3-1-1932

Bulletin No. 186 - A Comparative Test of the Caucasian with the Italian Race of Honeybees

University of Wyoming Agricultural Experiment Station

Follow this and additional works at: http://repository.uwyo.edu/ag_exp_stabulletins

Part of the Agriculture Commons

Publication Information
University of Wyoming Agricultural Experiment Station (1932). "Bulletin No. 186 - A Comparative Test of the Caucasian with the Italian Race of Honeybees." University of Wyoming Agricultural Experiment Station Bulletin 186, 1-24.

This Full Issue is brought to you for free and open access by the Agricultural Experiment Station at Wyoming Scholars Repository. It has been accepted for inclusion in Wyoming Agricultural Experiment Station Bulletins by an authorized administrator of Wyoming Scholars Repository. For more information, please contact scholcom@uwyo.edu.
A Comparative Test of the Caucasian With the Italian Race of Honeybees

Bulletins will be sent free upon request.
Address: Director of Experiment Station, Laramie, Wyoming.
UNIVERSITY OF WYOMING
Agricultural Experiment Station
LARAMIE, WYOMING

BOARD OF TRUSTEES:

Officers

WILL M. LYNN......................................................President
WALLACE C. BOND............................................Vice President
FRED W. GEDDES....................................................Treasurer
FAY E. SMITH.......................................................Secretary
E. O. FULLER............................................................Fiscal Agent

Executive Committee

WILL M. LYNN FRED W. GEDDES JOSEPH A. ELLIOTT WALLACE C. BOND
Appointed Members Term Expires
1921 .................................................. JOSEPH A. ELLIOTT . 1933
1921 .................................................. FRED W. GEDDES . 1933
1925 .................................................. HARRIETT T. GRIEVE . 1937
1927 .................................................. WILL M. LYNN . 1933
1929 .................................................. WALLACE C. BOND . 1935
1929 .................................................. MABELLE G. OVIATT . 1935
1931 .................................................. MARY SCOTT EMBREE . 1937
1931 .................................................. N. D. MORGAN . 1937
1932 .................................................. J. M. SCHWOOB . 1935
1932 .................................................. A. G. CRANE, Ph.D., President of the University Ex Officio
A. M. CLARK, Governor of Wyoming Ex Officio
KATHARINE A. MORTON, State Superintendent of Public Instruction Ex Officio

STATION STAFF

Administration:
A. G. CRANE, Ph.D., President.
J. A. HILL, B.S., Dean of College of Agriculture; Director of Station.
W. L. QUAYLE, B.S., Director Experiment Farms.

JANE M. NEAL, Station Clerk.

Agronomy and Agricultural Economics:
A. F. VASS, Ph.D., Agronomist.
GLEN HARTMAN, M.S., Associate Agronomist.
*T. J. DUNNEWALD, M.S., Asst. Soil Investigations.
HARRY PEARSON, B.S., Asst. Economist.
W. A. RIEDEL, B.S., Asst. Agronomist.
†M. REINHOLT, Asst. Field Economist.

Animal Production:
FRED S. HULTZ, Ph.D., Animal Husbandman, Beef Cattle.

Apiculture and Entomology:
C. L. CORRINS, M.S., Research Associate Entomologist and Apiculturist.
†A. P. STURTEVANT, Ph.D., Associate Apiculturist, in charge U. S. Bee Culture Field Station.
†C. L. FARRAR, Ph.D., Associate Apiculturist.

Botany:
AVEN NELSON, Ph.D., Botanist and Horticulutrist.

Chemistry:
O. A. BEATH, M.A., Station Chemist.
O. C. MCCREARY, Ph.D., Associate Chemist.
J. H. DRAIZE, Ph.D., Asst. Pharmacologist.
H. F. EPPSON, M.S., Asst. Chemist.

Home Economics:
ELIZABETH J. MCKITTRICK, M.S., Home Economics.
EMMA J. THIESSEN, M.A., Asst. Home Economics.

Library:
MARY E. MARKS, B.L.S., Librarian.

Veterinary Science and Bacteriology:

Weather:
FRANK E. HEPNER, M.S., Head of Weather Station.

Wool:
J. A. HILL, B.S., Wool Specialist.
ROBERT H. BURNS, M.S., Asst. Wool Specialist.

Zoology:
JOHN W. SCOTT, Ph.D., Zoologist and Parasitologist.

