer entirely for a scant performance at the pail during her first period of lactation if she shows a persistence in milking.

The herd received the same treatment as in former years, being on alfalfa pasture practically all the year. This is the same treatment that the majority of the dairy cattle in the Salt River valley receive and while they produce well with this treatment, the writer intends to see if better results cannot be obtained by soiling the alfalfa.

The yearly records of the cows, given in Table I, show that, of the five cows which completed a full year at the pail, Nos. 3 and 5 did not produce as much butter fat and Nos. 1, 2 and 3 produced considerably more than in previous years. From these records and the age of the cows, we would conclude that the average maximum performance for the herd under ordinary conditions had been reached.

The Station has put in a hand milk separator for creaming the milk from the dairy herd. The primary object in doing this was to have the skimmilk pure and sweet to feed pigs and calves. At no time is the skimmilk so healthful and nutritious as when it

is fed immediately after it comes from the separator, if the milk is creamed or separated as soon as drawn from the cow. It is also hoped that in the near future the creameries of the Salt River valley will send after the cream of the dairymen who separate their own milk as is done by the creameries in some parts of the Middle West.

TABLE I.—YEARLY RECORDS OF THE DAIRY HERD.

Herd number of cow.		1	2	3	4	5	6	7
Record for 1900-1901	Lb. milk	5087.8	4823 8	3625.2	5810.7	4374.8	5053.6	
	Av. % fat	4.24	5.54	6.08	5.00	5.50	5.50	
	Lbs. tat	215.66	267 59	220.70	290 45	240.24	277.79	
	“ butter	251.60	312 18	257.48	338 85	280.28	324.08	
Record for 1901-1902	Lbs. milk	5019.8	3931 5	6191 3	5253.0	7319.7	5144.5	
	Av. % fat	4.19	5.72	5.89	5.32	5 16	5.14	
	Lbs. tat	210.42	224.76	365.24	279 48	377.47	264.72	
	“ butter	245.49	262 22	426.11	326.06	440.38	308.84	
Record for 1902-1903	Lbs. milk	6904.5	5857.9	4978.7	6076 2	5850 4	4364.4	1277.4
	Av. % fat	4.54	5.74	5.91	5 04	5.25	5 48	4.58
	Lbs. tat	313.91	336.31	294 43	306.78	307.64	239.51	58.60
	“ butter	336.22	392 36	343.50	357.91	358.91	279.42	68.36

Note —In the record for 1902-1903, cow No. 6 gave milk but eight months and No. 7 but four months.

ALFALFA AND SKIMMILK vs. ALFALFA, SKIMMILK AND BARLEY AS RATIONS FOR GROWING PIGS.

Ten grade Poland-China pigs that had been farrowed and raised on the Experiment Station farm were available for this experiment. They were divided into two equal lots with due regard to size and apparent feeding qualities. Unfortunately one of them died from some unknown cause within twenty-four hours after the experiment was started. As the object in view was to ascertain the amount of alfalfa pasture and skimmilk required to produce a definite gain in Lot II as against the amount of alfalfa pasture, skimmilk and rolled barley to produce like results in Lot I, the experiment was continued with only four pigs in Lot II.

The pigs were weighed individually at the beginning and every two weeks thereafter until the close of the experiment. It was considered better to weigh them singly as by so doing a closer check could be kept on the health and thrift of the individual.

The two lots of pigs, so far as alfalfa pasture was concerned, had the same feed and treatment. Each lot was corralled with portable fence on plots of alfalfa containing one-sixteenth to one-twelfth of an acre and as often as necessary were changed to fresh plots. By the time they had been changed four times the alfalfa on the plot where they were first corralled had grown large enough to turn them on again. In this way during the ten weeks the experiment was running, they ate the alfalfa that grew on about one and one-third acres.

The skimmilk from the dairy herd was, for the first two weeks period, divided pro rata between the two lots of pigs, but from that time on, for certain reasons it was considered better to give Lot II, on skimmilk and alfalfa pasture alone, more than an equal share.

