State of Iowa

1928

REPORT OF THE

STATE APIARIST

FOR

The Year Ending December 31, 1928

Also Report of the Convention of the Iowa Beekeepers' Association in Cedar Rapids, November 16-17, 1928

F. B. PADDOCK, STATE APIARIST

Ames, Iowa

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LETTER OF TRANSMITTAL

HON. JOHN HAMMILL, *Governor*—

SIR: As required by law, I herewith transmit to you my tenth annual report as State Apiarist for the year ending December 31, 1928.

F. B. PADDOCK, *State Apiarist.*

Ames, Iowa, February 14, 1929.

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REPORT OF THE STATE APIARIST

REVIEW OF THE YEAR

The honey producers have been confronted again with unusual conditions under which colony management has been difficult. It was extremely difficult to retain colony strength and morale with which to harvest a maximum crop of honey. The bees of the state in general went into the winter of 1927-28 with good colony population and ample stores. More than the normal number were given winter protection, especially some type of out-door packing.

November temperatures were below normal and precipitation was light and scattered. Wintry weather prevailed during most of December. One severe storm brought most of the snow which did not remain on the fields. Mild winter weather prevailed during most of January, so that any kind of outdoor work was possible. The bees had a very good flight period which was of great value to unprotected colonies and an aid to packed colonies. There was practically no snow so that alternate freezing and thawing was hard on plants. February was considerably warmer than normal but dry. Crops were damaged by lack of snow covering. Outdoor work was possible and the bees enjoyed two periods of flight. The temperature during March was much above normal, so much outside work was possible. There was much alternation of freezing and thawing which was hard on field crops. Vegetation advanced rapidly and fruit buds swelled prematurely. Soft maple, and elm came into bloom early and were worked heavily by the bees with the result that brood rearing was well established in most all colonies. Precipitation was deficient over most of the state.

A great change occurred in April to the wonderful winter and early spring weather. Temperatures were continuously below normal with frequent severe freezes which further damaged field crops. However, fruit was benefited since budding was retarded. Precipitation came in heavy, damaging snow storms. Bees were forced to draw heavily on stores to maintain brood rearing and many colonies pulled out unsealed larvae. The balance of brood rearing was decidedly disturbed and on the whole the colony organization was worse than normal.

Temperatures above normal prevailed during May but the pre-

cipitation was hardly half normal. These conditions had a decided effect on field crops and early sources of nectar. Bees again brooded up heavily but at great expense to reserve stores. Toward the end of the month many colonies were starving and others had to be fed. This situation led to much robbing which is such a fruitful source of disease spread. This year gave another wonderful chance to find diseased colonies as the reserve stores were used freely so any disease germs in "Carrier" colonies had a chance to show up in the brood. Disease seemed to be much more prevalent than normal and beekeepers everywhere were confronted with the problem of treatment or destruction. One fact comes out of such a season as this. There are many people handling bees who do not even know that any disease may occur in their bees. Under such conditions the disease usually makes much headway before it is discovered. Such people are seldom prepared to treat diseased bees and they become indifferent to the problem so they become a menace to the honey producing industry.

The feature of the June weather was the persistent coolness. This had an interesting effect on beekeeping. It was expected that colonies would have an opportunity to get up to strength before the honey flow started and thus obtain the maximum returns. However, the flow was so long delayed that colonies started on a swarming rampage such as is seldom experienced, even by old beekeepers. It is interesting that this problem was so severe and so general over the state regardless of local conditions and type of honey produced.

The flow continued strong throughout July with favorable weather conditions. The temperature averaged normal but the precipitation was in excess of normal. The moisture caused a heavy late growth of many nectar producing plants so that the season was somewhat longer than normal. In fact the summer flow continued well into August in some areas. Along the Missouri river the climatic factors had the opposite effect as the honey flow there cut off abruptly two weeks earlier than normal. Local beekeepers attributed this to the persistent rainfall.

The honey crop for the season of 1928 was estimated at 87 per cent normal. This seemed like a short crop but it must be remembered that the 1927 crop was estimated at 110 per cent. Relatively the crop of Iowa this year was better than in most states. The crop of this year was somewhat spotted and in small spots.

The sweet clover plant was again the most dependable source

of nectar although it was influenced both ways by climatic conditions prevailing in different areas. Basswood yielded unusually well in most areas, as there was a heavy set of bloom and excellent weather for gathering the nectar. The white dutch clover seems to be more variable in nectar yield than any of the regular plants. The fall plants produced an unusual amount of nectar over much of the state which aided greatly in getting the bees in shape for winter.

Cold weather prevailed during September with one period of precipitation and the sunshine was much above normal. October continued with good temperatures and well scattered rains. Bees were able to build up in population and stores to go into winter in excellent condition. More bees than usual were given outdoor protection and this was provided earlier than usual. Cellar wintering can never be as successful as outdoor protection under the conditions which prevail in Iowa during the fall and spring.

HONEY PRODUCTION

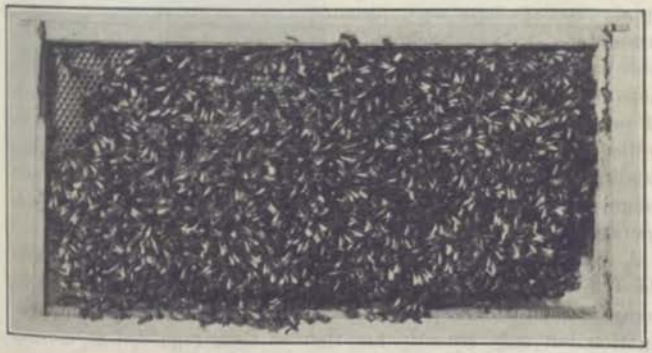
The problem of production is vital in any industry and in beekeeping there are so many factors which are unsolved that the situation is extremely difficult. The price which the producer gets for honey is not based on the cost of production but on what can be obtained. The cost of production is not known so it cannot be used for the basis of price. Attempts have been made to induce beekeepers to keep records in an effort to arrive at a cost price. Today we cannot even guess intelligently, much less estimate what honey production costs. The government has recently undertaken a study among some of the larger producers to ascertain what factors contribute to the costs. This work has already shown many producers that they are extremely inefficient in their methods of operation. If money cannot be made for the producer at present prices there are two plans to follow. The first is to raise the price of honey and the second is to reduce the cost of production. The first plan is not so easy and is almost out of the hands of the producer. The second plan is within the power of the producer. The cost of production must be reduced by better practices such as first class equipment, a race of bees better adapted to honey gathering in a region, better swarm control, more successful disease control, more careful winter practices to reduce the 15 per cent losses. Some producers are making money today in spite of all these handicaps and others are not. Some few are making headway to reduce these handicaps.

There is an increasing interest throughout the north in the use of package bees. These have been used quite often, to make a start in beekeeping and this plan is as good as any which could be suggested. It offers a means of getting clean stock operated in clean equipment, which is a foundation stone to successful production. Many producers have employed packages to make up losses, either from winter or disease. Some have introduced packages into weak colonies but the value of this is open to debate. There have been advocates of the practice of killing all colonies

A yard established from packages

at the end of the honey flow and restocking the equipment, with packages the following spring. Experiments were conducted by Dr. O. W. Park of the Iowa Experiment Station as early as 1918 on the cost of producing honey with packages and over-wintered colonies. He found that the cost was practically equal for conditions existing in central Iowa. Last year A. F. Karsten of northeast Iowa gave results in favor of packages, even two pounds, in that region. In more northern regions more beekeepers are adopting the package type of production. The evidence at hand would make this plan worthy of trial by honey producers. There is still another angle of the package production as outlined by Morley Pettit of Ontario, Canada. His methods have been unusually successful in the past but the new plan may be even more successful. His proposal is to unite the colonies in the fall and replace the half with packages in the spring. This would automatically requeen every other year and it would reduce the swarm control problem. This is only a step from the Colorado plan which is to double each fall and each spring make the increase from within the yard by new queens. One of the cuts in cost of production must come from reduced winter loss. It may be cruel to kill bees after the honey flow but it is equally as cruel to let bees go through the winter without protection and scant stores so that they may starve to death in an effort to meet a situation which is forced on them by the indifferent beekeepers.

The improved apiary practices for the last quarter of a century have revolved around good stock. The program has been to secure one race of bees to serve under the varied conditions throughout the length and breadth of this land. There can be no question but that much good has resulted from the interest in good stock and frequent improvement of apiary strains. However, the time is at hand when we need to do more good in order to secure still better results in honey production. It is expecting too much of any race, regardless of its merits, to meet all local conditions. It is not done in any other form of animal or plant life, as cattle, poultry, fruits and small grains. It is not sound business for the honey producers to hang on longer to a legend or tradition. The last year or two have seen much interest develop in a race of bees which might meet local conditions better than they are being met now. It is not safe to assume that any one other race will do better under all situations than the one being used now. Work is being done now in several widely scattered districts which indicate that another race of bees will bring greater returns to the



Better stock is essential

producer. This may be due to the ability of the race to winter better, work under unfavorable conditions, resist disease or gather nectar from plants with longer coralla tubes.

The producer must sense the pasture changes that are taking place. Iowa beekeeping has seen white clover go out and sweet clover come in. During the last decade white clover has been less dependable each year as a source of nectar for reasons thus far unexplained. Crops are now uncertain and cannot be forecasted as was the case former years. Beekeepers and apiaries have disappeared in the old white clover belt and any revival of production in this area is due to the coming in of sweet clover. Sweet clover made its real start in Woodbury county and has spread in all directions, first, the increase was largely along the river but recently the spread is eastward across the state. In the spring of 1928 ten thousand acres of sweet clover were planted in Boone county. All of this acreage will not be directly available as pasture for bees, some will be used as a green manure crop, some cut for hay but some will be used for stock pasture and some for seed. There is always some sweet clover getting established in the so-called waste spots. The demonstration apiary results in Boone county indicate very good territory for honey production. There are good possibilities for the beekeeper in those areas where dairy interests use sweet clover for pastures.

The disease situation is always interesting and is mentioned here only briefly. European foulbrood was not uncommon ten years ago. In some areas it was prevalent every spring, in other areas the disease would appear only during the unfavorable seasons. Requeening with a good stock of Italian bees and more active apiary management were recommended. This disease is seldom encountered today. Sacbrood is seen so seldom that it is not possible to make any correlations between its occurrence and conditions of environment. American foulbrood is a factor in the cost of production. It has been shown that the disease can be controlled by area clean-up methods and it can be cleaned up in a locality by a solid community effort, after an educational campaign. It takes time and money for this work as well as the cooperation of the beekeepers.

A very close inter-relationship is developing rapidly between the fruit grower and the beekeeper. It had been recognized for many years that the honey bee was an important agent of pollination but only recently has the bee been regarded as a necessity. This situation has developed along with intensive plantings of specialized crops. The grower of prunes, pears and apricots in California has been renting bees for the period of pollination. The cherry industry of the northwest did not flourish until plenty of bees were placed in the orchards to insure ample set of fruit. Bees are rented extensively in New Jersey to aid in the set of fruit in apple orchards and very satisfactorily results have been obtained in Illinois by the use of bees scattered throughout apple orchards. The practice has been established in Michigan of renting bees for the pollination of cherries. The wonder is expressed now if there will be enough bees in these localities to meet the demand of the fruit grower. Studies have been made on the management of getting the bees into and out of the orchard and also of the best distribution within the orchard.

There is certain to be a growing appreciation of the value of the bee in the pollination of truck and greenhouse crops. The importance of the bee in the growing of strawberries and raspberries especially will demand consideration when these crops are grown in large acreages. Bees are now used in the large greenhouses for winter pollination of cucumbers and tomatoes.

T. W. Blackman has found bees of value in his fruit and truck business.

The value of the honey bee in the pollination of clovers especially is well known but not generally appreciated. The extensive growers of sweet clover seed in North Dakota were anxious to secure plenty of bees and made inducements to beekeepers for the establishment of apiaries throughout the territory. The importance of the honey bee in the pollination of medium red clover is not fully realized. The importance of the bumble bee in this instance is entirely overrated and founded upon legend.

The development of beekeeping is coincident with the modern plan of general agriculture. The two must be closely associated

for the greatest success of either. As the sweet clover acreage increases the opportunities for profitable honey production will improve. The welfare of the fruit grower and the beekeeper are mutual in a similar manner. Nectar is produced in nature by many flowers which represents a natural resource of the soil. The honey bee is the only agent which can convert this raw product into a finished product for use by man. When nectar is not collected by the bee it is lost to man. It can be said that many times as much nectar is produced as is gathered by the bee and made available for human consumption. When all attention is directed to the utilization of by-products it is certain that the importance of the honey bee can not be overlooked. The functions of the bee are distinctly two-fold; for crop increase through more perfect pollination of fruit and seed and the conservation of nectar for honey as a further food for man. It must be remembered that the honey bee is of more value to the agriculturist in general than the beekeeper in particular.

CROP DISPOSAL

It is only natural for some to feel that too much attention is being given to increased production. It is the opinion that there is already an over-production of honey, especially in view of the increase which has been accomplished in the last ten years. In reply to such argument let it be said that the increase in production of honey has only kept up with the increase in population in this country. The consumption of honey in the United States in 1914 was 2 pounds per capita and in 1928 the consumption was still 2 pounds. The production of honey in this country is estimated at 2½ pounds per capita. No other nation has a honey consumption as low, even Italy has a per capita consumption of 11 pounds and Germany tops the list with 45 pounds. The United States is exporting more than 11,000,000 pounds of honey annually to such countries as Great Britain and Germany. These countries will accept only the superior grades of honey properly prepared and in the best of packages.

The future of honey consumption in the United States is the concern of the producer. There is every reason to believe that more honey will be used each year in this country. There are three important agencies at work on this problem now and the results are beginning to show what may be expected in the future. The Kellogg Company of Battle Creek, Michigan, is recommending the use of honey in connection with their foods. The word honey

appears on every package when over a million are produced daily, and in every piece of advertising including store window decorations. The home economics staff of this company is constantly testing new recipes for the use of honey.

The work of the American Honey Institute under the direction of Dr. H. E. Barnard at Indianapolis is gaining by great strides. A big effort of the Institute has been the connection with the baking industry of the United States. The use of honey in cakes is now being urged through the schools for bakers maintained by the Fleischmann Yeast Company. Preserves and Honey, Inc. was organized this year after the purchase of the four largest existing bottling plants of honey. This company has been able to treble the sale of honey at the end of three months' effort and they are now engaged in an extensive radio advertising campaign in and around New York. This company has great plans for the future increase in the use of honey by the consuming public.

There is another means of crop disposal which is available to producers everywhere, co-operative marketing. This plan has been in operation many years in Colorado but it has not spread rapidly. More recently the Inter-Mountain States Association was developed and the results have been very satisfactory. There is now one co-operative in Iowa, the Sioux Honey Company of Sioux City. The results of this organization have been equal to the expectations of any of its members. Co-operation is the means which has been widely recommended as a relief measure for agriculture and is considered by many as a magic word. According to Ed. G. Brown co-operation is merely the name of a system of loyal, honest endeavor by which a people can lift themselves to a higher level of living. There are three things required for the successful operation of co-operative marketing. Loyalty of membership is probably the most essential, but the manager must be one who has been trained in modern business methods and who has a vision, and inadequate financial backing has had much to do with the failure of many co-operatives.