*On leave.
†In cooperation with U. S. Dept. of Agriculture.
A Comparative Test of the Caucasian With the Italian Race of Honeybees

By C. L. Corkins and C. H. Gilbert

INTRODUCTION

The Italian race of honeybees has largely been used in Wyoming as well as other states of the Rocky Mountain region. It has not been certain that this is the best race of bees for our particular conditions. A few among our intermountain beekeepers have used the Caucasian race of bees. Caucasians were first introduced into the Wyoming Agricultural Experiment Station apiaries in 1925. Interest and questions concerning this race of bees soon greatly increased. It became apparent that a comparative study of the two races might yield information of value. Hence these studies were inaugurated in the spring of 1928.

Two major points of importance were made the object of this initial experiment: The first was honey production; the second was seasonal brood production. These characteristics of the two races of bees have been measured. Other characteristics of minor importance have been observed. The work has now progressed to the point where certain well defined characteristics have been determined. It is the purpose of this first report on this project to record these characteristics.

Environmental Conditions of the Experiment. It is recognized that there is a possibility that the results of an experiment of this nature may vary with differences of environment. The findings may not be universally applicable. Hence, the major characteristics of the environment at Laramie, Wyoming, are given as a guide in the use elsewhere of the information herein contained.

The apiaries of the Wyoming Agricultural Experiment Station are located on the Laramie plains at an elevation of approximately 7,200 feet above sea level. Here the average growing season is only 101 days in length. It is an arid plain surrounded by mountains, and honey plants are largely dependent upon irrigation.
for moisture. The summers are cool and the winters long and comparatively cold. Although the region is arid, often during the afternoons of July and August rains of short duration occur. These stormy days average nearly one out of three, and, in addition to these there are days of threatening weather which are cloudy and windy. This materially handicaps nectar gathering by the bees during the most important season of the year. On the whole, it may be said that, from the standpoint of climate, the Laramie plains area is on the upper border line of the Rocky Mountain beekeeping region.

The weather data for the years during which this experiment was in progress are given later.

The major honey flora are few. The nectar source environment is, therefore, very simple. Only three honey plants greatly affect the seasonal activity of the bees. During May, and lasting at times until the middle of June, there is a profusion of dandelions. Weather permitting, colonies can gather a surplus of dandelion honey beyond their needs for brood rearing until other plants bloom. Ordinarily, however, the weather does not permit the storage of surplus dandelion honey, and at times colonies must be fed during the dandelion flow.

Between June 15 and July 1 yellow sweet clover comes into bloom. There is not as yet a sufficient acreage of this plant to make it extremely important. Ordinarily it is still in bloom at the close of the season. The main honey flow starts about July 15 with the blooming of white sweet clover. This plant gives practically all of our surplus honey. The honey flow from this source ordinarily lasts about six weeks.

On the whole, the environment here is generally similar to that of the entire Rocky Mountain region. Long winters, comparatively warm summer days with cool nights, and a late season major honey flow characterize this entire intermountain territory. At Laramie all these conditions are a bit exaggerated, except that the summer days are cooler than in most areas because of the excessive elevation.
The Caucasian Race of Bees. The first importation of grey Caucasian bees which was established in the United States was made in 1897. At the suggestion of Frank Rauchfuss, late manager of the Colorado Honey Producers' Association, his brother Herman of Denver, Colorado, imported two Caucasian queens from Germany. These were, presumably, originally imported into Germany from the Caucasian mountains of Europe. However, they must have either been from the lower elevations of the Caucasians or mixed with other bees after reaching Germany. They were not entirely dark grey in color, most of them having one yellow band on the abdomen.

These bees were considered by Mr. Rauchfuss to be superior to Italians. They were gentle and good honey gatherers. At that time there was great interest in finding a race or strain of bees with sufficiently long tongues to gather nectar from red clover. It was found that this strain of Caucasians had longer tongues than any other race or strain of bees in the United States at the time. These bees built an unusually large number of queen cells. In one instance of preparation for swarming over 250 ripe queen cells were found in one colony. Seventy-two were on the bottom of one comb. However, they were not any more given to swarming than any other bees.

At the convention of the National Beekeepers' Association in 1902 at Denver, Colorado, Doctor Benton of the U. S. Department of Agriculture became interested in these bees. Two queens were taken to Washington, D. C. This interest was followed by a personal trip by Doctor Benton to the higher altitudes of the Caucasus. Here he obtained the Abkatz variety, and sent some of these queens to Mr. H. Rauchfuss. These bees were uniformly dark gray in color. This was the best Caucasian stock which has entered into the Rauchfuss bees.