Lot I, in addition to the regular ration of alfalfa pasture and skimmilk, received what rolled barley, made into a slop with water, they would eat up clean. They were watched closely in this respect to see that they had enough and still did not waste any.

TABLE II.—RATIONS GIVEN TWO FEEDING LOTS OF PIGS.

Period.	Lot I.		Lot II.
	Lbs. Skimmilk.	Lbs. Rolled Barley.	Lbs. Skimmilk.
First two weeks	626	304	543
Second two weeks	537	2m	539
Third two weeks	461	245	576
Fourth two weeks	464	218	620
Fifth two weeks	410	214	585
<b>Totals</b>	<b>2507</b>	<b>1273</b>	<b>2863</b>

In Table No. II is shown the amount of skimmilk fed each lot during each two weeks period; also the amount of barley fed Lot I during the same periods. It will be noticed that as the season advanced and the alfalfa contained more solid matter and not so much water, the amount of barley eaten by Lot I decreased slightly instead of increasing.

The two lots ate the alfalfa from approximately two-thirds of an acre (28275 sq. ft.) twice during the ten weeks the experiment was running. Each lot was corralled on plots of alfalfa equal in size at all times so that it will be seen that the four pigs not receiving barley ate the alfalfa from as much space as the five that did receive it.

When we come to sum up the results of this experiment, we find that Lot I gained 269 pounds or 53.8 pounds each and ate the alfalfa from 28275 sq. ft. of land together with 2507 pounds of skimmilk and 1273 pounds of rolled barley. We find from this that to produce one pound of gain in Lot I, it took the alfalfa grown on 105.11 sq. ft. of land in ten weeks, 9.23 pounds of skimmilk and 4.73 pounds of rolled barley.

Lot II gained 174 pounds or 43.5 pounds to the individual during the ten weeks the experiment lasted. These pigs ate the alfalfa from the same area of land as those in Lot I and 2863 pounds of skimmilk. In this case it took the alfalfa grown on 162.5 sq. ft. of land for ten weeks and 16.45 pounds of skimmilk to produce one pound of gain.

When we compare the amount of food required in each lot to produce one pound of gain we find that it takes the alfalfa from an area one-third larger in extent and nearly twice as much skimmilk where there is *no* grain food in the ration as where it *is* fed. If we consider the profit from each lot, however, there could be no conclusion drawn in favor of the grain fed lot especially as long as the feeder had to buy the grain.

If we compare the condition of the pigs in each lot at the close of the **experiment** from the standpoint of the packer, the pigs fed **the** grain in their ration would be considered the best. **Lot** II, fed only on alfalfa and skimmilk, did not have as firm flesh

TABLE III.—LOT I. SKIMMILK, ALFALFA PASTURE AND BARLEY.

No. of Pig		Lbs. weight and gain						Total Gain
		March 5th	March 19th	April 2nd	April 10th	April 30th	May 14th	
1	{ Weight Gain	80	114 34	124 10	142 18	158 16	152 -6	72
2	{ Weight Gain	140	154 14	160 6	176 16	188 12	186 -2	46
3	{ Weight Gain	135	150 15	156 6	168 12	176 8	178 2	43
4	{ Weight Gain	80	110 30	124 14	138 14	146 8	146 0	66
5	{ Weight Gain	90	100 10	114 14	126 12	134 8	132 -2	42
Total weight		525	628	678	750	802	794	269
Total gain for 1 period			103	50	72	52	-8	
Average gain for 1 period			20.6	10	12.4	10.4	-1.6	

LOT II. SKIMMILK AND ALFALFA PASTURE.