Honey prices during the fall of 1928 tended to rise in the carlots, whereas in a retail way there has been no such strengthening and in some instances there has actually been a weakening. Perhaps this has been caused by the volume of export sales, perhaps by the increased activity of the newly formed combine, "Preserves and Honey"; likely both. These two agencies must have carlot shipments to be economical. And now comes the pooling of several

cars of honey by Louisiana beekeepers to New Orleans, a blending of the same, and carlot shipments in turn. Will the markets in the future become wholesale or jobbing markets, asks the American Bee Journal.

The big reason why more honey is not consumed in this country is that the people are not made to want it more than they want a corresponding article of food. The producer in a feeble way has been trying to get honey used but this method has not brought results. Most producers do not know enough about honey to be able to tell its merits and superior points. In the case of any other article of food the marketing agency is telling the public. Every company has a staff to find out the merits of their food and how to use it in ways which are better than any which have been proposed before. It is to be hoped that honey may yet be taken in and treated as other food items are so that the public may be told in an impressive manner. All indications point to the beginning of a new era of marketing and consumption of honey.

EDUCATIONAL

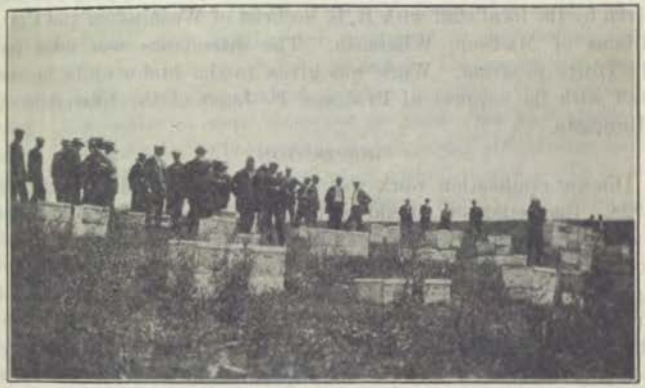
During the season of 1928 the Agricultural Extension Service, through its apiary specialists, has conducted demonstration apiaries in eleven counties. Twenty-three apiaries were established which were composed of 480 colonies of bees. The specialists actually operated 115 colonies and 365 colonies were "check" colonies or those operated by the owner. The check colonies were supposed to be operated according to the previous practice of the owner. The demonstration colonies were operated in accordance with the principles advocated in all information given out regarding modern apiary practice.

The 1928 yield of Iowa honey placed the average colony production at 70 pounds, which is below the three-year average. It is evident that the owners of the demonstration colonies absorbed some information immediately or were above average producers. The average production of the check colonies was 100 pounds per colony, an increase in returns of $3.00 per colony. The demonstration colonies showed an average yield of 147 pounds per colony, a trifle more than double the State average colony production. This means an increase in the returns per colony of $4.70 above the demonstrators or $7.70 above the state average. These apiaries were scattered over the state and represent all types of producing conditions.

The production of all colonies of the demonstration apiaries was

53,400 pounds of honey, which has a market value of $5,340. This amount of money was actually returned to beekeepers who served as co-operators in the demonstration apiary work.

Extension field work in beekeeping was conducted in 39 counties during 1928. This work consisted of demonstration apiaries, special meetings, general inspection, and area clean-up work. During the year 248 meetings were conducted and 1,016 apiaries were visited in connection with this work. Inspection visits brought



A field meeting in Woodbury County means an interesting day

the total number of persons given personal assistance as 4,710. There is no way to estimate the value obtained from extension work by those who attended the meetings and put into operation some practice which might increase production. There is no way to estimate the value obtained by a community when disease is cleaned up in apiaries where it is found. There is no way to estimate the value to beekeepers in general by the increase in honey sales. The co-operative purchase of equipment, bees and queens can be shown to save a very definite amount. It is hard to estimate the value to the industry of the state through the introduction of 3,000 pure stock queens as a result of extension effort.

The Beekeepers' Bulletin was sent every three months to over 17,500 people in Iowa who are interested in keeping bees. The object of this publication is to disseminate timely information and news items of general value, all having a definite education value. This publication serves a definite purpose to improvement for the

industry of this state. A circular of 4 pages on the Uses of Honey was sent out on request, about 3,500 were used. About 4,000 copies of a circular of 6 pages on the Installation and Care of Package Bees were needed for distribution. Bulletin No. 138 "Diseases and Pests of the Apiary" was used in all lines of work as a ready reference. The demand was heavy for Bulletin No. 142 "Wintering Bees in Iowa."

The annual short course for beekeepers was held for 4 days during the Farm and Home Week in February. The program was given by the local staff with E. L. Sechrist of Washington and C. D. Adams of Madison, Wisconsin. The attendance was good for the entire program. Work was given to the junior clubs by the staff with the support of Professor F. Jager of the University of Minnesota.

INSPECTION

Disease eradication work was conducted in 32 counties during 1928. Inspection on special request was done in 17 counties; on locality basis in 10 counties and on the area clean-up basis in 5 counties. The number of colonies examined was 21,211 in 816 apiaries. Disease was found in 1,368 colonies, 543 were destroyed and 521 treated either by the owner or inspector. The returns to the industry from inspection work is hard to estimate. Any colonies which were treated and put on a production basis have a value of $10.00 as against no value if left diseased. This will mean a returned inventory value to the industry of $5,210 for 1928. These treated colonies will produce an average of 60 pounds of honey for market, which gives a cash income to the industry of $3,126 making a total of $8,336 as a direct cash return to the industry from inspection work. A factor which cannot be given a cash value is the indirect value of eliminating disease in a yard, territory or area.

CLEAN-UP WORK IN 1928

The work during 1928 was conducted with a reduction in staff inasmuch as no temporary help was employed during the summer. This change was made necessary through a reduction of funds available for inspection purposes. The permanent organization of the inspection force permitted a concerted effort on early work with satisfactory results. There is much work to be done by an inspector at times when it may not be possible to open hives for colony examination. It is possible to locate many obscure apiaries

and prepare the owner for inspection later. A big feature of this early work is the detection of empty hives and the treatment or destruction of them. One of the most fruitful sources of the spread of foulbrood is the early spring robbing. Unprotected honey is almost certain to be found by bees for there is no nectar flow to attract their attention. The modern beekeeper is fully aware of the situation and fearful of results. The indifferent beekeeper is a menace to the industry and a serious handicap to disease clean-up effort.

It was possible to time the clean-up work to coincide with honey flow conditions. Reinspection for treatment or destruction took considerable time but was fully justified by the results obtained. General inspection was conducted when possible after clean-up work. More colonies were inspected in 1928 than any previous year. This was possible because the large amount of clean-up work was in old territory. A great deal of effort and time was put in on new territory for organization and survey work. The local cooperation was most excellent this year in the new territory where clean-up work was started. The colonies are in for better equipment and general condition in the old clean-up areas. Three or four years of constant, concentrated attention is raising the standard of beekeeping. Inspection can be conducted more rapidly under these improved conditions. Less disease is found in these areas which requires less reinspection and treatment or destruction. The attitude of the beekeepers in these old areas is entirely helpful instead of indifferent or antagonistic.

The problem of treatment or destruction is of interest to both the owner and the inspector. It is demanded by law in some states that the inspector destroy by burning immediately any diseased colony found. The owners have usually felt that this was unnecessarily severe and that there should be some compensation for the destruction of personal property. A diseased colony is a public nuisance in Florida and must be burned at once. Burning has been used in Texas for many years and in Wisconsin it has been the practice to burn not only colonies but old contaminated equipment. The inspection work in California has recently been reorganized and clean-up is based on a "careful burning" of all diseased colonies. The "shook" treatment is not permitted longer as experience shows that the diseases is spread by this means instead of controlled. It is therefore of great interest to observe the change in attitude of Iowa beekeepers in regard to the disposition

of treated colonies. Wherever disease is found in new territory the owner requests permission to treat. After two or three years of treatment the owner appears glad to burn any diseased colonies at once. In fact disease is detected by the owner in many instances before the visit of the inspector.

GENERAL INSPECTION

The demand for scattered inspection work was heavy during 1928. It is the policy to discourage this type of work and all requests are carefully considered before any start is made on the work. All of the demands were taken care of and on an economical

It is hard to inspect such colonies

basis. It is the custom to arrange the requests so that several yards can be inspected on a single trip. There are several reasons for the demand for scattered inspections, such as sale of bees, sale of honey, newly discovered disease, serious situation in a community.

This last class of work usually develops into locality effort, sometimes with the aid of demonstration apiary work. Sometimes general inspection may be made in conjunction with the early organization of demonstration apiaries. Work of this type was done in 15 widely separated counties during 1928.

LOCALITY INSPECTION

This type of work is more intense than the general and in many instances furnishes the foundation for area clean-up effort later. This kind of inspection is divided into two classes, that which is done purely as inspection, either through or in conjunction with the Farm Bureau office, and that which is done as an adjunct to the organized demonstration work. The first class is done usually by the inspector and the second type by the specialist after the educational meetings have been completed. This method is efficient and cheap with highly satisfactory results.

Work of the first type was done in Black Hawk, Bremer, Cherokee, Decatur, Guthrie, Harrison and Shelby counties. The work was continued this year in Black Hawk, Bremer, Cherokee and Harrison counties.

Black Hawk County—The work has been conducted around Cedar Falls for three years. The old area was checked and some new territory was worked. The results are satisfactory although the disease shows higher than 1927. Inspection was made of 21 apiaries composed of 224 colonies and 107 colonies were reinspected. The real results are evident in the disposition of the 58 colonies found diseased. Treatment was given to 5 colonies but 53 colonies were destroyed.

Bremer County—The work was cut short in this county because of shortage of funds. The work centers around Waverly where disease has been very bad. Only 33 apiaries of 134 colonies were inspected, and 91 colonies were reinspected. Disease was found in 25 colonies and 9 were treated and 16 destroyed. The per cent of disease was 19.4 compared with 27.2 in 1927.

Cherokee County—Inspection was made of 127 colonies in 11 apiaries in and around the town of Cherokee and every colony was reinspected. Treatment was given to the 4 colonies found diseased, which shows only 3.1% infection.

Decatur County—The work centered around Lamoni and Leon where disease was quite prevalent. Disease was found in 68 of the 485 colonies of which 422 were reinspected. Destruction was com-

pleted of 27 colonies found diseased but conditions did not permit care of the other diseased colonies. The infection in this county was 14.3 per cent.

Guthrie County—Inspection was made of 12 apiaries with 271 colonies and 246 of these were reinspected. Disease was found in 14 colonies, 9 of which were treated and 1 was destroyed.

Harrison County—The work was not so extensive as last year and was more in the nature of check-up work. The disease was 6.0 per cent in 35 apiaries. Inspection was made of 680 colonies, 41 of which were diseased. Treatment was given to 22 colonies and only one was destroyed. No reinspection was made in the county this year.

Shelby County—Considerable work was done in and around Harlan. Twelve apiaries were visited, 116 colonies were inspected, 11 of which were diseased or 9.4 per cent. Seven of the diseased colonies were treated. No reinspection was made as the season was too far advanced.

Inspection in conjunction with demonstration apiary work was continued in Chickasaw, Dallas, Fayette and East Pottawattamie counties during 1928.

Chickasaw County—The results of the work in this county are all that could be expected. The efforts of 1926 and 1927 certainly are proof of the possible chance to reduce disease. From 87.5% infection in 1926 to 5.3% in 1928 is the story. Disease was found in 12 colonies of the 223 inspected and 118 reinspected.

Dallas County—Special mention was made last year of the co-operative effort to eradicate disease in this county. An unusual example of educational effort is offered here. The specialist who also did the inspection conducted treatment demonstrations and made it possible to treat every one of the 51.2% of diseased colonies. This year inspection was even more extensive and not a single case of foulbrood was found. The work covered 542 colonies in 24 apiaries and reinspection of 162 colonies.

Fayette County—The work in this county shows the need for drastic action and the first step was taken this year when 177 of the 214 colonies of disease were destroyed and 9 were treated. The infection is very little less this year at 24.7% than last year. Five hundred forty-two colonies were inspected and 162 reinspected in 24 apiaries.

East Pottawattamie County—Inspection was more extensive this year than last and the results indicate a reduction in disease from 7.5% to 3.1%. Treatment was given to 16 colonies and 4 were destroyed of the 20 colonies found diseased out of 645 colonies inspected.

AREA CLEAN-UP

Work was continued during 1928 in three counties, Ida, West Pottawattamie and Woodbury. Work was also started in Henry and Page counties. The plan of work on this basis is generally understood and needs only review here. When a campaign is undertaken in a county it is the aim to locate every colony of bees. Where disease is found a vigorous effort is made to clean up or destroy it. It is seldom possible to work over an entire county the first or even the second year. Reinspection is made frequently in those communities where disease is found but the disease cannot be eliminated in a short time. It is not hard to reduce the disease to a very low factor as is indicated by the results obtained in the three old countries.

Ida County—The results obtained in this county are very satisfactory, in fact, the most progress in the eradication of disease has been made here. This is due to the fact that diseased colonies were destroyed according to Inspector Shipton. The beekeepers are now anxious to destroy in preference to treatment. The infection has been reduced from 10.4% to 3.5% and the continued co-operation for another year should reduce the disease still more.

West Pottawattamie County—Considerable improvement is shown in the eradication of disease. Progress has been retarded to some extent as most beekeepers insist on treating disease under all conditions. The old territory is proving so difficult to clean up that little new area can be included with the present shortage of funds. The local co-operation is improving slowly and will govern the rate of progress in the future. The infection was found to be 14.5% compared with 15.0% last year. Treatment was given to 180 colonies and 17 were destroyed of the 221 colonies found diseased.

Woodbury County—Some disease was found this year among apiaries located along the river for the first time. It has been impossible to locate the source but it is possible to believe that it may have been carried from across the river. Most of the beekeepers in this county are in favor of destroying all colonies found with disease. The results of the campaign over a period of five years are satisfactory to the beekeepers and those in charge of

inspection. The work this year covered 92 apiaries of 6,339 colonies and 87 were reinspected. Disease was found in 119 counties, of which 66 were treated and 55 were destroyed. The infection now is 1.8%, which is exceedingly low.

Work was started in two new counties during 1928, these are Henry and Page.

Henry County—A very severe situation was found to exist in this county, centered around the town of Mt. Pleasant. The work covered 47 apiaries composed of 295 colonies, and disease was found in 95 colonies or 32.2%. Treatment was given to 69 colonies and 19 were destroyed. A heavy recheek was made, in all 191 colonies. A situation of this kind needs attention constantly over a period of several years. It is to be hoped that local co-operation will be extended for future effort.

Page County—Very little disease was found in this county outside of the towns of Clarinda and Shenandoah. Most of the infected colonies were treated. This was considered advisable where entire yards were found diseased. It is understood that any re-occurrence of the disease in these yards will be destroyed. Local co-operation in this county was most excellent and an appreciative attitude was expressed at all times. This work covered 577 colonies, of which 117 were diseased or 20.2%. Treatment was given 43 colonies and 76 were destroyed. Reinspection was made of 135 colonies. Future work in this area should give very satisfactory results.