The final importation made by Mr. H. Rauchfuss was in 1924, when he secured three queens from Doctor Gorborscheff of Georgia, Russia.
These three strains of Caucasian bees are the only ones which have entered into the Rauchfuss stock. Since the original importation in 1897, constant selection has been made by Mr. Rauchfuss under commercial beekeeping conditions in Colorado and Wyoming. As a consequence, Rauchfuss Caucasian bees were largely used in this experiment as a standard of comparison with Italian bees.

A few Caucasian queens from the Bolling Bee Company of Bolling, Alabama, have also been tested, and the records of three of these are included in the data. The foundation stock for these Caucasians was obtained from the Tiflis Experiment Station, U. S. S. R.

The Italian Race of Bees. The so-called black bees of early colonial days were introduced into this country about 1638. These bees were not well suited to conditions in this country, but practically no effort was made to improve them. The yellow Italian bees of north central Italy were not generally recognized until the middle of the 19th century. These yellow Italians were first taken to Switzerland by Conrad Von Baldenstein in 1832. Ten years later Dzierzon, after hearing favorable reports from Switzerland, made the first importation of Italians to Germany. France received its first importation of these bees in 1856, and it is probable that the first yellow Italians arrived in the United States in 1859.

These Italians were far superior to the old blacks of earlier importations. They seemed to fit the needs of the American beekeeper who began to build up the stock by careful selection and breeding. As a result, it has always been easier to get good Italian stock than any other race in the United States. This fact may account for the rather general popularity of the Italians today.

In this experiment the strain of Italian bees of no particular breeder was favored. Rather, an endeavor was made to introduce Italian bees from several of the leading breeders of these bees in the United States.
METHODS

Honey Production Records. The basis for the figuring of seasonal honey production records was a gross weight of 110 pounds per colony at the close of the honey flow, which assured ample stores for winter. The final reduction of the colonies to this weight was made for all colonies in the experiment on the same day. Of course, not all colonies used the same amount of honey during the winter. Those which consumed below a normal amount had that much advantage during the next season, and vice versa. This, obviously, does not distort the production record.

Full depth, ten-frame supers were used in the experiment and extracted honey was produced. The net production of honey was figured by subtracting the weight of empty supers from that of the full supers. In order to make this operation simple, the average weight of wet and dry supers with 7, 8, 9, and 10 frames was calculated. Thus it was necessary to weigh individually only the filled supers coming from the apiary. “Wet” supers were those which were returned directly to the apiary from the extractor, containing a certain residue of honey. “Dry” supers were those from which all residue honey had been removed, either by washing or by bees other than those on the experiment. The empty wet supers average in weight 22½, 21, 20½, and 19 pounds with 10, 9, 8, and 7 frames respectively. The dry supers averaged in weight 17, 16, 15½, and 15 pounds with 10, 9, 8, and 7 frames respectively.

Brood Rearing Calculations. There have been several studies of the rate of oviposition of the queen honeybee beginning with the classic investigation by Von Berlepsch in 1856, when he determined by actual count the laying of 3,021 eggs in one day. Nolan (1) gives a good resumé of the earlier investigations, which were largely based upon actual counts. The counting method, of course, is not applicable to extensive investigations, the work being both very tedious and time-consuming. Its accuracy, aside from the personal factor, is undeniable. In the case of seasonal studies based upon periodic counts, deviation in the length of the brood cycle is the only variable.
Nolan (1) in 1921 developed the photographic method of counting brood which was a vast improvement over the previous method of counting, especially in the saving of time. “Photographs were taken weekly of every frame containing sealed brood, and counts made later from the negatives, the sealed brood only being counted because of its greater clearness.”

Later Nolan (2) amplified his method and added to the speed of calculation by placing a net of wire, forming one-inch squares over the brood area. It was found that worker comb averaged 27 cells to the square inch.

Brunnich (3) seems to have been the first to use linear measurements and a mathematical formula for the counting of brood.