No. of Pig		Lbs. weight and gain.						Total Gain.
		March 5th	March 19th	April 2nd.	April 16th,	April 30th	May 14th,	
6	{ Weight Gain	94	106 12	120 14	130 10	140 10	136 -4	42
7	{ Weight Gain	160	166 6	172 6	182 10	192 10	188 -4	28
8	{ Weight Gain	80	94 14	104 10	114 10	130 16	130 0	50
9	{ Weight Gain	90	110 20	120 10	132 12	142 10	144 2	54
Total weight		424	476	516	558	604	608	174
Total gain for 1 period			52	40	42	46	-6	
Average gain for 1 period			13	10	10.5	11.5	-1.5	

and showed more distension of the digestive organs and in every way their condition indicated a larger percentage of offal with a smaller percentage of marketable flesh.

Previous to the experiment the pigs had been confined in rather a small pen. When first driven out on the alfalfa pasture they showed some distress from seeming lack of lung capacity but as time passed and they had more exercise this difficulty disappeared although they were carrying more flesh at the close of the experiment than at the beginning. This teaches that hogs that have had plenty of exercise will stand transportation much the best if shipped very far, consequently there would be a smaller percentage of cripples and loss at the final destination.

It will be noticed in Table No III that, during the last two weeks of the experiment, the pigs as a whole lost slightly in weight instead of gaining. The only cause of this evident to the writer was the hot weather. They had the same care and plenty of water to drink. Their feeding on the alfalfa after it began to be extremely hot was entirely nocturnal in character instead of continuing throughout the day, which would at least partially account for the loss. The large individual gains noticed in some cases at the second weighing was due to the pigs gorging themselves on alfalfa when first turned into it.

After the experiment had been running a short time, it was noticed the pigs had commenced rooting up the soil more than was considered best. To obviate this trouble the writer concluded to try one of the several so-called "hog tamers" that are so widely advertised in agricultural journals to prevent rooting.

These "hog tamers" are designed to take the place of the hog-ring to prevent the animals from rooting. They are supposed to be less cruel, in that they make a clean cut wound that will heal readily instead of leaving a piece of metal inserted in the cartilage of the snout to cause constant irritation. The hog-ring accomplished its purpose by creating an irritation that was more or less constant whether the animal attempted to root or not. The new method is supposed to accomplish the same object by partially removing the cartilaginous ridge that is placed transversely on the end of the pig's snout. The new method, in this one case, was entirely successful and much to be preferred to the hog-ring.

T. F. McCONNELL,  
*Animal Husbandman.*

## DEPARTMENT OF BOTANY.

### RANGE CONDITIONS AND RANGE IMPROVEMENT

The condition of the enclosed range near Wilmot is somewhat improved, the change being due both to the protection afforded by the fence and to the increased rainfall. During the nine months ending August 1st, 1902, but two inches of rain fell on this area, a condition which is responsible for the rapid deterioration of the range during that time, while of the 11.92 inches rainfall for the year ending July 1st, 1903, 7.17 inches fell between November 1st, and April 1st, leaving only 4.75 inches for the seven months of most active plant growth, an amount entirely inadequate for the growth of the grasses. Seven to eight inches of rainfall from June to October, if timely, is considered sufficient on the higher mesas and foothills to produce a fair to good growth of the perennial grama grasses.

The following table gives the precipitation records for the small range reserve, the University grounds, and Prince's ranch, from July 1st, 1901 to July 1st, 1903:

	Small range reserve.		University grounds.		Prince's ranch.	
	'01-'02.	'02-'03	'01-'02	'02-'03	'01-'02.	'02-'03.
July	2.33	.78	2.58	.42	3.37	.56
Aug.	.82	.89	1.87	1.31	2.55	1.24
Sept.	.34	.72	.28	.58	.32	.47
Oct.	1.27	.39	1.18	3.64	1.49	1.02
Nov.	.05	1.84	.00	1.34	.02	1.86
Dec.	.00	2.03	.00	2.15	.00	1.96
Jan.	.60	.00	.48	.00	.82	.00
Feb.	.00	1.34	.00	1.11	.00	1.11
March	.40	1.96	.42	1.58	.41	1.62
April	.00	.00	.00	.00	.00	.00
May	.00	.62	.00	.20	.00	.23
June	.20	1.35	.18	.22	.16	.19
	6.01	11.92	6.99	10.55	9.14	10.26

The rain-gauge at the small range reserve is located six miles southeast of the University on a typical mesa area, while that at Prince's ranch is situated four miles north of Tucson.