SUMMARY

More colonies were inspected this year than any year under the present management and the amount of reinspection was greater than in any previous year.

The percentage of disease over the state was less this year and in all of the counties where continuous effort has been made there is a material reduction in the infection.

A greater proportion of disease found is either treated or destroyed and the amount of destruction has greatly increased. It is felt that this practice will prove beneficial here as it has in other states.

The results of the inspection effort this year shows again the value of concentrated work to reduce disease, indicated by area clean-up.

There is no way to estimate the ultimate benefit to the industry from inspection work. The control of disease is based on the best

of apiary management. Box hives of all types are being replaced rapidly by modern equipment in all counties in the locality and clean-up areas.

One of the outstanding features is the splendid co-operation received from beekeepers in the old clean-up areas. Hostility has been replaced with hospitality. Friendship comes with results, beekeepers want to see the good to be obtained from inspection before they give co-operation. Time and special effort has been put on the inexperienced beekeeper where disease was found. The man without experience is seldom successful in handling disease. Co-operation and success will be found together.

There is a lack of appreciation on the part of beekeepers of the shortage of funds for inspection works. There is a common knowledge that a state fund is provided for such purpose but there is no thought of the amount or what it will actually permit. Local support must be given more in the future if inspection is to have a fair chance to control disease. Inspection is for the protection of the industry, to make possible the profitable production of honey.

TABLE I—SUMMARY OF 1928 INSPECTION

County	Apiaries	Colonies	Diseased	Treated	Destroyed	Reinspected	Incomplete	% Diseased
Allamakee	5	225	92	27			2	40.8
Bremer	38	134	25	9	16	91		19.4
Black Hawk	21	224	58	5	53	107		25.2
Boone	3	74	4		4	70		5.4
Buchanan	4	130				130		
Butler	2	57	6			6		10.5
Cass	2	45	31	31		11		73.8
Cherokee	11	127	4	4		127		3.1
Chickasaw	8	223	12		2	118	1	5.3
Crawford	7	243	36		36			14.8
Dallas	24	542				162		
Decatur	25	485	68		27	422	6	14.2
Fayette	21	861	214	9	177	861	6	24.7
Dubuque	1	270						
Guthrie	12	271	14	9	1	246		5.1
Harrison	35	680	41	22	1			6.0
Henry	47	295	95	69	19	191		32.2
Ida	120	1,313	46		34		3	3.5
Kossuth	2	41	4	4				9.7
Marion	6	232	3		3	157		1.3
Marshall	5	148	61				2	41.2
Monona	1	174	11		11			6.3
Montgomery	1	125	2		2	123		1.6
O'Brien	1	150	5	5		150		3.3
Page	75	577	117	43	76	135	3	20.2
Pottawattamie W	174	1,515	221	180	17	841	14	14.5
Pottawattamie E	48	645	20	16	4	57		3.1
Shelby	12	116	11	7				9.4
Story	9	180	8	3	5	15		4.3
Webster	1	260	12	12		260		4.6
Woodbury	92	6,442	119	66	55	87	1	1.8
Worth	6	84	11				2	32.3
Total	816	16,844	1,368	521	543	4,267	41	8.1

TABLE 2—SUMMARY OF IOWA INSPECTIONS

	Apiaries	Colonies	Diseased	Reinspected	Per Cent
1919	66	....	32	....	...
1920	118 (94)	....	....	....	...
1921	155 (81)	....	....	....	...
1922	238	4,086	920	....	22.5
1923	198	4,152	567	....	13.6
1924	629	11,631	1,512	....	13.0
1925	829	11,429	1,702	....	14.9
1926	794	11,071	1,779	....	16.1
1927	964	13,934	1,893	2,803	13.6
1928	816	16,844	1,368	4,367	8.1

TABLE 3—SUMMARY LOCALITY INSPECTION

REGULATORY

	Apiaries	Colonies	Diseased	Per cent	Reinspected	Treated	Destroyed
Black Hawk County							
1926	25	162	53	32.1	...	...	...
1927	30	190	38	20.0	80	...	...
1928	21	224	58	25.2	107	5	53
Bremer County							
1927	42	169	46	27.2	18	...	...
1928	33	134	25	19.4	91	9	16
Cherokee County							
1926	15	140	9	6.4	...	...	...
1927	17	195	28	14.3	...	...	...
1928	11	127	4	3.1	127	4	...
Decatur County							
1928	25	485	68	14.3	422	...	37
Guthrie County							
1928	12	271	14	5.1	246	9	1
Harrison County							
1926	4	443	30	6.7	...	...	...
1927	54	763	210	27.5	250	...	...
1928	35	680	41	6.0	...	22	1
Shelby County							
1928	12	116	11	9.4	...	7	...

EDUCATIONAL

	Apiaries	Colonies	Diseased	Per cent	Reinspected	Treated	Destroyed
Chickasaw County							
1926	12	104	91	87.5	...	...	...
1927	33	415	219	52.7	354	...	...
1928	8	223	12	5.3	118	...	2
Dallas County							
1926	24	261	24	9.2	...	...	...
1927	17	267	137	51.2	148	...	...
1928	24	542	...	...	162	...	...
Fayette County							
1927	26	743	190	25.5	646	...	...
1928	21	861	214	24.7	861	9	177
East Pottawattamie County							
1927	29	382	29	7.5	68	22	5
1928	48	645	20	3.1	57	16	4

AREA CLEAN-UP

	Apiaries	Colonies	Diseased	Per cent	Reinspected	Treated	Destroyed
Ida County							
1926	94	749	80	10.8	...	...	...
1927	152	861	90	10.4	73	...	...
1928	120	1,313	46	3.5	...	...	24
West Pottawattamie County							
1926	116	1,017	476	46.8	...	...	...
1927	219	2,043	308	15.0	997	...	...
1928	174	1,515	221	14.5	841	180	17
Woodbury County							
1924	120	5,236	314	6.0	...	...	...
1925	166	2,838	482	16.9	...	...	...
1926	322	5,719	526	9.2	...	...	...
1927	214	6,339	223	3.5	42	...	...
1928	92	6,442	119	1.8	87	66	35
Henry County							
1928	47	295	95	32.2	191	69	19
Page County							
1928	75	577	117	20.2	135	43	76

BEEKEEPERS' CONVENTION

The seventeenth annual convention of the Iowa Beekeepers' Association was held at Cedar Rapids, Iowa, November 16-17, 1928.

Officers of the Current Season

President—N. Williamson, Bronson.
Vice President—J. G. Jessup, Council Bluffs.
Secretary-Treasurer—F. B. Paddock, Ames.
Director—Ed G. Brown, Sergeant Bluff.
Director—G. H. Ohmert, Dubuque.
Director—A. F. Karsten, Alta Vista.
Director—Harry A. Pease, Shenandoah.
Chairman, Legislative Committee, W. S. Walker, Iowa Falls.

PRESIDENT'S ADDRESS

N. Williamson, Bronson

I am very glad to meet with the Linn county beekeepers to hold this, our 17th annual convention. I hope that we may become better acquainted during the sessions, that we may enlist many of you as regular members of our Association, and meet you and many others at our meetings.

We have had to fight to get from the Legislature the necessary funds to carry on the fight against foulbrood over the state. So far we have been able to get only enough to barely make a showing, not enough to make any real progress in the fight against the disease. We need the help and influence of every beekeeper of the state.

The honey crop of Iowa this year has been very unsatisfactory in most of the state. I believe that only the Missouri river valley has had anything like a good crop; that has not been as good as we would like. Eastern Iowa, I am told, has had a very light crop. As usual the beekeeping industry lives on hopes; we will be looking for a better crop next year.

In a 1915 Apiarist report I find a statement made by C. E. Bartolomew, then president of this Association, that beekeeping was not up to the standard that this state deserves. I have the statement of men who have estimated the possibilities and have found our present production far below what it could be. Also I have the verdict of other men who believe that the state is now producing more honey than is good for the industry.

I am wondering if it will always be said of Iowa that it is not producing as much as it should; then I feel that that very thing might be said of us right now; it probably will be true of us as a state for many years to come, and justly so, because I believe there is hardly a limit to what we might produce. But I have faith to believe that the time will come when Iowa will produce more honey than any other state in the union. I believe that intelligent support of our Association will be the means of bringing this happy result about.

That same year of 1915 the president in his address said that we ought to be thankful that we have a course in Bee Culture added at Ames. If, in the years to come, as many things can be accomplished as has been done in the past, what ought we to expect of the future?

We are facing another siege against the Corn Sugar Bill. Some of the leaders in this battle thought that the corn sugar question has been settled for all time when it failed to pass the last time. As I see it we are only in the beginning of the fight. We will surely have to keep on the alert for some time yet or see the bill become a law. Then corn sugar will go into any and every food product without label.

We are to entertain the Honey Producer's League in Iowa this winter. We are being told that we have a large job on our hands—that we will need the united efforts of all the beekeepers of the state to put it over. So we are not only going to expect the beekeepers of this part of the state to help in the boosting of the meeting, but we will expect your attendance also.

EUGENE SECOR'S CONTRIBUTION TO BEEKEEPING

Frank C. Pellett, Hamilton, Illinois

Alas, how brief is the span of man's activity and how soon is the most diligent forgotten! But a few brief years ago, Eugene Secor was a prominent figure among American beekeepers and horticulturists. He was a man of high ideals, worthy purposes and sincere friendships. It is well for those of us who knew him and loved him to pause for a time to consider what he did for our industry, for his home community and for the state of Iowa. To me has been assigned the task of recording his contribution to the business of honey production.

Secor's interest in bees, like his interest in flowers and fruits, came from his desire to live a rich and full life. His days were filled with such a round of duties as fall to the lot of a busy man. He had large business interests for the time and place in which he lived, but the things which meant most to him were his home, his family and his garden. In 1883, he wrote in the American Bee Journal, "I belong to the amateur list. I keep bees because I like to, in fact because I cannot help it, and not merely for the dollars and cents it brings me. I belong to that number who believe in occupying their leisure moments in a profitable industry, rather than with fast horses, dog or gun, billiards or baseball. Hence I have drifted into those delightful employments of cultivating fruits and keep bees as a recreation, and as a means of furnishing the family those luxuries which money cannot buy in the markets of an inland town."

Secor first became interested in bees in 1867. His interest in them continued until his death on May 14, 1919, a period of fifty-two years. During those years he was destined to hold an important place in the affairs of the industry and to wield a great influence in the national organizations of beekeepers.

In the same article already quoted, he wrote, "My love for the fascinating art, made practical by the immortal Langstroth, increases with my years, and some day I may make it my specialty."

Eugene Secor never did make his bees a specialty. He had too many interests, and loved too many things to devote his attention to any one thing closely. In telling of his "Fourth Annual Report," he mentioned having secured more than 1,200 pounds of honey, an average of slightly more than 86 pounds per colony and said that he would never be satisfied until his per colony average was a hundred pounds or over. In that day small apiaries were the rule and such crops of honey as are produced now were seemingly impossible.

So great was his interest in his little apiary that he began writing freely for the bee magazines; within a short time his name became familiar to the readers of both the American Bee Journal and of Gleanings in Bee Culture. The first article that I have been able to find from his pen appeared in Gleanings in March, 1881, and told of a report of honeydew stored in large quantities in Oregon. It appears to refer to what is now known as fir sugar.

Within a short time articles from his pen appeared on a variety of subjects relating to bees. He told of planting alsike and white clover and the resulting bee pasture; he wrote of extracting honey and breeding bees with peculiar traits; of results from giving water to bees in the cellar on the approach of spring. Evidently, he early developed the habit of close observation, for in September, 1882, he wrote in the American Bee Journal, "It is clear to my mind that the Langstroth hive is too shallow for outdoor wintering in a cold climate." Time has vindicated this opinion, for the shallow combs in that hive have resulted in the loss of untold thousands of outdoor-wintered-colonies here in the Middle West.

The variety of his interests is manifested in his writings; for along with his bees he mentions numerous other subjects, sometimes seriously, sometimes humorously, and he frequently spices his comments with a few lines of poetry. Finding that late swarms in Iowa frequently filled the hives with honey or even made some surplus, he made over some old rhyme to fit the western conditions.

"A swarm of bees in May, is worth a ton of hay.
A swarm of bees in June, is worth a silver spoon.
A swarm of bees in July, isn't worth a fly."

This old couplet he changed to read as follows:

A swarm of bees in May is a 'hip, hip, hooraa'—in Iowa.
A swarm of bees in June, is in the same tune—in Iowa.
A swarm of bees in July, you need not be afraid to try—in Iowa.
An August swarm, as the weather is warm,
Is all O. K.—don't fool it away—in Iowa.
A swarm of bees in September is rare,
But even that can be saved with care—in Iowa."

The arrival of a baby daughter was the occasion for an interesting commentary on "Bees and Babies," which appeared in Gleanings in September, 1883. He said that the arrival of a baby was no particular novelty for he had had seven before—but they were all boys. This one was a girl and the extraordinary event aroused great enthusiasm on the part of her fond father who said, "That first girl baby created an enthusiasm in the neighborhood among the old maids and the young maidens, the married women and little children equal to a beekeeper's convention."

This daughter held a large place in the affections of her father until the day of his death. She grew up to be his constant companion, interested in all the things which interested him and after his death she was the one to carry on the projects which he left unfinished. It was a happy day for Eugene Secor when Miss Nina arrived and he came to depend upon her for that intimate companionship which every individual requires when the shadows begin to lengthen and the ordinary affairs of life no longer require close attention.

In 1883, a meeting was held in the tent of Rev. Clute, superintendent of the apiary exhibit at the State Fair at Des Moines. At that time an association was formed with Clute as president. This was probably the first attempt at state wide organization in Iowa. We are indebted to Secor for making a record of the fact. He likewise reports a very good exhibit of apiary products at the fair that season and says that there was an eager crowd constantly present.

During those early years he often wrote of the importance of cultivating the home market and urged his readers to put up their product in attractive form and use a neat label. Since so many food products were sold in bulk at that time, Secor was somewhat in advance of his day by appreciating the value of an attractive package in the sale of the goods.

We wrote much on the subject of wintering at a time when winter losses were so heavy in this region as to be disastrous. He advocated putting the bees into the cellar early, rather than leaving them on the summer stands as long as possible. He advocated a dry cellar and stated that losses were often the result of low temperatures in the cellar. Time has vindicated his position, for we now know that the warm cellar is safer than the cold one. Secor stated that he secured favorable results with the thermometer standing at 44 degrees while his neighbors with colder cellars lost heavily. He contended that after the flow was over the bees were safer in a dark cellar where they were quiet than when foraging far afield on the mild days of late autumn.

For many years Secor's verses appeared at frequent intervals in the

bee magazines. They had to do with many subjects until he came to be known as the beekeepers' poet. He wrote a poem of eight verses about the beekeepers' convention of 1887, of which the following was a part:

"At Chicago they met, a right jolly set,
On a soft balmy day in November,
Such a buzz and roar I heard once before—
At an old cider mill in September.

They talked about bees—their legs and their knees,
Of the God-given nectar in flowers,
Of its value as food, of bare-headed brood,
And the late sad failure of showers."