In the selection of a method for this study which would involve many colonies, naturally counting was eliminated. The photographic method was open to criticism because of the following reasons: 1. It is rather expensive when used for many colonies. 2. Complete disruption of the colony is necessitated every seven days, as all bees are shaken from the brood frames and these removed from the hive for a time during the process of photography. 3. Even with the aid of the wire netting to mark off the brood areas into one-inch squares, the calculation of the brood involves a great amount of time. 4. A curve from the data can be based only upon the total amount of sealed brood present at each seven-day period. Variability in the date of the capping of the larvae, which has been demonstrated by Milum (4), makes any further calculation very uncertain.

The use of linear measurements and the determination of brood from a mathematical formula eliminates the above objections. No expensive equipment is involved. The colony is manipulated for brood determinations but once in 21 days, and then there is not a complete disruption of the colony. The frames are removed one at a time, only part of the bees shaken off, measurements quickly made, and the frames immediately returned to the colony. Calculations of the amount of brood may be quickly transferred from a table, thus reducing the time factor to a minimum. Since the measurements include both sealed and unsealed brood, the method is independent of the time of the capping of the larvae.
This method has in common with others the factor of variability of the length of brood development. It is only possible to use the commonly accepted figure of 21 days as the average length of the developmental period. Milum (4) has shown that a variability in the length of the developmental period may range from "less than 197\% days to 24 days."

The measurement method here used has one fault peculiar to itself. The formula is based upon a mean of many observations. Deviations from this mean in individual brood areas occur in practically every case. Therefore, the working accuracy of the formula is contingent upon a normal curve of variations with a relatively small standard deviation.

The formula here used for the calculation of the amount of brood is: 
\[ 25.65 \left( \frac{ab}{4} \right) \pi, \]
or an ellipse multiplied by a constant. The axes of the ellipse are measured in inches, \( a \) being the maximum vertical axis and \( b \) the maximum horizontal axis of brood area. This area has been found to be, following the elimination of empty cells, 5% smaller than an ellipse. The constant, therefore, was derived by reducing the number of cells of brood to the square inch by 5%.

The formula was derived from an actual count of 58 brood areas from six colonies during August, 1930. Table I gives the data on these in a consolidated form.

The average total deviation per brood area for each colony between the brood calculated by the formula and the actual count is remarkably small.

The deviations of the brood data derived by means of the formula from actual counts of each brood area were used as a basis of deriving the standard deviation. This gave a standard deviation of \( 173\pm10 \). The average number of brood cells, by actual count for each of the 58 areas, was 1,402. This is a comparatively small standard deviation and indicates a fair degree of accuracy in the application of the formula even to individual brood areas. Usually from 10 to 20 brood areas are figured in each colony, which further reduces the possible error.
### TABLE I.

CONSOLIDATED RECORD OF COLONIES USED IN DERIVATION OF FORMULA

<table>
<thead>
<tr>
<th>Race</th>
<th>Age and Condition of Queen</th>
<th>Number of Brood Areas Counted</th>
<th>Av. Amount of Brood per Area by Actual</th>
<th>Av. Total Deviation per Brood Area for Colony Age (deviation from formula)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>Old and very poor, skipping</td>
<td>10</td>
<td>1634</td>
<td>15</td>
</tr>
<tr>
<td>Caucasian</td>
<td>Old queen, but still vigorous</td>
<td>8</td>
<td>1848</td>
<td>-83</td>
</tr>
<tr>
<td>Italian</td>
<td>Young queen in good condition</td>
<td>10</td>
<td>1158</td>
<td>21</td>
</tr>
<tr>
<td>Italian</td>
<td>Young queen in good condition</td>
<td>10</td>
<td>1104</td>
<td>28</td>
</tr>
<tr>
<td>Caucasian</td>
<td>Young queen in good condition</td>
<td>10</td>
<td>1346</td>
<td>88</td>
</tr>
<tr>
<td>Caucasian x Italian</td>
<td>1929 queen, doing poorly, and skipping</td>
<td>10</td>
<td>1410</td>
<td>-65</td>
</tr>
<tr>
<td>MEAN</td>
<td></td>
<td></td>
<td>1402</td>
<td>0.8</td>
</tr>
</tbody>
</table>

There is the possibility of criticism of the size of the sample used in the derivation of the formula. If one were attempting to make a study of the rate of oviposition only by this method undoubtedly it should have been much larger. However, in this particular case, the comparative seasonal rate of oviposition of two different races of bee was to be determined. As a consequence, any inherent error in the derivation of the formula applies equally to either race of bees. Furthermore, the polygon of the frequency distributions of the deviations of the formula computations from the actual count of the 58 brood areas superimposed upon the normal curve for this distribution shows a comparatively good fit, with the data clustering well about the mean.