Attention has already been called to the importance of the summer rains for southern Arizona, the sparseness or copiousness of which means short or abundant grazing on the range for the ensuing six or eight months. The local or "patchy" character of the summer rainfall, so evident to one upon examination of the data from day to day, is less apparent from a comparison of the monthly records. The writer noted during the past summer, that the belt of country benefited by a good, large summer rain was rarely more than five or six miles in width, and usually much smaller. The fall and winter rains, on the other hand, are more general in character, and heavier, but less frequent.

The abundant winter rains caused the winter, annual vegetation to appear prominent upon the mesa early in December, 1902, though no grazing was afforded until the following February or March, since these annual plants pass the colder months in an inert, rosette condition, and begin active growth only with the warmer spring days. The writer enumerated fifty species of annuals in blossom on the small fenced area during the latter part of March, the most important of which was Indian wheat, *Plantago fastigiata*, the species which furnishes the bulk of the spring forage on the lower mesas. With a few local exceptions, this small plantain appeared equally abundant on the fenced and unfenced portions, though everywhere, except within the areas benefited by the storm-water embankments, its growth was decidedly inferior to that of two years ago. *Alfilaria*, *Erodium cicutarium*, was noted at several stations on the range reserve, in patches ranging from one-half to several acres in extent. With the exception of the slender fescue, *Festuca octoflora*, which occurs infrequently over the mesas, no grass was listed among these spring bloomers.

The scattering bunches of Rothrock's grama, *Bouteloua rothrockii*, which resisted the prolonged drouth of the past year, began growth with the early summer rains. In a recent report \* to the Division of Agrostology, U. S. D. A., the writer took occasion to call attention to this promising but, heretofore, overlooked grama grass. While the species is apparently a short-lived perennial, it

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\*Report upon Range-work on the Small Range Reserve Tract, July 1, 1903

ranks first, up to this time, in drought and heat-resisting qualities, seed-production and facility of seed-collection, and in the occupancy of those areas on the mesa which enjoy more or less flooding from the storm-water. This grass does best without cultural operations of any kind, discing of the surface, apparently, having killed most of the bunches even in favorable situations. It confines itself, largely, to the broad, swale-like depressions and other flat areas of the lower mesas, and to the higher mesas in the vicinity of mountains.

During the latter part of June several of the storm-water embankments constructed the year before were modified so as to retain more water over a larger area; also a new one was added. The last one is a low, broad dam five hundred and fifty feet long and twelve inches in height. It is constructed, approximately, on a surface contour line across a broad, shallow swale, and begins to spill over at the lower lip after the water in the dam attains a depth of six or seven inches. This dam is superior to those constructed heretofore, in that it distributes the water over a relatively large area, and also has the advantage of being more economical in construction, the work being done entirely with teams and scrapers. The areas watered by four of the dams were disced deeply, and sown with seeds of twenty of our promising native and introduced forage plants, the more important of which are the following: *Andropogon leucopogon*, *Panicum texanum*, *Bouteloua curtipendula*, *B. rothrockii*, *B. oligostachya*, *B. hirsuta*, *Sporobolus wrightii*, *S. strictus*, *S. cryptandrus*, *Pappophorum apertum*, *Chaetochloa composita*, *Eriochloa punctata*, and *Chloris elegans*.

#### RIDGING THE SURFACE TO CONSERVE THE RAINFALL.

During the past year the construction of ridges a few inches in height at suitable angles and intervals over the surface to conserve the rainfall has been employed in both the cactus and the forage gardens with excellent results. The formerly unobstructed surface of the cactus garden, that absorbed but little of the rain-

fall on account of its prominent slope, now retains all of it, with the result that no irrigation has been found necessary since August, 1902. The utility of this plan in connection with range reclamation will be given a trial on the small range reserve.