Everything from "Weighing the Baby" to "The Linden Tree," served to stimulate him to express his feelings in rhyme. The nineties may be remembered as the great convention period of beedom. In those days there were but few organizations and they attracted men from a large territory. In these days of county and state organizations, conventions have a much more local aspect than was the case then. Now a man can drive a hundred miles to attend a bee meeting and satisfy his craving for contact with his fellow craftsmen. At that period the National Convention was the big time of the beeman's year and hundreds took advantage of the occasion.

Songs were a popular feature of those gatherings and on numerous occasions Secor composed the words and Dr. C. C. Miller or George W. York set them to music especially for a particular meeting. Several of these songs, with others, were published and offered for sale. "The Beekeeper's Lullaby," "Beekeeper's Reunion Song," "Buckwheat Cakes and Honey" and several more, were composed by Eugene Secor.

Considering that beekeeping with him was but one of several hobbies followed to provide diversion from his business, Secor gave a great deal of his time to furthering the cause of the industry. He was a member of a banking firm and also extensively engaged in the real estate business. Beekeeping and horticulture claimed such time as he could spare from business. His fellows were quick to recognize his ability for leadership and demands followed rapidly until they made large claims upon his time.

In December, 1889, he was elected first vice president of the International Bee Association at the convention held at Brantford, Ontario. This was but the beginning of a long succession of similar honors. In September, 1890, he was elected president of the Iowa State Beekeepers' Society and re-elected in 1891 and 1892. He was also president of the Iowa Horticultural Society at this time.

In December 1891, the North American Beekeepers' Association held a convention at Albany, where Secor was elected president of the organization. The following year he presided at the convention at Washington, D. C.

In 1893, the World's Columbian Exposition was held at Chicago. It was a magnificent enterprise and set a new standard for shows of this character. Secor was chosen to judge the apiarian exhibits and spent some time in Chicago as a result.

The adulteration of honey with the near ruin of the market for extracted honey as a result, greatly agitated the beekeepers of that day. There was much speculation as to ways and means of meeting the menace of glucose sold as honey. Charles Dadant had urged the enactment of a pure food law which met with general favor with the beemen. In 1897, a new organization known as "United States Beekeepers' Union" was formed for the purpose of combating the adulteration of honey, the defense of legal rights of the beemen and the prosecution of dishonest commission men. Eugene Secor was selected as general manager of the organization.

The following year, Secor received 216 votes of the 229 ballots cast for re-election.

At this time much publicity was given to the statement that combs could be made of paraffine and filled with glucose in such manner as to have the appearance of honey. Secor gave much attention to addressing the editors of publications in which such statements appeared and advising them that honey in the comb could not be successfully imitated. Likewise such limited funds of the association secured were spent in the prosecution of adulterators. The first case in the city of Chicago resulted in the discharge of the defendant but the resulting publicity in the city papers was helpful. Another case in Michigan resulted in involving a man well and honorably known among beekeepers. He was accused of selling honey which was largely adulterated. The grocer who bought the honey was convicted and fined.

Next came the defense of a New York beekeeper who was sued for purported damage to peaches in a nearby orchard. The justice court decided against the beekeeper but upon appeal, the bees were exonerated from blame. In such matters, the Union performed a very real service to the beekeeping industry during the period that Secor was general manager. The case of a beekeeper in Rochester, New York, who was arrested for violation of an ordinance against keeping bees in the city without consent of all property owners within 100 feet, attracted wide attention and resulted in victory for the beekeeper.

With his fifth annual report, Secor asked to be relieved of the duties of the office because of the press of other and more congenial work. He was not relieved, however, until a year later when N. E. France succeeded him.

In 1899, a fund was raised for the purpose of erecting a monument to L. L. Langstroth, inventor of the movable frame hive. Secor was a member of the committee having the matter in charge. Such references as we see to the movement are letters written by him to the bee magazines.

When the affairs of the organization no longer required his attention, our friend devoted himself to writing, although his contributions appeared in the bee magazines less frequently. He became editor of the bee department of the Northwestern Agriculturist, which claimed a weekly circulation of 150,000, and wrote frequent articles for the "Twentieth Century Farmer," and other rural publications. It is doubtful whether any other writer on beekeeping had so wide an audience as Eugene Secor during the years of his greatest activity. When we remember that he also wrote with equal facility on fruits, flowers and country attractions, we wonder how he ever found the time to do so much outside his business.

In his later years, Secor met serious financial reverses. His friends could see no change in him as a result, unless it be that he manifested even greater interest in the things relating to the out-of-doors. When business no longer required his constant attention, he gave himself fully to his bees and flowers, his fruits and his farm. He gave no sign of regret for the losses he had met but was the same genial friend. Although he continued to write an occasional article about bees until near the end of his life, his later years were devoted especially to horticultural pursuits with emphasis on the culture of peonies. Some of his seedlings were of outstanding merit and had he been permitted a few more years of life, he would probably have won wide recognition in that field. One of the world's leading authorities states that he considers the Nina Secor as one of the finest peonies so far produced.

Our friend was a man of wide interests. When I visited him, I found him apparently as much interested in his shorthorn cattle as in his bees or his flowers. He weighed the milk and kept careful records of production of each cow. In the evening of life, he seemed to find the keenest of pleasure in every detail of activity on his little farm.

He kept in close touch with progress in all lines of agriculture. As

an active member of Farmers' Institutes, Agricultural Society, Horticultural Society and Beekeepers' Association, he gave real service to each. In the beekeeping field he left no important discovery or invention to perpetuate his name, but his service in establishing the legal rights of the craft, and calling the attention of the public to the service of the bee in the pollination of fruit and the value of honey as food for man, should not be forgotten by his generation.

SPRINGTIME IN THE BEEYARD

J. H. Merrill, Raynham Center, Mass.

Spring management of bees, when properly practiced, begins during August of the preceding year. It should include all of the activities of the beekeeper before the honey flow begins. To postpone these activities until the spring of the year would be equivalent to locking the barn door after the horse has been stolen. Yet now is the time to check up on our practices, plans and improvements, and then make certain that we carry out these plans during the coming season.

The year in an apiary should be divided into two, rather than four, seasons, if the character of the work to be done is considered. These might be called the season before the honey flow begins, and the season of the honey flow, or, the preparation and participation periods. In nearly every locality the first period will be longer than the second, and the amount of honey stored during the participation period will depend upon the nature and thoroughness of work done during the preparatory period.

It is a mistake to believe that such manipulative practices as requeening and stimulative feeding in the spring, will, alone, result in developing strong colonies. Perhaps it would be well to consider here some of the factors which favor the development of strong colonies. When we understand why a colony becomes strong we can adapt our beekeeping practices to meet the needs of our bees.

Regardless of the locality where beekeeping is practiced there are certain fixed factors which influence the rate of colony development in the spring of the year. A normal colony of bees will develop in a normal way, and, other things being equal, will arrive at its peak of strength in time to reap the fullest benefit from the honey flow.

By a normal colony is meant a colony which has a large number of young bees, plenty of stores, and sufficient room to permit uninterrupted brood rearing. It will be recognized that it is not possible to fulfill these conditions in the spring of the year. They result rather from attentions and manipulations which the colonies received before being placed in winter quarters. An examination of what happens if these manipulations are neglected will reveal the necessity of applying them at the correct time.

In a normal colony of bees the peak of brood rearing is usually reached coincident with the beginning of the honeyflow, and will in some cases be reached even prior to this time. Colonies which are insufficiently supplied with stores do not reach their peak of brood rearing until the honeyflow has continued long enough to enable them to overcome the deficiency of stores in the hive. Furthermore, even when they do attain their peak, such colonies will not have as high a rate of brood rearing as did those colonies which were well supplied with stores and which reached their peaks before the honeyflow began. This in itself should convince us of the fallacy of attempting to stimulate brood rearing by resorting to so-called stimulative feeding in the spring. It might be possible to do this feeding early enough to overcome a deficiency in stores but it is not probable that it would be attended to in time.

The queen automatically begins egg-laying whenever the temperature within the hive reaches the egg-laying point. This temperature depends upon the activities of the bees themselves. In weak colonies, in colonies insufficiently supplied with stores, or in colonies supplied with honey of a poor grade, the activities of the bees will be abnormal. The result

of this is, that the egg-laying temperature is reached early in the season, and, consequently, the colonies may have become weakened and perish before the honey season even begins. In normal colonies, however, it is an entirely different story. Whenever the bees have had an opportunity to break the cluster and fly from the hive they avail themselves of this privilege. If this flight be followed by a marked drop in temperature, the bees, in their attempt to restore a normal hive temperature really carry their exertions farther than necessary, and as a result the temperature within the hive is sufficiently raised as to cause the queen to begin egg-laying, and brood rearing will continue from this point; if not, and the colony is normal, it soon rights itself and no harm results from this unseasonal egg-laying.

In normal colonies the worker bees rear to maturity a majority of the eggs which the queen lays. The ability to do this varies in different hives and probably in different localities. It would require considerable study to learn just why this phenomenon occurs. There has, however, been noticed a definite relation between the strength of a colony and the percentage of eggs which are developed into adults. This does not depend upon the food supply because it has been observed in colonies of varying strengths as far as the number of bees were concerned and where all were plentifully supplied with stores. The importance of stores at the proper time has been mentioned before, but there are other factors which cause a variation in the rate of brood rearing. When queens were exchanged from one hive to another it was found that, regardless of the ability of the queen, the amount of brood which was reared correlated with the strength of the particular colony in which the queens were placed. Queen breeders who receive conflicting reports from customers regarding the performance of their queens would probably understand the reason if they could secure accurate information as to the strength of the colonies in which their queens were placed. A new queen should not be considered as a cure-all for poor beekeeping. This would indicate the necessity of having a large number of young bees in a hive at the beginning of winter. Such colonies would not only be able to carry on the work of maintaining a proper hive temperature throughout the winter but would have enough energy in the spring to enable them to successfully perform the duties of brood rearing. If colonies are strengthened by uniting, or by adding package bees, there will be an increased rate of brood rearing.

Bees are creatures actuated by but one instinct at a time. When they are gathering nectar their attention is turned from brood rearing. Consequently, it will be found that the number of bees which perish every day during the heavy part of the honey flow exceeds the number of new bees which are developed in the colony. Another argument for strong colonies before the honeyflow begins.

Since it has recently been demonstrated that brood cannot be reared on artificial pollen it will be necessary to have each hive supplied with combs containing natural pollen, if a maximum development of the colonies is expected.

It will not be necessary to call attention to the fact that every colony of bees should be provided with sufficient room to house its food supply and at the same time furnish plenty of space for brood rearing. A failure to observe this will cramp the bees in their activities and retard development. This, too, is a condition which should be met in the fall of the year.

A new queen, introduced into the hive late in the season, will, ordinarily, result in an abundance of new bees before winter. Then, if the bees are supplied with plenty of hive room, sufficient stores, and protected from weather changes, the question of spring management of the colonies will be disposed of even before winter begins.

TREATING AMERICAN FOUL BROOD IN IOWA

A. D. Worthington, Ames, Iowa

The first step in cleaning up American foulbrood is to understand the cause, spread, symptoms and the treatment of disease. This can be accomplished by carefully reading and studying a bulletin on American foulbrood. Second, is to carefully work out a definite plan to suit your conditions in eradicating disease. Have the operation and actual work to be done clearly outlined in your mind. The actual cleaning starts by first disposing of all means of infection in your honey house and carefully remove all surplus equipment from apiary grounds and disinfect them. The apiary is cut down to only strong colonies. This is done by uniting, the uniting being done by shaking the diseased colony into another diseased colony. The colonies should be thoroughly smoked before shaking them together. After all surplus equipment has been disinfected, honey disposed of, and all possible means of infection, besides that in the one story diseased colony cleaned up, the actual treatment begins.

The time of year, per cent of disease and the circumstances in regard to the number of colonies being exposed to disease, determines the exact method of treatment. For example if 30% of the colonies are diseased I would shake the entire apiary provided this disease was found in spring or summer. If on examination of the apiary in spring, summer or fall, the apiary shows 10% disease and has not been exposed to diseased honey in the apiary I would destroy the diseased colonies. If 20 to 25% disease showed in the apiary in early spring then in all probability not more than 10% disease will show later in the remaining colonies. I would treat the above colonies by shaking.

If 30% or more should show disease or if several colonies in the apiary died of disease and were robbed the entire apiary should be treated provided the infection was found in spring or summer. If infection was found in fall the bees should be killed and equipment cleaned.

In explaining the treatment I think it is best to take a definite apiary, say one consisting of 25 colonies. On inspection in early June of the 25 colonies, 10 show American foulbrood, 5 are new swarms or increase placed in new hives on full sheets of foundations. We at once decide the entire apiary should be treated with the exception of the 5 new swarms. The first step is to remove the 5 new swarms, 30 or 40 yards so they will not get disease. Treatment is started as soon as healthy colonies are moved away. The first preparation is to dig a large hole 5 feet deep and 6 feet square, start a good fire in bottom and place an old iron wheel or iron bars in the hole so as to prevent old combs and honey from falling directly on fire. A large tank filled with boiling water and lye should be in readiness. The first colony is set to the side. The new hive is placed on the original stand, a newspaper is spread in front and extending into entrance of hive, the paper being held in place by the bottom and hive body. The diseased hive is then opened, the top placed in the tank of boiling lye water and the bees brushed from comb or shook on newspaper in front of clean hive. The diseased comb is placed in a sack immediately after bees are brushed off. After all combs from one hive are in sack dump on fire in hole. The hive body and bottom is then placed in boiling lye water. The equipment is left in only several minutes or long enough to take off all honey and comb, provided the tank is not large enough to take equipment as it comes from diseased colonies. After shaking the 20 colonies, go back and smoke the bees in, remove and burn the newspaper and place queen guard on entrance of hive to prevent the bees from absconding.

Three men are required to treat an apiary in that way. I feel certain it doesn't pay to try and save brood honey or combs taken from the brood nests of the diseased colonies. All supers are boiled in lye water at least 15 minutes. Extracted combs should be rendered up, frames boiled, or the extracted combs are disinfected by placing them in water formaldehyde solution for 48 hours. This operation should be done previous to the above treatment.

Colonies should be shook only during a honeyflow or an ideal condition is just at the beginning of the honeyflow. Any colony or even an entire apiary found diseased in the fall should be killed. The best time to do this is in late fall on a cold day when no bees are flying and there is no chance of robbing. I prefer calcium cyanide to any other chemical to kill bees. It is cheaper to kill diseased colonies than to winter them and shake the following spring. A thorough cleaning can be made and hives filled with package bees in the spring.