Brood measurements were taken in this experiment every 21 days. The total amount of brood cells for each such period was then divided by 21 to reduce the data to the average number of eggs laid per day. The data are presented and analyzed in these units.

**Location and Manipulation Conditions.** Every colony of both races of bees in the experiment was kept in the same environment throughout all seasons of the year. During the summer all the bees were removed to and kept in the same outyard. For the winter
period they were moved into winter quarters at the University, and all those colonies which were to be returned to the experiment the following season were given the same type and degree of winter protection.

In the case of package bees, every possible effort was put forth in order to give all of them similar conditions of establishment. In so far as their food and location were concerned, this was possible. However, in the receipt of package bees from several sources it was not always possible to get and establish all of them on the same day. But this variation was reduced to a point where it is doubtful if there was any material advantage gained by any colony or group of colonies received first.

Variations in manipulation practices were reduced to a minimum. In general, manipulations were the same as they applied to the individual needs of the colonies. Everything possible was done to insure the maximum yield of honey by each and every colony. A surplus of storage room was always available. When the honey flow was good, the colonies were supered once a week. In supering, two important manipulations were always made. First, empty supers were lowered to a position immediately over the brood chambers, and the partially filled supers raised. Second, full combs of honey, which were free from brood, were lifted from the brood chambers and placed in the upper storage supers. This latter manipulation is very important in this location, especially if the honey flow is not good. The queen was given access to two hive bodies throughout the season, which gave ample room for maximum oviposition when the honey was regularly removed from these brood chambers.

Swarming was completely eliminated throughout the course of this experiment.

Each season a certain number of abnormal colonies developed. Disease, supersedure, accidental death of queens, or other cases of abnormality, were considered just cause for removing affected colonies from the experiment. The records of such colonies were disregarded. However, when a colony had either a poor brood rearing or production record or both, and its seasonal record was normal, it, naturally, was not removed from the experiment.
HONEY PRODUCTION

Naturally the most important measure of the characteristics of a race of bees is its propensity for honey production. Table II summarizes the honey production record. Figures 1 and 2 contrast production records of the two races. The weather data for the active season during these years may be found in Table III.

It is clear that this location is not a good one for commercial honey production. Since the Caucasians are shown to have their maximum advantage over the Italians during the poorer years, perhaps their greater propensity for honey production is slightly exaggerated. The season of 1930 was an especially good one, and the contrast may be fairer. Even then, the Caucasians produced 71 per cent more honey than the Italians.

![Honey Production 1930](image)

Figure 1. Individual honey production records, 1930. Each bar represents a colony. The solid bars indicate the average for either group.
### Table II. Comparative Honey Production Records by Years

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Honey Production Per Colony</th>
<th>Differences in Favor of Italians over Caucasians</th>
<th>Percentage Greater Production by Italians of Caucasians</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Caucasians</td>
<td>Italians</td>
<td>Pounds</td>
</tr>
<tr>
<td>1926</td>
<td>160 6</td>
<td>23 1</td>
<td>137 5</td>
</tr>
<tr>
<td>1927</td>
<td>44 5</td>
<td>1 8</td>
<td>42 13</td>
</tr>
<tr>
<td>1928</td>
<td>92 13</td>
<td>48 5</td>
<td>44 8</td>
</tr>
<tr>
<td>1930</td>
<td>320 2</td>
<td>187 3</td>
<td>132 15</td>
</tr>
<tr>
<td>1931</td>
<td>80 0</td>
<td>40 6</td>
<td>39 10</td>
</tr>
</tbody>
</table>