#### EXPERIMENT STATION FORAGE GARDEN.

The grounds for a permanent forage garden have been laid out and one-half the area planted. This garden is located east of the main University building, and is slightly over a half acre in area. The surface, which slopes prominently to the east, is laid out in rod squares, by means of earthen embankments six to ten inches in height. The embankments were constructed primarily for irrigation purposes, but as already noted they serve to retain the excess of rainfall which would otherwise run off. In this garden the behavior, under cultivation, of our promising meadow, pasture, and lawn or turf grasses may be studied, also the season of growth of the native and introduced forage plants, the relative amount of irrigation required by the various species, and the yield of forage. The garden is of special interest to botanists, since such important lines as plant selection and the comparative study of specific differences of closely allied species are now possible.

#### MISCELLANEOUS.

##### *The Melon Plant-louse.*

Timely Hint No. 46, entitled "The Melon Plant-louse and the Manteca Disease" appeared in April. The life-history of the insect is given in brief, with a list of our commoner weeds and other plants it has been observed feeding upon. The burning of weeds and ether trash about melon fields in the fall, and the extension of clean cultivation as late as possible in the spring or summer are recommended as preventative measures. Also, rich soil with an abundance of irrigation water is suggested to encourage a vigorous growth of the vines after they become too large for fumigation or spraying. The carbon bisulphide treatment is

described briefly and recommended as an efficient and economical means of dealing with the pest. It is gratifying to report that during the past season little damage has resulted from the insect, the conditions being, in general, less favorable for the melon-louse and more favorable for the melon plant

*Growing Eucalypt Seedlings.*

The second attempt to grow Eucalypt seedlings on a considerable scale has demonstrated the possibility of the work. The department has several thousand plants of *E. rudis* and *E. tereticornis*, which will be available for distribution in the spring. After the seedlings have attained a height of six inches or so in the greenhouse, their further growth is continued outside under an open, lattice-covered frame, where the plants become somewhat accustomed to the weather conditions, before being set out.

SCIENTIFIC.

During the past spring, owing to the favorable season, a large amount of work was done on the flora of the mesa and mountain regions adjacent to Tucson, the collections to July 1st, aggregating 12,000 specimens. As far as possible all species have been collected in sets of twenty-five specimens, five of which are reserved for the University collections and the remainder offered for exchange. Particular attention has been given to the Santa Rita region on account of the recently established forest reserve, and a botanical survey of this area is well under way.

J. J. THORNER,

*Botanist.*

## DEPARTMENT OF CHEMISTRY.

The work of the chemists has, as usual, been miscellaneous in character, due to requests made by the public upon this department for numerous small but time-consuming items of service.

### UNDERGROUND WATERS.

The principal demand upon this department results from the natural interest which the people of this region, many of them newcomers, feel in an eccentric domestic water supply. This supply, varying from exceedingly pure mountain drainage to very salty plains waters, though usually healthful, in most instances sets at naught the conventional standards of purity for sanitary waters. The acceptability of a given water for domestic use, so far as amount and quality of salts are concerned, appears in most cases to depend upon getting used to it. For instance, one manifestly salty well supplying a public institution, apparently without detrimental effects, has been found to contain no less than 250 parts of soluble salts in 100,000 of water,—five times the amount allowed by ordinary sanitary standards.

These waters are also of increasing interest as boiler waters and for irrigation. The results of numerous analyses made during the last ten years with reference to irrigation, steam production and domestic use have been prepared for publication, appearing (October 12, 1903,) as Bulletin 46, of the Station.

### THE COLORADO RIVER.

The study of this interesting stream, made for the year 1900 and published in Bulletin 44, was not entirely satisfactory because of the abnormally small flow of the river during that time. For this reason a repetition of the work in co-operation with the Geological Survey during 1903 was arranged for. The flow of the river for this period has been exceptionally high, and the data

now being secured, including complete observations on daily river flow and amount and quality of silts and soluble salts carried by the river, will greatly amplify the data previously obtained.