After bees are treated, great care should be taken to send them into winter in the best condition. This is a place where beekeepers fall down. For example, I know a beekeeper at Guthrie Center who treated some 15 colonies during the spring of 1927 which did well that reason. However, he left them out exposed and did not give them sufficient winter stores. Five colonies died; one of the five showed disease and was robbed out. Seven colonies in his apiary showed disease in 1927, approximately after the diseased colony was robbed. The apiary did not show disease for 12 months, with the exception of the one colony dying in the winter. From every indication the new infestation came from the one colony dying in his apiary and being robbed, then when he was urged to clean up again he argued it was impossible, that he had made an earnest effort and he wasn't anxious to treat again. He did not make an earnest effort. If he had, the one hive would have been found in the spring and destroyed, giving him a clean apiary. The colonies should be carefully examined in the fall and exceptional effort made to prepare them for 100% wintering. They should be examined in early spring and weak colonies united to prevent any robbing. All supers the following year should be numbered correspondingly to hive they are used on and no brood equipment, supers, etc., should be interchanged. If interchanging is done have a definite record so if disease does show in one or two hives you can stamp it out for certain. Ninety per cent of spread and disease is right at home. A careful beekeeper can keep a clean apiary in a diseased community.

In Dallas county in June, 1927 some 26 apiaries around Perry, Bouton and Minburn were found to be affected with American foulbrood. The 26 apiaries consisting from 1 to 60 colonies were treated as described previously and not a single colony showed disease in 1927 or 1928. It can be done and done effectively.

In summing up it might be said that the causes why beekeepers fail to make a thorough and successful clean-up are:

1. Fail to understand the spread and nature of disease.
2. Does not plan definitely in clean-up.
3. Tries to save too much.
4. He is not convinced that he can clean up and keep disease out.
5. Tries to control instead of eradicate.
6. Does not dispose of diseased honey, combs and equipment but stores them in his supposedly bee-tight honey house.
7. Fails to prevent robbing.
8. Fails to prevent drifting.
9. Does not practice air tight apiary management.
10. Fails to properly disinfect equipment.

A DRASTIC CURE FOR AMERICAN FOULBROOD

A. F. Karsten, Alta Vista, Iowa

Perhaps the subject of this paper should be "How we are trying to eradicate foulbrood" for we have not yet seen the results in our apiary. Yet it is not an altogether new method. Others have gone at it, at least, in a similar way, and have been very successful.

We have been fighting this disease for six years. We came by it innocently enough, getting our first bees from a man who had it and not knowing what we were getting into. We feel that we have been con-

scientious in fighting it, yet we have not succeeded. Some of the reasons, I believe are these:

First: We got some of the supers from diseased colonies mixed up with the others as we took off supers before we knew they were diseased and then lost track of them and put them back on in the spring, which according to authorities is not safe. Yet if beekeepers would want to examine every colony before taking off a super, what an expense it would be.

Second: We took all the diseased material into the honey house and disposed of it there, which should not be done. One should have a pest-house, where it should be taken, including full supers, and should be left there until thoroughly disinfected. This house should contain an extra extractor that should be used for nothing else, for I doubt whether anyone throws away all the honey found in supers of diseased colonies. Needless to say, this house should have bolted windows and a padlocked door. This is expensive, of course, but I know of no other way unless one does as we are doing now.

Third: I doubt whether it is possible to find and shake all diseased colonies at one time. How will you find them? You may find all that have diseased brood, even those which show only one cell. You may want to be safe and dispose of all material in a pest-house, but even then, how do you know you have eradicated the disease? Other colonies may have honey containing spores that have not been fed to larvae, but will be fed next spring. And there may be spores in the supers of those same colonies, so you spread it next spring, when you distribute them.

Under these conditions how are you ever going to make a thorough clean-up? We at least have come to the conclusion, that it is a hit and miss method, mostly miss. We have been assured that in certain cases it has been accomplished, but in most cases that we have heard of, it has not.

So this year we are trying a new way, new at least to us. We killed every bee we had on the place about September 1st—42 colonies and 12 nuclei with young queens that we had intended to introduce. We used sulphur, which we are glad to learn is an antiquated and clumsy method. The latest is calcium cyanide, which we learn is quicker, sure and pleasanter, pleasanter for man. I didn't take time to inquire how the bees liked it. We killed the bees, disinfected or disposed of all material and will make a new beginning in the spring. The bees were buried immediately to protect neighbors. This is essential, as a post-morten examination revealed particles of honey among them, which had been shaken or brushed off with them. Also to protect neighbors all materials was taken into the honey house at once. The combs that contained brood were burned in a pit. Authorities claim it is not safe to treat them. Most of the others were melted. We kept and treated only enough to supply the packages with drawn comb in the spring. These are mostly surplus combs. The honey was extracted and sealed in tin containers, being careful to clean all honey from the outside. The hives, including supers, were washed, dried and, when dry, scraped and painted inside and outside. Painting, we think is cheaper and safer than scorching. We did not boil them, as that is not practical with double-walled hives. Another objection to boiling is that it takes off all the paint, at least when a lye-solution is used. The frames, inner covers, queen-excluders, etc., that were small enough to go into the boiler, were boiled in a lye-solution, and immediately taken into a clean building. The extractor, storage tanks, uncapping-tank, and melter were disinfected and removed. The floor was scrubbed with a lye-solution, the woodwork was washed, the plaster walls were calcimined. Beside all this we dug a pit where there was a gravel sub-soil, boarded it and covered it with boards, leaving a 6/12" opening, fitted with a 4" collar and a telescoping cover. Into it we poured all waste from the honey-house, being careful not to spill the least little bit. When we are through this pit will be filled.

We believe we are doing a thorough job, and it should be a sure cure.

We have heard of cases, where it was done (except that they shook the bees instead of killing) and they had no recurrence in 5 years, when it probably was brought in again from the outside.

But how about the expense? Yes, there is the stumbling block. Yet it is not as great as you might think. We need not figure painting the outside of hives as an expense, for they need it anyway, and it is more or less of a permanent improvement, depending on the quality of the paint. Nor (in my case at least) should I figure the labor for painting them on the inside; the time I saved in not needing to feed the bees this fall easily offsets that. I doubt whether I found 50 pounds honey in the last 18 colonies I killed. It surely would have taken more time to feed 60 pounds syrup into each one of the 40 colonies than to scrape and paint the insides of their hives. To make it plain, however, I shall carry 3 days of labor on both sides of the ledger, nor do I figure the loss of the bees. In the paper presented to this body last year I tried to show under certain conditions it is just as cheap to kill all bees in the fall and buy packages in the spring. Those conditions prevailed this fall; the honey flow ceased the first part of August and it would have been necessary to feed 9½ months till the next honey flow. While that seldom happens in sweet clover sections, it often does in other parts of Iowa. Again it is fair to figure only a part of the combs that are melted as a loss. Some are not fit for use anyway and should be melted. Some authorities claim it is economy to change all combs every 3 years. Those clogged with pollen should be discarded under all circumstances. The expense of giving the honey-house a thorough cleaning should be figured in part only. Mine needed that cleaning anyway and maybe some others do too.

On the other hand, in following this method you have certain advantages aside from eradicating the disease that must not be overlooked. You get a pure stock of Italians with all young queens, and forty of the latter should be worth $40.00 of anybody's money. I know that it costs me much more than that to get 40 new queens installed, but I am not figuring any more nor am I giving the new method credit for the pure stock, as I want to figure the expense high enough.

But there is an expense and it is by no means negligible. About 500 combs must be treated and 700 replaced with foundation. (Remember I am always figuring on the basis of 40 colonies). At 12c per comb that would be $144.00, including labor and material. The other labor is hard to estimate, as the boys and myself did all the work. I'm sure, however, that it would not take one man more than 15 days.

Expenses:		
1,200 combs @ 12c		$144.00
Labor, 15 days, $3.00		45.00
Labor, painting inside hives		9.00
Paint, painting inside hives		10.00
Lye, calcium cyanide and fuel		4.00
		$212.00
Credits:		
Labor feeding	$9.00	
Melted combs sold	20.00	
Young queens	40.00	$ 69.00
		$143.00

According to that it would cost $3.55 per colony and I have tried to be fair. In fact, in making my estimates I have tried to favor the old method, but even at that figure I believe it is economy to clean up in this way. If you do not of course you do not have that expense all at once but you have it just the same and more of it. A friend of mine who runs about 60 stands claims it costs him $150.00 per year to fight the disease by the old method. I believe he is exaggerating, but let us be conservative and call it $75.00. Then in two years it would cost as

much as this method and still you would not be rid of it but that expense would go on year by year. So much is sure, that in the last four years I have treated more colonies by the old method than I treated by the new method this fall. Consider also the loss sustained by having a number of colonies that are so weak on account of disease that they cannot give you any surplus. And if we maintain a pest house with an extractor you have another source of expense.

All in all I am satisfied (and I considered this problem from every angle before going at it) it is cheaper to do the house cleaning all at one time. As far as my experience goes I admit however, it does not go as far as it should.

If we adhere to the old method we will be doing like the woman that swept one room clean, then swept the next one but left the dirt lie there on the floor while she went to tend to the baby. When she got back the wind had got into the window and blown it all over both rooms. So she started all over again and got just that far again and was called away and again the wind did its business and so the whole performance was repeated over and over. Things done by halves are never done right.

LESSONS LEARNED IN TEN YEARS OF AREA CLEAN-UP WORK

C. D. Adams, Madison, Wisconsin

In 1918 Wisconsin found itself badly infested with both American and European foulbrood. For more than twenty-five years, Mr. N. E. France, our only apiary inspector at that time had been trying to clean up the state. The authority given him by law as well as the appropriation was insufficient to cope with the situation.

At last with the aid of the State Beekeepers Association and the State Department of Agriculture a law with teeth in it was passed by the Legislature and an increased appropriation was made. The State Department of Agriculture canvassed the situation and decided that the only way to cope with the situation was to adopt the "area clean-up" method. A start was made that year, but as the honey crop of 1918 was almost a complete failure, it was impractical to do much with the bees. The following year an ambitious program was outlined and the work started in several counties.

It was then that our education began. As a sample of what we did not know, I might give the program that was outlined for me. I was instructed to go to Richland county and inspect all the bees and tell the owners how to treat the diseased colonies. This was to be done in Jefferson county also, and the remainder of the season was to be spent in cleaning up Milwaukee county. I did work in all three counties and found hundreds of colonies of diseased bees, but by no stretch of the imagination could the work be called a clean-up. We had yet to learn that it required more than inspection and education to eradicate disease from a yard.

The next year when we checked up on the results, we found an increase of disease in many yards instead of a decrease. It was then decided that instead of one inspector cleaning up three counties in a season, a team of two men would be assigned to two counties. Gradually the inspector's territory was cut down until now not less than two men are assigned to a thickly populated county, and in one or two instances four men have been assigned to one county.

Our next lesson was that the beekeeper could not be depended upon to do an expert job of "treating," so the inspectors were told to help the beekeeper. It must be confessed, however that the results were not much better. It dawned on those in charge that we were making little progress, if any in eradicating the disease. True, the colonies treated were, in most cases, freed of the disease but for every one treated two or more colonies became infected in that yard.

Then some beekeepers began to go further than our instructions by burning the diseased colonies instead of treating them. We decided

this was a good plan, and our methods were gradually changed until today treating is done under one condition only. As previously noted, we found that a carefully treated colony was usually free of disease at the next inspection. We reasoned that if a whole yard was infected and all treated, the disease would be eradicated. This did not work out, however, as there always was enough honey scattered about and infected equipment left to reinfect the yard. It is needless to enumerate all the variations of the "shaking" treatment (which really is the brushing treatment) that we followed out, or found the beekeeper practicing. After six or seven years' experience, we settled upon the burning treatment in ninety-nine cases out of a hundred. The one exception is where it is practical to shake the whole yard at once and move them to a new location, preferably three miles from the original yard. This plan was originated by one of our largest beekeepers who had seen his eight hundred colonies dwindle down to three hundred under the ordinary methods of treatment. His truck carried thirty colonies, so he prepared thirty disinfected hives with foundation in frames that had been thoroughly boiled in lye water. Late in the afternoon he shook thirty colonies into the prepared hives and immediately moved them to a new location. The next forenoon was spent in preparing thirty more hives. In the

The inspector salvaged the hives and wax, and destroyed the rest

afternoon these were filled with bees and moved during the evening. He continued this moving until his whole yard was in a new location.

While this plan seems to be about as satisfactory a method of treating as can be found, it is not perfect by any means. In the first place it is not often possible to find a satisfactory new location that does not encroach upon some other beekeeper. Aside from the question of sufficient pasturage for the bees no real beekeeper welcomes a recently infected apiary in his neighborhood. Another real defect in the plan is the well known fact that the single shaking method has a small but persistent percentage of reoccurrences. The beekeeper referred to knew this, and planned to reinspect and destroy the infected ones which he did in all but one yard. The two infected colonies were left here until robbing time and were robbed out and the trouble started all over again. In a small yard the "double shaking" plan would overcome this, but it is a debatable question as to its advisability.

In the few cases where this plan was chosen by the beekeeper the

work was supervised by one of our inspectors. In only one case the new yard was found infected that fall and there the suspicious inspector looked in the added supers and found old extracting combs which the beekeeper could not satisfactorily account for. When this method is suggested one question is asked—"Why treat the uninfected colonies?" The answer is, that in an infected apiary no inspector can say that any one hive is not infected. Infected honey is often stored there weeks or even months before it is fed to the brood. Our motto is to clean up one hundred per cent at one time rather than ninety per cent each year.

The above paragraph explains why the immediate destruction of all known infected colonies does not eradicate the disease at once. If the inspection is done early in the season, we try to reinspect and destroy infected colonies twice more that year and at least once next year before the yard is pronounced free of disease. It is not surprising that beekeepers with a thirty to forty per cent infection choose to destroy all at the end of the honey-flow, put in the fall and winter clean-up and start over again with package bees or bees from a disease-free yard in the spring. I believe that most, if not all experienced inspectors know that this is the most economical thing to do, but beekeepers are an optimistical lot and they frequently choose to put off the day of reckoning as long as possible.

Getting back to lessons we have learned, I think one of the most surprising is that we have had to lay down the rule that it is not safe to allow the beekeeper to burn his own bees. In the first place he is almost certain to get out of the notion, in some cases it is put off from one week to the next until his neighbor's bees or his own start robbing and then it is too late. Even worse than this is the man who destroys on time but does a poor job of it. Some of the most discouraging stories our inspectors have to tell is of the man of good intentions who starts a good fire on the bare ground and throws all his old equipment on it and then adds the hives with the destroyed bees.

Mr. H. J. McMurry, formerly with our department, laid down the rule that "you cannot burn honey" and in practice it is true. The neighbors bees smell the burning wax and come by thousands to clean up the honey. The only satisfactory way we have found is to dig a pit not less than two feet deep and burn everything in it, and fill up the hole the same night. Simple as this may seem, the beekeeper is not the only one who makes slips. The inexperienced inspector is apt to leave some honey or gassed bees uncovered and thus undo the good he has attempted to do. I should add here that we do not destroy hive-bodies or supers that are worth saving. They are easily made safe to use again either by scorching or boiling in lye water. Even in this work it is seldom safe to leave it for the owner to do. With the best of intentions on his part this work is too often neglected. While the fire is burning in the pit the inspector is busy scorching out the hive bodies. It is not every inspector that can do all this for the beekeeper without giving offense. One of the easiest lessons we had to learn is that a first class beekeeper may be a flat failure as an inspector. On the contrary it is quite possible that some of our best and most popular inspectors have far from ideal yards at home. I hasten to add, however, that these are exceptions. The point is that in the make-up of an inspector diplomacy is far more important than knowledge of beekeeping. Lest I be misunderstood let me say that by the term diplomat I do not mean a smooth talker that knows how to put things over. I mean a man who is honest and has the beekeeper's welfare at heart. In addition his experience has taught him the best thing to do under the given condition and the ability to get the beekeeper to listen to a reasonable way out of his difficulties.