**Figure 2.** Individual honey production records, 1931. Each bar represents a colony. The solid bars indicate the average for either group.
<table>
<thead>
<tr>
<th>Year and Month</th>
<th>Sunshine in Days</th>
<th>Precipitation in Inches</th>
<th>Temperature °F.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clear</td>
<td>Partly Cloudy</td>
<td>Cloudy</td>
</tr>
<tr>
<td>1926 May</td>
<td>11</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>June</td>
<td>11</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>July</td>
<td>9</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>August</td>
<td>12</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>September</td>
<td>15</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Totals</td>
<td>58</td>
<td>80</td>
<td>15</td>
</tr>
<tr>
<td>1927 May</td>
<td>6</td>
<td>23</td>
<td>2</td>
</tr>
<tr>
<td>June</td>
<td>8</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>July</td>
<td>12</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>August</td>
<td>13</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>September</td>
<td>11</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Totals</td>
<td>50</td>
<td>91</td>
<td>12</td>
</tr>
<tr>
<td>1928 May</td>
<td>14</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>June</td>
<td>7</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>July</td>
<td>12</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>August</td>
<td>8</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>September</td>
<td>13</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>Totals</td>
<td>54</td>
<td>69</td>
<td>30</td>
</tr>
<tr>
<td>1930 May</td>
<td>16</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>June</td>
<td>24</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>July</td>
<td>15</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>August</td>
<td>11</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>September</td>
<td>16</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Totals</td>
<td>82</td>
<td>56</td>
<td>15</td>
</tr>
<tr>
<td>1931 May</td>
<td>9</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>June</td>
<td>13</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>July</td>
<td>13</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>August</td>
<td>6</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>September</td>
<td>14</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Totals</td>
<td>55</td>
<td>69</td>
<td>29</td>
</tr>
</tbody>
</table>

**BROOD REARING RECORDS**

In this study no attempt has been made to correlate brood production with environmental factors. The primary object has been to compare the brood rearing characteristics of the two races of bees under identical environmental conditions in order to determine which race is better adapted to this region. The consolidation of the seasonal records of all colonies in the experiment are given in Table IV.* These are graphically represented in Figures 3, 4, 5, 6, and 7.

*The production and brood rearing record of each colony in this experiment may be secured by writing to the Wyoming Agricultural Experiment Station, Laramie, Wyoming.
Figure 3. Averages of five Caucasian and five Italian packages.

Figure 4. Averages of four Caucasian and five Italian overwintered colonies.
Seasonal Characteristics. Three outstanding differences in the seasonal characteristics of brood rearing between the Caucasian and the Italian bees are apparent. They are:
1. During the early part of the season and up until the main honey flow starts, about July 15, the Caucasians consistently far outstrip the Italians in brood production. This is shown to be the case in every instance on the graphs. The three brood rearing cycles prior to the beginning of the main honey flow are exceedingly important, as it is during this period that at least 75 per cent of the bees which gather surplus honey are reared. The relationship of the two races of bees in this regard is seen in Table V. For the three years the Caucasians have a 22.6 per cent advantage over the Italians in the amount of brood reared from May 14 to July 15.

2. During the honey flow, the Italians have a marked tendency to a larger production of brood than the Caucasians. On an average for three years, the Italians produced 7.1 per cent more brood than the Caucasians during two brood cycles of the honey flow.

3. The Caucasians consistently produce far less brood during the period of decline of the honey flow on into early fall than do the Italians. They also completely stop brood rearing from two to three weeks earlier than the Italians.
<table>
<thead>
<tr>
<th>Year</th>
<th>Race</th>
<th>Number of Colonies</th>
<th>Average Honey Production in Pounds</th>
<th>Average Number of Eggs Per Day at Median Date of Period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>June 3</td>
<td>June 24</td>
</tr>
<tr>
<td>1928</td>
<td>Caucasian</td>
<td>9</td>
<td>92.93 ± 9</td>
<td>969 ± 50</td>
</tr>
<tr>
<td></td>
<td>Italian</td>
<td>10</td>
<td>48.45 ± 5.19</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>April 17</td>
<td>May 8</td>
</tr>
<tr>
<td>1930</td>
<td>Caucasian</td>
<td>8</td>
<td>320.16 ± 18.37</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Italian</td>
<td>9</td>
<td>187.24 ± 18.60</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>May 3</td>
<td>May 24</td>
</tr>
<tr>
<td>1931</td>
<td>Caucasian</td>
<td>11</td>
<td>80.03 ± 8.98</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Italian</td>
<td>8</td>
<td>40.34 ± 5.74</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE IV.**