### HONEYS.

Southwestern peculiarities of vegetation and climate affect the chemical and market qualities of honey to a marked degree. Estimates on the production of honey from certain characteristic plants were made, and a series of samples of honey produced in Southern Arizona were judged and analysed with reference to their value in comparison with other sources of supply. The average of results indicates unusually high percentages of total sugars (80.12 per cent), low moisture content (16.85 per cent), and usually, most desirable color, flavor and aroma. The practice of liquefying honey in cans placed in boiling water was also looked into with the result that honey was found to be seriously changed by this manipulation. Liquefaction at a temperature of 150 to 160 degrees F. was found to least affect composition and market qualities of honey. At prevailing prices for honey, sugar and glucose it was observed, also, that there was no commercial margin of profit to encourage the adulteration of honey in Arizona.

### RANGE FORAGES.

A number of typical range forages, including native salt-bushes, grasses and shrubby plants, were examined with reference to their food value for grazing animals. Some of these analyses are shown in the following table :

## AIR-DRY RANGE FORAGES.

Laboratory number	Sample.	Source	Water	Ash	Protein, N x 6.25.	Fiber.	Nitrogen free extract	Ether extract
			Per ct	Per ct	Per ct	Per ct	Per ct	Per ct
2834	Saltbush <i>A. canescens</i>	N W. of Tucson	6 29	13 19	12 25	30 02	36 75	1 50
2821	Australian Saltbush <i>A. semi-baccata</i>		6 30	17 90	14 13	20 75	38 81	2 11
2823	Saltbush <i>A. elegans</i>	5 mi N. W. of Tucson	5 21	23 70	12 56	18 65	38 01	1.87
2826	Saltbush <i>A. polycarpa</i>	3½ mi. N. W. of Tucson. In full flower	5 73	13 19	13 06	29 90	38 22	1 90
2953	Saltbush <i>A. coronata</i>	University grounds. In full flower	7.16	13 97	13 69	19 53	38 79	1 86
2827	Grease wood <i>S. sermoularis</i>		4 55	14 41	19 81	24.50	34.23	2 45
2835	Paloverde twigs		5 10	5 70	10 94	36 01	39 05	3 20
2951	Water grass <i>Chloris elegans</i>	Empire ranch. Robust plants	7 60	11 76	8 88	33.62	36 53	1 61
2950	Grass grass <i>Bouteloua oligostachya</i>	Empire ranch Growing	6 98	14 08	6 50	28.19	42 45	1 82
2952	Grass grass <i>Bouteloua rothrockii</i>	Range reserve 1 year old, dead, weathered grass.	7.35	4 67	2 56	33.62	50 58	1.22

Four native saltbushes are here seen to closely resemble the well-known Australian saltbush in forage qualities. Protein, fat (ether extract) and carbohydrates (nitrogen-free extract) are nearly the same in most instances, the chief variations being in ash and fiber,—substances of no food value.

Greasewood and paloverde twigs are instances of the "browse" forage upon which animals so largely depend in semi-arid country when grass is short. These are of surprisingly nutritious character, as indicated by the analyses here given, being rich in protein, fat and carbohydrates. The sample of greasewood is especially good, being considerably richer in protein and fat than a sample of alfalfa hay from the Station farm.

The low protein in old, weathered "grama" grass as compared with fresh grasses of the same general nature bears out the low estimate generally placed upon weathered grass as forage.

#### MISCELLANEOUS.

Sundry samples of canaigre, guano, minerals, silts and soils have also been analysed from time to time, the total number of substances examined, including those described above, being about one hundred and eighty.

As usual, no charges have been made for analytical work, the results of which are of general interest and may be published. Compensation is required for private work and the receipts are turned over to the Station.

R. H. FORBES, *Chemist.*

W. W. SKINNER, *Associate Chemist.*