Recently just such an inspector reported to me for the first time in his seven years of service that he had failed to convince a stubborn beekeeper that he should do as his neighbors had done. He suggested that I might be able to get the co-operation of this man. I had never met him, but I felt sure that there was little hopes of anyone succeeding where this particular inspector had failed. For the first time in my life I invited an officer to accompany me. As I had anticipated, my best arguments were futile until I introduced the deputy sheriff. That was all that was necessary, and within a few minutes a roaring fire was going in a good sized pit. The lesson is that where all other means fail force may and should be used.

The last big lesson we learned was that the "campaign of education" of the beekeeper carried on in this state by all of us co-operating with the help sent us from Washington was apparently very effective in helping us control the European foulbrood as well as making better beekeepers. We are not so sure about its help in controlling American foulbrood, however.

I regret to say that among the number of those who were and still are regular attendants at these meetings a surprisingly large number were either among the last in their respective neighborhoods to clean up or have not done so yet. I hope other states have been more fortunate in this respect.

CO-OPERATIVE MARKETING

Ed. G. Brown, Sergeant Bluff, Iowa

Co-operation, the means which has been widely recommended as a relief measure for agriculture is considered by many to be a magic word, the mere repeating of which will lift them out of their difficulties and do for them what Sesame did for Alladin. In reality co-operation is merely the name of a system of loyal, honest endeavor by which a people can lift themselves to a higher level of living. It is not a grappling hook attached to a hoist which will reach down in the quagmire of depression and lift you up and after passing you through a clean rinsing solution, deliver you on a high plane with a life income with no effort on your part. Co-operation is better illustrated as a cable anchored to a sound mooring of education, fellowship and honest endeavor and within reach of all but it requires that you take hold and by your own strength and endeavor, and in unison with your fellow beings in a like endeavor, collectively lift yourselves to a higher plane.

There are three things required for successful operation of co-operative marketing: Loyalty, Management, Finance. Loyalty of its membership is probably the most essential for unless its members fully desire and believe in the ultimate success of their association and are willing to make sacrifices if necessary to bring it into action, then there is little hope of its success. Because of the weakness of human nature all of the members should be under contract and they should understand at the time of signing the contract that it is a legal and binding obligation and that the terms therein will be enforced. If it was not necessary that co-operation be earnestly desired before it can be brought into being, Management might come before Loyalty and at least a close second if not an equal.

The manager of a co-operative must be one who has been trained in modern business methods and who has a vision capable of grasping the possibilities and ideals of co-operation and linking them together. Modern business has certain channels and ethics which have to be conformed to and it is easier for a man with a business training to learn the special line he is taking up than it is for the average producer to adjust himself to business channels.

Inadequate financial backing has had much to do with the failure of many co-operative ventures and it is therefore necessary that some definite plan of financing be determined on in the beginning and that it be a part of the contract. Credit is the basis of all modern business and an adequate financial backing is necessary both for the purpose of establishing credit with the business world and with its members. At this point the element of sacrifice comes in as most new businesses do not start off making a startling profit but show a loss for a period of time

and this is where the real test of loyalty comes into evidence. A certain amount of actual cash is necessary for the transaction of business but a greater source of backing comes from the product furnished by the producers. A good manager, with a fair cash backing and the crops of the producers supplied him for marketing, has little to fear if he adheres to the strict co-operative principle of economically marketing the product he is dealing in and after deducting the marketing expenses, returns the proceeds pro-rata to the producers.

When co-operative marketing is mentioned the tobacco growers and wool pool are held up as "shining examples" of its failure but in both of these ventures the true co-operative marketing principle was set aside and a price setting plan set up in its place. If the wool and tobacco had been sold for the best price the market of the time would afford, there would have been no disastrous losses but they were held for a price, not sold at the market price and consequently, when they were sold, they only served to break an already overstrained market.

Co-operatives cannot expect to set prices by holding crops already produced but by orderly control of future production and efficient and orderly marketing. The benefits of co-operative marketing should be far reaching. It should tend to improve the quality of goods placed on the market. Return to the producers a large share of the price paid by the consumer. Give its members a better understanding of business and market conditions and keep them informed on what quality and kind of products the markets demand, and at what price they are sold to the ultimate consumer, and because of the fellowship developed in working for a common end, each stage of improvement lifts all to a higher level of living.

An occasional man working independently in a community can make a single outstanding success but when these efforts are worked out co-operatively, the whole community is lifted to the same high plane.

THE OUTLOOK FOR HONEY CONSUMPTION

John G. Jessup, Council Bluffs

Honey production has increased remarkably during the last few years. This increase in production is largely due to the increased acreage of sweet clover and commercial methods being used in production. In Iowa and eastern Nebraska car-lots for shipment have doubled in the last five years. Consumer demand has not kept up with this increase in production, as there was nothing done to stimulate the demand. As a result the inevitable happened, the price reached the lowest level in years and there was a large carry-over of the 1925 crop.

To move the large amount of honey that had accumulated, efforts were put forth to dispose of the surplus in foreign markets. The result was that by July 1, 1927, eleven million pounds had been exported, as compared with four million the twelve months previous. This takes care of a large volume of honey, but the price is not as high as producers generally feel is necessary to make beekeeping profitable. It has been very effective in arresting the decline of prices, and is no doubt responsible to a great extent for prices to the western producer being nearly one cent per pound more than in 1926. This is about a 15% increase in price.

Although the export trade is responsible to a great extent for prices being no lower than they are at present, there is little hope that this trade alone can be expected to result in higher prices. Honey sold in foreign countries has to meet the same competition as other agricultural products which we have heard so much about during the last four years. With the lower labor cost and a lower standard of living in foreign countries, it will be impossible to expect a satisfactory price from our honey crop, if the price is based on the price received for our exportable surplus, any more than could be expected in the case of wheat and corn.

Right here in the United States there is a sufficient population to

consume many times our present production, at a price that would make beekeeping more profitable than it is at the present time. Such an increased demand could not be secured without advertising the merits of honey to the public, so that they might know its real value and so that it might compete with the many other food products that are widely advertised and bidding for the public's dollar.

The great need of the industry was recognized by the bee supply manufacturers and honey distributors of the country, and in order to promote such a program, the Bee Industries Association of America was formed. This organization then promoted and established March 31, 1928, The American Honey Institute, located at Indianapolis, with its sole object, the widening of markets for honey everywhere. The work is headed by Dr. H. E. Barnard of Indianapolis, Indiana, a food expert of wide experience and national reputation. He was state chemist of New Hampshire, and State Food Commissioner of Indiana. He organized the American Institute of Baking for the great baking interests, which is an outstanding success. During the war he was Federal Food Administrator for Indiana, and later because of his efficiency, was made chairman of the food administration forces of Illinois, Wisconsin, Michigan, Kentucky and Indiana. His work with foods and food legislation has been very extensive. He has been a great writer and lecturer on foods, so that he is especially well fitted to undertake the popularization of honey.

Dr. Barnard's promotion plans are extensive and will be developed just as fully and rapidly as funds available will permit. These include big possibilities in tying up honey with the products of various large food manufacturers and securing free publicity for honey in their advertising of all kinds. The W. K. Kellogg Company have been giving honey a great deal of such support, and it is hoped to secure much more of just such advertising. A continuous flow of information and propaganda for honey will go to Home Economic Departments of high schools, colleges and universities giving especially the nutritive and medicinal values of honey. Information regarding the food value of honey will be constantly furnished to the flour and baking industries, cheese manufacturers, breakfast food manufacturers, preservers and canners.

Special attention is to be given to supplying honey articles and stories not only to the food columns of the newspapers and magazines, but free press articles on honey and bees will be furnished all newspapers. The headquarters and business office of the American Honey Institute is at 410 Chamber of Commerce Building, Indianapolis, Indiana. Dr. Barnard asks all of us to aid him by sending him everything of particular value that you know about honey. If you have a good bee story or good bee picture, send it along to him, for these will help greatly in securing free press articles for honey.

In August Gleanings in Bee Culture there is reported the effort being made to determine what amount of honey should be used in the manufacture of products such as honey candy, or honey crust bread, to entitle them to the use of the word honey in their name. To aid in this work we are all requested to send in local advertisements of food products containing the word honey in their name. October Gleanings in Bee Culture reports a vigorous drive to increase the use of honey in baking. October American Bee Journal reports several radio talks have been prepared and other interesting material, which will be furnished special lecturers and the operators of radio stations. The Philadelphia Child Health Society in a pamphlet called, "Food, Teeth and Health," classifies the food that children from 6 to 16 years of age should use in building strong teeth. Honey is placed in a picture besides a plate of figs as a most desirable food for the teeth. The establishment of the American Honey Institute has been a great step forward for the industry, and alone should do a great deal toward increasing the demand for honey, with a resulting higher price.

The establishment of Preserves & Honey, Inc., was heralded by the

August issue of Gleanings in Bee Culture as "The Dawn of a New Era in Beekeeping." This corporation is backed by American Linseed, and has ample capital for the merchandising of honey on a much larger scale than has ever before been attempted. A merger of the three largest distributors of bottled honey was formed, which includes the A. I. Root Company's Airline brand, Weber's honey and Hoffman and Hauck. Since this merger the honey department of the A. L. Boyden Company of California has been purchased. Already only three and one-half months after the announcement of the formation of the new corporation, sales are reported greater than the combined sales of the individual packers last year.

Plans for newspaper advertising in eight cities are being developed and will soon be carried out. Considerable radio advertising will also be carried on. A great deal of this advertising will be for honey in general and not for any specific brand. This will be a great help to all honey. Bottling plants will be established at strategic points for distribution, so that shipments can be made to all parts of the country to the best advantage. Nation-wide distribution is anticipated. Two or three large preserving plants have been purchased and are being operated. We understand that just as soon as possible they are going to market fruit preserved in honey. If this is done it will be a new outlet, that will require large quantities of honey.

The effect of consolidating the four largest packers in the country is bound to be beneficial to beekeeping. These people have consolidated food packing industries in the past, and have never failed to produce an increase in the volume sold. It is true that it removes a certain amount of competition in buying, but there are still many small packers in the field, and there is no danger that their large buying power will be used to force prices down. The fact that honey bottling requires comparatively little equipment to pack, gives assurance of this. Whenever the price to the beekeeper becomes sufficiently low, it tends to induce more people to go into the business of merchandising honey. Although Preserves and Honey are the largest single distributors of honey, they by no means have a monopoly, as they distribute only a small part of the total annual crop produced.

September Gleanings in Bee Culture announces that the biological and experimental department of Preserves and Honey, has made very definite progress in the way of finding new uses for increasing the consumption of honey. Surely we may expect great things from this new organization controlled by those who have had a vast amount of experience in the merchandising field.

During the last year arrangements have been made by the Bee Culture Laboratories at Washington, for the establishment of another field station in Louisiana. A honey poster has been prepared by the government and is available for only 15 cents. Government free grading at various points in the country is now available to all. The government is carrying on research work at Washington, to determine just what claims can be made for honey and to develop new uses.

Honey is being used in new lines of industry. Manufacturers of anti-freeze radiator solutions are using it. It is being used by a Cleveland manufacturer in making gaskets. Now it is reported that it is being used extensively by a Cincinnati hair dresser, two to three tablespoonfulls per client per treatment. The W. K. Kellogg Company did a great deal for beekeeping last year, by mentioning honey in their advertising. This year they are doing far more by showing a jar of honey along with their breakfast food, on their advertising material that is used as window trims. These are very attractive and this advertising is going to help beekeeping a great deal.

The coming administration has promised to aid agriculture. If agricultural conditions in general are improved the beekeeper will come in for his share of the prosperity that surrounds him. With the many new uses for honey that are developing, with the Honey Institute and Preserves and Honey working full time, with beekeepers individually and organized, boosting for honey, and the Kellogg Company's advertising, the outlook for the future of the beekeeping industry is the brightest that it has been for years.

THE NECESSITY OF KNOWING ABOUT HONEY

Dr. E. F. Phillips, Cornell University, Ithaca, New York

Recent years have seen the initiation and continuation of newer types of investigation regarding many foods used by man and animals which have given a better foundation of fact regarding these necessities. To make such facts useful, they must be widely disseminated and become part of our lives, for they do not greatly benefit mankind so long as they are recorded only in scientific journals and books. Not only is it necessary that the expert in nutrition become informed, but it is even more necessary that the consumer of food have a sound knowledge of these findings, in-so-far as his training and experience will permit.

Honey has been investigated for years, so that there is now available a vast information regarding it. Chemists, nutrition experts and physicians have added to this knowledge, all of which concerns beekeeping, the beekeeper and the consumer of honey. Beekeepers constantly complain that the consumer must be educated to the use of honey, so there is no lack of appreciation on their part as to the necessity of spreading this knowledge as widely as possible. Beekeepers also complain that consumers are less well informed regarding honey than regarding other foods and that until this balance is restored, beekeeping will not prosper. The question which may profitably be considered is: fundamentally whose business is it to educate the consumer?

There has recently been considerable agitation for further investigations on honey, and we certainly cannot know too much about this product. At the risk of being misunderstood, it should be said that a spread among beekeepers of the facts already known is more important than such additional scientific facts as may be obtained from immediate investigations. A vast literature on honey is now available, practically none of which has become an integral part of beekeeping knowledge. The first task of the beekeeper is to study what is now at hand, and when he finds gaps in the information he will better be able to demand investigations which will be helpful.

In the recent demands for further research on honey, there has been a tendency to ask for studies of the use of honey in various ways, such as in cooking, candy making and in the manufacture of various commercial articles. While such knowledge would be helpful a far greater need lies in the obtaining of fundamental facts about honey, such as its vitamin content, its enzymes, the composition of the mineral constituents of honey, the constituents which give honey its flavor and color, the phenomon of granulation and many other fundamental problems which might be named. A vast part of the honey produced in this country goes to American tables. The market now demands, whether or not unwisely, a liquid honey, yet our knowledge of the granulation of honey is so scant as to be lamentable. We have erroneously believed that the per cent of dextrose in honey determines whether or not it will granulate quickly, but this problem is far more complex than such a theory would suggest. We unwisely heat honey in bottling until many of its valuable ingredients are destroyed. We have even injured our honey to some extent in the ordinary processes of extracting, yet have not generally recognized this fact. It seems to be time that facts about honey itself be sought, rather than to worry about uses to which at best only a minute quantity of the honey crop might be put.

Honey enjoys a commercial advantage possessed by few other foods, since at one stage of its progress from the hive to the consumer it is owned by almost a million people, and the further advantage that these numerous owners are unusually enthusiastic about their business. Officers of public utilities, for example, now recognize that by spreading

ownership in their corporations they thus create more persons interested in the affairs of the companies than is possible when the ownership rests with a few people. They spend thousands of dollars to build for their organizations just such an advantage as honey already possesses. This advantage for honey is nullified if the owners know little about this commodity and cannot intelligently come to its defense. Until there are thousands of informed boosters for honey among beekeepers, who know the available facts about honey, this wonderful food cannot reach that place in the American diet to which it is entitled by its merits. That consumers must be educated is obvious, but it seems to be less generally appreciated that this education must come about largely through the incessant and intelligent talking and writing of beekeepers. No amount of paid advertising and propaganda can take the place of the publicity which will come when beekeepers know their own product.