**SUMMARY OF PRODUCTION AND BROOD REARING RECORDS**

**Wyoming Agricultural Experiment Station Bul. 186**
March, 1932  A Comparative Test of Honeybees

TABLE V.
COMPARATIVE BROOD PRODUCTION DURING THREE PRE-HONEY FLOW CYCLES
AND TWO HONEY FLOW CYCLES

<table>
<thead>
<tr>
<th>Average Total Brood Per Colony</th>
<th>Average Number of Eggs Per Day Per Colony</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>May 14—July 15</td>
<td></td>
</tr>
<tr>
<td>Caucasians</td>
<td>Italians</td>
</tr>
<tr>
<td>63,410</td>
<td>51,723</td>
</tr>
<tr>
<td>July 16—August 27</td>
<td></td>
</tr>
<tr>
<td>Caucasians</td>
<td>Italians</td>
</tr>
<tr>
<td>41,759</td>
<td>44,726</td>
</tr>
<tr>
<td>May 14—July 15</td>
<td></td>
</tr>
<tr>
<td>Caucasians</td>
<td>Italians</td>
</tr>
<tr>
<td>1006</td>
<td>821</td>
</tr>
<tr>
<td>July 16—August 27</td>
<td></td>
</tr>
<tr>
<td>Caucasians</td>
<td>Italians</td>
</tr>
<tr>
<td>994</td>
<td>1,065</td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
</tr>
<tr>
<td>1.297</td>
<td>1.065</td>
</tr>
</tbody>
</table>

Individual Variation Within the Races. In the manipulation of bees in the commercial apiary, it is very desirable to maintain the colonies as nearly uniform as possible. Hence, a race or strain of bees with a small variation in brood production would be superior to one with a large variation, other conditions being similar. A study of the variation in brood production for the critical month of June, July, and August for three years was made. The coefficient of variation based upon the standard deviation was: Caucasians, 30.3% ± 0.028, and Italians, 30.8% ± 0.028. This clearly shows that in the case of the colonies studied there is no advantage in favor of either race in the amount of variation of brood production during the summer months.

Effects of Seasonal Brood Production Upon Honey Production. At least a portion of the greater honey production of the Caucasian bees over the Italian bees may be accounted for by differences in their seasonal brood rearing characteristics. Perhaps the most important factor here involved is the more rapid building up tendency of the Caucasians prior to the main honey flow.

The difference in the brood production of the two races during the main honey flow may partially account for some of the differences in honey production. The rearing of a larger amount of brood during this period by the Italians would retard maximum surplus honey production for two reasons: first, a larger propor-
tion of bees would be essential for hive duties, thus cutting down on the field force; second, a larger proportion of the nectar gathered would be needed for the feeding of the developing brood.

These two factors, although unmeasurable from these data, are doubtless of importance in the greater production of honey by the Caucasian bees. Yet it is clearly recognized that they do not account for all of it. It seems altogether possible that inherent characteristics, likely in their reaction to environment, are even more important. Additional research is necessary to establish this relationship.

MINOR OBSERVED CHARACTERISTICS

During the course of these experiments observations were made upon the minor characteristics which have a bearing upon the use of a particular race of bees in commercial beekeeping. These characteristics may vary greatly with strains and with environmental differences. However, the points here mentioned have been consistently apparent.

Temperament. Basing a comparison on seasonal manipulation, Caucasians are the most gentle bees ever used at the University of Wyoming. In this respect they are far superior to all Italians with which they have been compared. If Caucasians are handled roughly or disturbed by a thief they resist furiously and protect their hives well. If Caucasian colonies are opened during bad weather they are sometimes more difficult to handle than Italians. This has been noticed from time to time in experimental work when records must be taken regardless of weather conditions. It is a common occurrence for Italians to follow a beekeeper about the yard, continually striking at the veil and hat. In some instances bees from other hives are attracted by the disturbance, and finally there are literally hundreds of them flying desperately about one's head. Such a condition has never been observed in an apiary of Caucasians. If they do become enraged they sting immediately, or, after striking the object, they crawl about seeking a spot to sting.
While it is difficult to compare the sensation following a bee sting, it has generally been recognized by all who have manipulated bees at the University that the sting of the Caucasian is more painful than the sting of the Italian.

**Swarming.** Swarming has never been a problem in the University apiaries. All colonies are used on experiment and are manipulated regularly. Queen cells are carefully removed, and the colonies are never permitted to become crowded. All colonies are manipulated for extracted honey production. Swarming propensity is cut to a minimum under this system of management. However, it is indeed significant that, during the past seven years, not one Caucasian colony has swarmed. Some colonies have been prepared to swarm, but ordinary methods of swarm control have been very successful.

During the same time three Italian colonies swarmed. It has been observed that the Italians prepare more queen cells, which fact might be interpreted as showing more tendency to swarm. From these observations it seems logical to assume that the Caucasians are not more addicted to swarming than the Italians.