For some months an effort has been made to learn why beekeepers know so little about their product. One would surmise that persons dealing with so interesting a material as honey would try to learn everything possible about it, and if they do not, there is some reason for this neglect. Beekeepers do not read and study about their product because they apparently labor under the erroneous idea that such things are too technical for them to appreciate and understand. This error is natural and arises in part from the fact that an intelligent discussion of honey entails the use of certain technical terms which are so far unfamiliar to the beekeeper, scientific terms, used solely for brevity and accuracy. The beekeeper is in no position to complain of the use of technical terms since his literature and conversations are filled with terms such as super nucleus, honey board, excluder, frame, section and the like, words which are utterly meaningless without the technical definitions which beekeepers alone have learned. Occasionally beekeepers use terms, like entrance and cover, which mean what they say, but most beekeeping terms are unintelligible to non-beekeepers. Why then should beekeepers complain if technical men in other lines use words which appear strange until one delves into the subject? If an article appears in a bee-journal in which the words sucrose, dextrose, and levulose are used, it often happens that readers simply pass the articles by.

Not all the blame lies with the beekeeper. Many persons writing about honey for beekeepers use more technical terms than are necessary and fail to define those used, since these people often do not speak the beekeeper's language. In order properly to present a subject to any special group of readers, one must be able to appreciate the background which these readers have for the newer information presented and must above all know what their need for information is. If a chemist who is not a beekeeper writes for beekeepers, he frequently omits those things which are most important to the beekeeper and emphasizes things which are important to the chemist but unimportant to the beekeeper. If, however, a chemist uses the Greek technical word dextrose, this is no greater crime than for a beekeeper to use the Latin technical term super.

Believing, first of all, that until beekeepers obtain the information now available about honey beekeeping cannot prosper, and believing further that there is no reason why beekeepers cannot understand the information which will be applicable to their businesses, some experiments have recently been tried which may be mentioned. This is done to indicate an unfortunate attitude on the part of many beekeepers. The beekeeper claims that the consumer must be educated but himself refuses to be educated, an inconsistency which need only be mentioned to be entirely clear.

For some years I have felt that our bee-journals and other avenues for disseminating information among beekeepers should contain more information about honey, and less statements to the effect that "honey is nature's own sweet," which means nothing at all. In lauding honey, it is quite necessary to explain the reasons for its superiority. Believing

this, I have for some years been "growling" at the editors for not including more such material, and their replies have been that when they have included articles on honey, they have actually received complaints from their readers! It seems incredible that any beekeeper should ever complain if an effort is made to present facts to him about his product. Part of the fault perhaps lies in the methods of presentation, but even if such material is presented so as to be somewhat difficult to understand, one would think that the beekeeper who has trouble with such articles would feel sorry for himself and would not complain that the editors are trying to bring to him information which he sorely needs.

Last spring in writing to Mr. George S. Demuth, editor of Gleanings in Bee Culture, on another subject, I renewed my complaints at the lack of articles on honey, and he defended himself in the usual way. Thereupon I listed twenty-five questions which it seemed justifiable to ask any intelligent beekeeper about his product, without assuming on his part any technical knowledge of chemistry or nutrition. These questions were submitted to Mr. Demuth, himself a beekeeper rather than a chemist or nutrition expert, asking which ones, in his opinion, were unfair, and what additional questions might properly be included in such a list. He left all twenty-five questions untouched but added nine which occurred to him as indicating desirable information for the beekeeper. One of the questions formulated by Mr. Demuth appeared to be nearly the same as one already included, yet not exactly the same, so in order to omit trick questions, this question was omitted, leaving then thirty-three questions. At Mr. Demuth's invitation, these questions appeared in Gleanings for July, 1928, as a catechism for the honey producer. At the same time Mr. Demuth asked me to reply to these questions later, since he seemed willing to risk complaints from his subscribers.

The experimental feature of this catechism will appear from the following explanations. In presenting this catechism, it was stated that answers were not to be sent to either the editor or myself and that the questions presented would not be answered, being given merely that the honey producer might check up on his information. This statement was made for a purpose, for it seemed to both the editor and the author that if beekeepers could not answer the questions but actually wished to know the answers, they would write either to the editor or the author to demand the answers. Naturally when the statement was made that answers would not be given, any such demands would come from those most intensely concerned to know the replies.

It would be interesting to run a guessing contest as to the number of such demands which came in, indicating the insistence of informed beekeepers that the answers be given, but further anxiety may be relieved by stating that not a word of comment was received. Being inexperienced in bee-journal affairs, I concluded that beekeepers are not interested in honey, but the editor took a different view. He wrote that not a single beekeeper had written in to complain that these questions occupied space in the journal, from which he concluded that his readers were interested. It appears that many beekeepers strenuously object to articles which appear and which they do not like but that they rarely or never write to commend any article.

Instead of preparing direct answers to the questions, which would have resulted in a disorganized presentation, a series of articles was begun which would ultimately include the answers to all questions formulated in July. The first appeared in August and they will continue until my scant knowledge of honey is exhausted or until the readers rise in arms against such material. The purpose of this account is to advertise neither Gleanings nor these articles, but to outline this experiment in education. At this writing, November, it may be reported that several favorable comments have been made which are appreciated and there have been further indications that beekeepers actually desire such information, so that the outlook is more hopeful than it appeared at first to be.

The extension specialist in Apiculture, Mr. B. A. Slocum, has tried other experiments. Shortly after the catechism appeared, he asked at some of the meetings attended how many had read the questions, and found few who had done so. He then asked how many could answer some or most of them, and the beekeepers present usually considered them too technical. Having taken these experimental steps, Mr. Slocum then discussed honey in just the manner suggested in the questions and reported that the beekeepers listened with interest. On one occasion he began discussing honey at about one o'clock and found it necessary to stop in time to make a 5:55 train, which does not indicate a tendency on his part to talk too long but shows that his hearers were interested. Other such incidents might be recorded.

Each winter at the Short Course for Beekeepers at the New York State College of Agriculture a special topic is selected for the important discussions. For 1929 this topic is Honey and the usual discussions of production and marketing will be omitted or subordinated. A discussion of Honey is a phase of marketing, but emphasis will be placed on honey itself rather than on means of spreading this information to consumers. It will be interesting to see how many beekeepers are enough concerned in this subject to attend such a meeting for a week.

Certain experiments have also been made in preparing press material, but this feature has progressed slowly, in order better to weigh the results. A press notice on the disinfecting value of honey was prepared not long ago and this has been reprinted in all parts of the country. One Chicago Sunday paper featured it with a scare drawing that would cause anguish to any scientific worker, and this notice was actually published in one bee-journal. At present it seems less important to learn what the public wants than it is to determine what beekeepers want, for the spread of such information must rest chiefly in their hands.

At this stage of the experiment, the following rough results are indicated: (1) Beekeepers are moderately interested in their product and may easily be still further interested; (2) they have entertained an unreasonable fear of presentations on honey which contain some technical terms; (3) many writers on honey for beekeepers have not written understandingly; (4) when the same material is presented in different form, such material is read intelligently by at least the more interested beekeepers, but (5) this interest is not so intense as it should and must be if this marvelous product is to occupy its rightful place in the American diet.

This discussion is not presented as a sermon to beekeepers, to tell them exactly what they must do to be saved from their present marketing problem, but merely to suggest one means of doing this. It is fair to conclude that until beekeepers do their share in spreading information about honey, others cannot justly be criticized for failing to do so. It is time to stop talking vaguely about honey as a superior food and to stop saying that honey is "nature's own sweet" and get down to facts. Silly and sentimental promotion of honey has not been profitable, and it is time to try another method.

RACES OF BEES

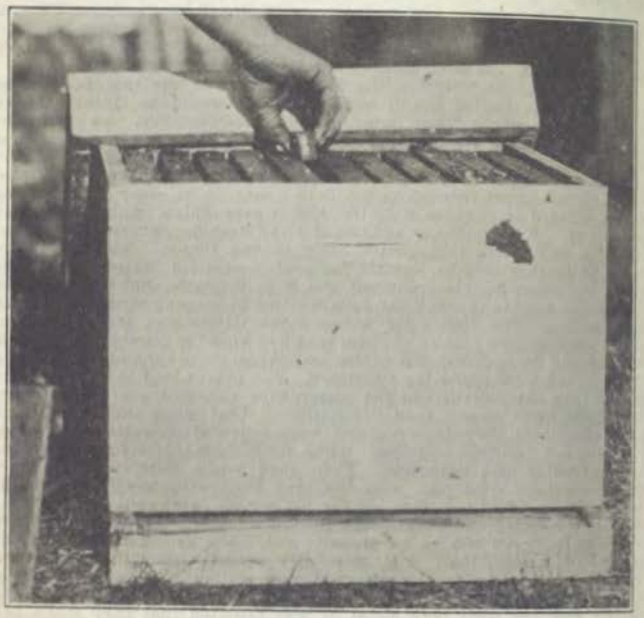
Jay Smith, Vincennes, Indiana

I have been a strong advocate of the Italian Bee believing that if we would continually breed from the best, we could produce a better strain of bees than any we might import of other races. However, I read with a great deal of interest the series of articles by Phillip J. Baldensperger in Gleanings on the races of bees. He points out that the different countries in which bees are kept, have each developed a bee peculiar to the country in which the race was developed. For instance in Egypt the bees have lost the instinct to gather and store large quantities of honey as the weather is such that it can gather enough to live on any time of the year. At the weather is warm, the bees do not form a cluster and when moved to cold countries they die when cold weather comes. The bees in warm countries are invariably cross while those that have lived for many generations in cold countries are gentle. Mr. Baldensperger gives as the reason that in warm countries there are so many natural enemies of the bee such as wasps, ants and lizards that the fighting instinct has been bred into the bee. In the colder countries where the bee has few or no natural enemies they have lost their irritable disposition. The Cyprians, Palestinians and Egyptians are all vicious in nature, while the bees of northern Italy, Caucasia and Carniola are gentle.

As Mr. Baldensperger has made a most thorough study of the different races of bees, their origin and the conditions under which they are kept and has also kept bees in a large way in many countries, he is undoubtedly by far the best authority on the races of bees.

After reading his writings, the thought came to me that in an area as large as the United States and Canada, it would be strange indeed if there is any single "Best Race" for this vast territory. As conditions are so different in different parts of this area what might be the best race for one locality might be a very indifferent race for another. Where there is one large honey-flow it would be desirable to have a race that would curtail brood rearing as the flow comes on in order to avoid producing a hoard of workers after the flow is over which would be "useless consumers." The Italian is undoubtedly the best bee where there is but one flow and where that comes early in the season. Thinking there might be another race for certain parts of the United States and Canada where the honey-flow is prolonged and it is desirable that the bees continue brood rearing through the flow in order to keep up strength, I began investigating. The choice lay between the Caucasians and Carniolans. Of the ten inquiries I made of those who had kept them only one objected to them and he had had but a few and these were kept in small hives. He said they were excessive swarmers. The others said they were more prolific than the Italians and the reason they swarmed was because they filled their hives sooner than the Italians. That when they were given the management they deserved and were provided with plenty of room, they did not swarm to excess. Some used them for comb honey and had no trouble with swarming. Their good points were that they were gentle, excellent winterers, kept the hive filled with brood through the honey-flow so that they were strong for winter, wintered well, built up early in the spring and worked well in cold weather. It was also reported that they gathered almost no propolis and when necessary to chink up cracks for winter, they used wax. My reports from the Caucasians were that they were gentle and good workers but were such bad propolizers that the frames had to "be dug out" when manipulating. From parties who had tried both races, it was reported that they much preferred the Carnolians. I found another serious objection to getting a start of pure Caucasians and that was that it was very difficult to import them as they were so far away and transportation facilities were unfavorable. I wished to be sure of getting pure stock as it was stated by some who gave them a trial that it was almost impossible to get pure Causasians in the United States. I failed to get replies to my letters for Caucasians, but got immediate response from Carniola. Mr. Hambleton at Washington ordered three Carniolans for me as all imported bees must come through the Department of Agriculture. These came from upper Carniola in the famous Alps Mountains. Bees in that region have to be hustlers to survive for there is little flora in that barren country and the winters are severe. I was quite impressed by what these bees had to go through before getting to me. First they were put aboard train and were carried to the coast. They they went by steamer to New York. Then by train to Washington where all nurse bees were destroyed, and the queens placed in a new cage with strange workers. They then came by train to Vincennes and had to go through the ordeal of introduction. I used the Push-In case and all were safely introduced and the three are now in comfortable packing cases for the winter. I

came near having an accident in introducing one of them. To make sure that there was no queen or ripe cell, I introduced one to a colony that had contained a virgin. I removed the virgin and formed a nucleus by putting a cup full of bees and their own virgin in a small nucleus hive. Two days after, I looked to see if the virgin was laying and found her missing. I guessed she had gone out on her wedding flight and having marked her former location would go back to the colony now containing the cage in which was my valuable imported breeder.



Requeening will introduce a new race into a yard

I guessed correctly for there she was laying nicely and making herself very much at home. I removed her, putting her back into the nucleus and clipped her wings to be sure she would stay put. Two days later the Carniolan was released and at once filled the hive with brood.

In addition to these three breeders, I purchased two dozen Carniolans from the best breeders in the United States. While I have not gone far enough to form a definite opinion concerning them, I am satisfied that the Carniolan race of bees is a splendid race. Some things that have been said for and against them have not been verified thus far. They say they do not rob. I kept both races in the same yard and when robbing was going on, it was 50-50 Italians and Carniolans. They say Carniolans do not drift, but again I see no difference between them and Italians. I have found them in Italian hives fifty feet from their own. How about their swarming? I cannot say yet as to that, but I had a number of strong colonies go through a honey flow and no signs of swarming. I expected to rear a number of queens but although I gave them starters, they built only worker comb and as I could get no drones,

I did not attempt rearing queens from them. I can test them thoroughly the coming season. As to their temper, they are gentle but not as much so as my best Italians. I can handle them without smoke, but get an occasional sting. I will keep them in a yard several miles away from other bees and give them plenty of drone comb to insure pure mating. I doubt if they are excessive swarmers provided plenty of room be given. If they are, this trait can be bred out in a few generations by giving plenty of comb room. On page 86, February issue of Gleanings, 1926, Mr. Baldensperger says of this, "However this exaggerated swarming fever may be calmed down in a generation or two provided the bees are hived in good sized spacious homes."