**Robbing.** Observations made during these experiments have shown that Caucasian bees are not as active during the robbing season as are the Italians. It cannot be said that Caucasians do not rob, but they do not rob on a wholesale plan. This fact is of utmost importance in the control of bee diseases, especially American foulbrood. A weak or deserted colony in a Caucasian apiary will be robbed, but the activity will probably be confined to a very few colonies.

In an Italian yard robbing is rather general.

**Comb Building.** The dark races of bees, particularly the Caucasians and Carniolans, have long been recognized as producers of beautiful, white cappings on the honey cells. Caucasians produce an abundance of wax and draw foundation rapidly. If the hives are not equipped with properly proportioned bee ways, or if the colony becomes crowded, the excess of wax is used to build burr and brace combs. If badly crowded, the bees will fill the
space between supers with burr combs in which they will store and cap honey. This is also done by Italians when they are extremely crowded, but not to the same extent. In some instances the Caucasians jam the queen excluder with combs and honey. It has often been found necessary to remove the burr comb from the top bars of the frames. If this is not done it sometimes becomes difficult to remove frames. It is also a common occurrence to find the two outside frames attached rather firmly to the hive body. These are very noticeable characteristics of Caucasian bees, which are almost entirely absent in the Italian colony.

**Propolisation.** The supposedly lavish use of propolis by the Caucasian bees has long been a subject of discussion, and they have been condemned severely for this practice. Excessive propolisation has not been encountered, and has, therefore, not been a problem in manipulation of Caucasian bees during the course of investigations at this Experiment Station. These bees do, in some instances, reduce the size of the entrance and close holes and cracks in the hive body with propolis. This practice has its advantages, and no serious objection has been found.

In a few instances the bottom bars of some of the frames in the brood chamber were attached to this entrance block of propolis, but such cases are rare. The rather general propolisation of all frames so that they are removed with difficulty from the hive body has never been observed in any Caucasian colony here.

**Disease Resistance.** Caucasian bees, as well as Italian, are susceptible to American foulbrood. Once the organism gains entrance in the hive the colony gradually weakens and eventually dies.

Sacbrood is found in Caucasian and Italian colonies.

No observations have been made at this station on the ability of Caucasians to resist European foulbrood.

**Comparison of Package Bees.** In a comparison of standard three-pound packages received early in May it was found that Caucasians reared brood faster and were able to build up more rapidly than Italians. During the dearth of nectar which fol-
lowed the cessation of the dandelion flow the Caucasian colonies continued to build up, draw foundation, and provide sufficient nectar for brood rearing. Brood rearing came to a standstill in the Italian colonies, and all of them had to be fed.

_Miscellaneous._ In general, it may be said that Caucasian bees require more careful manipulation than Italians. The hives should be equipped with close-fitting frames which provide proper beeway throughout the hive. A careless, slipshod beekeeper may be more successful with Italians.

If the dark color of the Caucasian bees makes it difficult to find the queens they may be marked with red or yellow markings. This, however, is not a serious matter in commercial beekeeping.

Caucasians cease brood rearing early in the fall, while the Italians continue until cold weather prevails. The brood chambers of Caucasian colonies are always heavy with new honey in the fall, while the Italian colonies are light. This is an advantage of Caucasians over Italians when the colonies are prepared for winter.

**SUMMARY**

1. Linear brood measurements and the use of a mathematical formula are practical as a means of making comparative studies of brood production.

2. The Rauchfuss strain of Caucasian bees produce far more honey in this environment than Italian bees from many of the leading strains of this country. The minimum advantage of the Caucasians in honey production is 71 per cent over a five-year period.

3. In brood production, the Caucasians build up more rapidly than the Italians before the main honey flow, the Italians produce more bees during this flow, and then the Caucasians decrease brood rearing more rapidly and bring it to a close earlier than the Italians at the end of the season.

4. In minor characteristics the Caucasians seem to be superior to the Italians in the following regards: temperament, robbing, whiteness of honey cappings, and concentration of winter stores
in the brood chamber. Italians have one distinct advantage in the building of fewer brace and burr combs, and the doubtful advantages of less propolization and the ease of finding unmarked queens.

LITERATURE CITED

(1.) Nolan, W. J.

(2.) ................

(3.) Brunnich, Karl.

(4.) Milum, V. G.