CAUCASIAN BEES IN NEW JERSEY*

Ray Hutson, Assistant Entomologist
New Jersey Agricultural Experiment Station

Caucasian bees have been known in the United States for about 50 years (3). They have never been popularized because Italian bees as developed in this country fulfill the requirements of beekeeping practice when compared to the German hybrids that beekeepers are loath to admit an equal or better race exists. The changing conditions of beekeeping have recently, however, intensified the feeling, never given up by comb honey producers and gradually formed by other beekeepers, that the Italians are not the best possible race of bees for all purposes. Baldensperger (1), well known writer on the races of bees, has persistently called attention to the robbing propensities of Italians and their poor provisioning of the broodnest. This criticism points out well known failings in the Italian bee. These habits together with the poor cappings on combs and other less obvious faults have been nurtured by the utter disregard of everything except color by many extensive breeders so long that beekeepers are again trying races previously slighted. The darker races, Carniolans and Caucasians especially, are apparently foremost in this reconsideration.

Charles W. Quinn in Florida and Herman Rauchfuss in Colorado to name two outstanding figures in this connection have had marked success with Caucasians. Quinn and Rauchfuss steadfastly maintain that the Caucasian bee has been underrated by beekeepers at large and point to their consistent production of good crops of fine quality honey as proof of their stand. Beekeeping literature (3, p. 197) abounds with testimony as to the swarming propensities of Caucasians and the excessive amounts of propolis carried in by them. Such habits would seem to forestall results such as those reported by Quinn and by Rauchfuss. These conflicting reports when all the factors are considered seem to indicate the existence of strains of Caucasians. Reference to the literature confirms this indication. Mikhailoff (2) recognizes two main strains of Caucasian bees while Gorbacheff the leading authority further subdivides them. It is an interesting thing that these men ascribe to different strains the very characteristics which account for the conflicting reports noted in this paper.

The various reports given out all agree in two favorable respects. Caucasian bees build up well, and have white cappings. These considerations are of interest to New Jersey beekeepers and led to a trial of the race under our conditions.

Trials of two strains were made. In the main the first trial gave the following results. The Caucasians built up quickly to swarming strength and swarmed in some cases in spite of "shook" swarms. Every colony showing any mixture of Caucasian blood built propolis defenses. Burr and brace combs were excessive. The cappings were uniformly whiter than that of Italians in the same yard. The original source of these Caucasians is unknown.

*Paper of the Journal Series, New Jersey Agricultural Experiment Station, Department of Entomology.

The queens used in the second trial were daughters of a queen secured direct from C. A. Gorbacheff (5) of Tiflis and warranted by him to be of a desirable Caucasian strain.

The first examination of these uniformly grey banded bees was made without a smoker on a raw windy day during pear blooming time. The bees did not fly from the combs. Fifteen out of eighteen colonies had three frames of brood; one had six; two had two each. Eight colonies of Italians examined the day before in the same region had an average of two frames. Brace combs were absent. The propolis defense was absent, although there was evidence in the hives of Caucasians and Italians that propolis was available.

This strain of Caucasians when established as three pound packages in northern New Jersey built up well. The maximum amount of brood, fourteen frames, was reached during the first week of the clover flow. The brood was compact. The tendency toward laying a frame full of eggs was so noticeable that it was possible to mark the frame with the queen upon it in the morning and find the queen upon the same frame at any time that day. The daughters of these queens exhibited the same tendency.

The pure Caucasians were exceedingly gentle. When crossed with Italians the gentleness of the progeny was not as marked as in the pure race but in over sixty cases showed the influence of the Caucasian blood.

The Caucasians repelled robbers readily in spite of their gentleness when robbing was induced. Caucasians tried to rob the honey house in about the same number as Italians. Caucasians in this test were not found in Italian colonies during weekly examinations. This last fact would indicate that Caucasians do not practice "sneak thievery" to any great extent for the Italians were of a good three branded strain making the Caucasians readily seen.

Burr combs between and upon the top bars were noticeably absent. However, there was a tendency present toward the deposition of small lumps of wax of a height and diameter of one-eighth inch or less. Brace combs were absent. It is possible that the light crop influenced this tendency. The absence of brace combs together with the white cappings produced should recommend a trial of this strain of Caucasians to comb honey producers in New Jersey. In the light flow during the season this strain was tested. The Caucasian colonies yielded an average of 11 pounds more surplus than the average of an equal number of Italians in the same yard. At the end of the season there was 14 pounds per colony more honey in the broodnest of Caucasian colonies than in the broodnests of Italian colonies in the same yard.

The amount of propolis carried in by the Caucasians was no greater than that collected by the Italians in the same yard. This condition obtained for both pure and hybrid Caucasians. There was no attempt at the construction of the propolis defense at the entrance which is associated with Caucasian race in beekeeping literature.

The results of these tests of two strains of Caucasian bees leave no doubt that the diverse reports found in the literature refer to different strains of that race. It is obvious also that the first strain tested is responsible for the undesirable reports current concerning this race. On the other hand the activities of the second strain show it to possess certain advantages over the Italians. To the New Jersey beekeeper the production of well capped honey appears most important. The extreme gentleness of the race and its ability or tendency to seek its own hive successfully should further recommend it.

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PROGRESS IN THE FAR WEST

G. H. Vansell, College of Agriculture, Davis, California

The subject of disease control may have played too large a part in the discussions of bee meetings since much of such discussion is reported in the press to be read by folks unacquainted with bees and their diseases. Be this as it may, the control of disease in any agricultural undertaking is an important phase of the operations. The far west is taking such an important part in honey production and in the package bee business that a report of progress with reference to inspection will undoubtedly prove of interest to beekeepers reading the annual Iowa report.

Several of the western states have long enjoyed a more or less complete control of the movement of bees until such bees were found free of serious trouble. Certain of the states have maintained a quarantine against bees from other states presumably on account of protection against disease. Conditions generally are becoming such that these state line barriers are no longer justifiable. One of the most important recent movements is the interest taken in bees by the Western Quarantine Board. This board is made up of men from all the seven western states particularly trained for their work. There is at least an annual meeting with other gatherings as conditions require. A uniform rule relative to bees may soon make this large area a unit.

J. S. Harbison, the first man to keep bees extensively in California. The first carload of comb honey in the state is reported to have been produced by him.

Until recently California bee men have been working under an independent county system of apiary inspection with all the resulting county line barriers instigated somewhat at least by selfishness and suspicion. For over a year now a new system of apiary inspection has been followed entailing all the county horticultural commissioners and a trained man in the state department of agriculture as a sort of state inspector or head for the system. The horticultural commissioner in each county is ex-officio bee inspector which makes him responsible for the work in the confines of his county. In many cases the horticultural commissioner does nothing more with bees than to see that funds are in the county budget for the support of some one or more men according to needs of the area and season, to do the actual inspection or clean-up work. This sort of an arrangement at once begets the interest of many thinking men for things relating to bees. The work under the horticultural commissioner proves to be a happy solution of many problems particularly since he is already familiar with the extensive fruit interests.

I wish to point out that in contrast to the eastern United States the honey in the west is generally produced in favorable spots on account of the cultivation of plants yielding nectar (orange, alfalfa, etc.). Irri-

gation is of course confined almost entirely to the level valley which make up less than one-fifteenth part of the total area. Even much of the valley land is unirrigated on account of lack of water. In addition to the cultivated plants are certain indigenous ones, sage along the southern coast line of California, fire weed in parts of Oregon, Washington, etc., and the wild buckwheat of the southern California foothills and mountains.

It is admitted that bee disease was all too prevalent in certain spots in this wonderful state. In general, however, the best bee-keeping areas both for honey and package bees were in good shape for a long time because the profitable pursuit of the bee business necessitated efficient control of disease. The none too good spots are now "cleaned up" by the cooperative invasion of outside men working hand in hand with the local owners and men in authority. The practice of burning infected stock is in vogue. An efficient bacteriological procedure must be used in any case for good results. The treatment of infected combs with chemicals is not encouraged generally. Treatment with the formalin mixtures has been proved entirely satisfactory from the bacteriological standpoint but its position is not so good from an economic viewpoint. Time is an important item in any undertaking. Many combs are still being saved by sterilization in the hands of those properly fitted for the work and who have enough of the material to justify the practice. In the case of the "clean-up" areas fire is used almost to exclusion. The bees are killed with cyanide and the contents of the hive burned in a pit so the remaining ashes may be deeply covered.

A California swarm. Over a barrel of bees in this united swarm in the apiary of Wm. H. Baker of Davis.

The efficiency of the new procedure is appreciated by the industry in the west. That the state-wide control of bee disease is meeting with favor among the beekeepers (and others interested in the bee industry) is evidenced by the number of commendatory statements received by the state department of agriculture during the past few weeks. Only recently a letter from one of the most prominent bee journals had this to say:

"Let me take this opportunity to commend you (and the commissioners) on the excellent work you are doing under the new apiary inspection law.* I had the opportunity to visit some Michigan people this year and they are wonderfully encouraged with the progress they are making by burning. Undoubtedly in your own state with the necessity there is for bees for pollination you will have no difficulty in influencing sentiment rapidly to the burning and quick clean-up method."

The aim here is eradication in so far as this is humanly possible.

*A copy of this may be obtained upon request from the California State Department of Agriculture, Sacramento.

Too much is at stake to think otherwise. The importance of honey as an item of food is no small matter. The 1927 production of honey was about 8,000 tons according to State Bee Inspector Frank E. Todd. The value of the bees themselves in their role as pollinators cannot be overestimated. Many millions of dollars worth of an infinite variety of fruit and nuts go out of California each year, and all grant our honey bees a place of honor in the production of this wealth. The package and queen business is a large one in this state. Beekeepers outside the far west may not be so interested in the immense honey tonnage since it may tend to reduce the price paid to the producer everywhere in our country, but all are favorably interested in the constant supply of fresh fruits going out to make life more worth while in snow and ice areas, and all purchasers of early bees or queens for use in their own apiaries are keenly interested in disease control.

I, for one, believe that the day is not far distant when the sale of honey will come into its own. Perhaps the millennium is close at hand also. Anyway the increased strength of individual beekeepers and the accompanying boost in cooperative efforts is sure to help the industry because she will be more able to help herself (and no one else is going to do it). Enough honey is at last being produced to begin to think of making it a staple in home and shop. The vision of a united industry working to stimulate the public mind with reference to "the best of foods" honey is not an idle one. Never before in the history of mankind was so much being said and done to strengthen the position of this natural product of the hive. I need but mention the interest now displayed by supply manufacturers and honey dealers in advertising and better merchandising. This is a day of advertising and the time has arrived when honey is in a position to justify a modern program of marketing. The public will buy honey only when we sell it to them.

WATER STORAGE BY BEES

H. B. Parks, San Antonio, Texas

Contribution from the Texas Agricultural Experiment Station

During recent years considerable misunderstanding has occurred among beekeepers on account of what may be called "locality difference." A number of years ago a statement was published to the effect that a worker honey bee is very similar to a dry-cell battery. It has within it a certain number of responses to certain stimuli and this number of responses is the same and the reaction to the stimuli is the same no matter where the bee may exist. Many have taken this to mean that a bee's behavior is the same no matter where it is found. The statement is absolutely true. The misunderstanding has come from the fact that the stimuli which bring about the action in the bee differ in number and with locality.

One of the peculiar things which is to be noted in the semi-arid districts, where beekeeping is common, is the storage of water by the bees. In the naming of substances stored by bees the ordinary beekeeper will seldom mention water although all of them know that bees visit water holes and carry a great deal of this material into the hives, especially during that season of the year when brood rearing is rapidly advancing. So far as my observation goes the water carried into the hive during brood rearing is used for two separate purposes. The first, a small part of the water becomes an ingredient of the food for larvae. The larger amount is used to keep the relative humidity within the brood nest at the correct point for advantageous brood rearing. From my observations, made in Illinois, Missouri, North Carolina and Texas, I believe that the amount of water brought into the hive during this period is about the same per colony, no matter which state is mentioned.

In the semi-arid districts of southwest Texas the temperature reaches a daily mean of about 93 degrees, the first part of the month of June and the mean relative humidity will be about 51. Honey bees will not work in the field when the temperature is above 94 degrees and the

relative humidity is below 50. Thus, shortly after sunrise by the middle of June the honey bees no longer are at work in the field. The outside heat of the colony will be between 94 and 110. The outside relative humidity will be between 28 and 50. On account of crowding of the entire force of the worker bees within the hive, due to the excess heat outside the temperature has a tendency to rise very considerable. Some brood must be reared throughout this hot period of the summer or there would not be a sufficient number of adult bees to raise the fall brood, so the bees must maintain the brood chamber humidity and temperature throughout the summer. To do this it becomes necessary to store a great amount of water and then to cause the evaporation of this water to bring about the desired humidity and with the humidity the correct temperature. In all that portion of southwest Texas which may be described as semi-arid the bees are fortunate in being able to collect quite large quantities of dew during the early mornings. They seem to show a preference to collecting dew rather than to the collection of water from regular places provided for them. In 1928, in one yard where there were ninety three-story colonies, the bees used up 50 gallons of water per week, in addition to what they obtained from dew, during the period of time between June 15th and August 20th. The amount of water which was used prior to the first date and after the second date was very small.

To those who have never visited this section of the world the storage of water within the hives may seem quite curious and a description of where the water is stored is therefore given. Every beekeeper has noted the presence of small cell-like enclosures on the top-bars, generally made of old wax and propolis. These same cavities are found on the upper surface of all the brood combs and brace combs in the hive. In the district of which I write and during the hot period of summer if you will remove the cover from the hive the first thing that will attract the attention is the presence of water in considerable quantity in each one of these cell-like structures on the top-bars. Very often it is in sufficient quantity that drops of the water will run from the comb that is tilted. Removing a frame, especially one which contains a great deal of sealed brood every indentation in the capping will be found to contain a small amount of water. In fact, the comb looks as if it has been sprinkled and the droplets had spread out in the cavities over the points where the hexagons meet. All beekeepers have noted that the capping of brood is very soft and spongy, and here, during hot months this spongy capping material will be found saturated with water. Removing combs from the sides of the brood nest a considerable circle of what appears to be fresh nectar will be found in several of the side combs. This supposed nectar proves to be water.

If one will take the time to compare the amount of water found in a hive between 8 o'clock in the morning and 6 o'clock in the evening he will be very much surprised to find that during the day the water has almost disappeared from the hives. The water stored is of sufficient quantity that the hives on scales will show the amount. This ranges from three-fourths to one pound to each three-story hive. During extremely dry periods the bees very often cannot store sufficient water to last between the periods of the day when the temperature is below the 94-degree mark and one quite often finds the bees driven to bring in water during the hottest portions of the day. During these periods the water is not only stored in the brace combs and on the faces of the brood but very often the entire bottom-board is a receptacle for minute droplets of water.

As has been said bees respond everywhere to the same stimulus. It appears that the bee's body is very susceptible to changes in atmospheric conditions and that the bee can tell somewhat ahead as to what the atmospheric activities will be. It has been noted many times in our scale records that two or three hours prior to the arrival of hot winds or hot dust storms that the bees increase their activity very greatly

and store in a short period of time an ample water supply. Another difference which is noted in the storage of water is the difference in the sources which the bees favor. During the early spring the bees seem to favor places where they can suck the water from moist ground or from the edge of muddy streams. It has been suggested that they do this in order to get water which is somewhat warmer than that which would occur in standing containers. It has also been suggested that there are certain salts in the water thus obtained that is needed for the growing brood. Just what the answer is I do not know but I have observed that in the spring the bees prefer the muddy places and the edges of water holes to secure their water, however, during the summer months when they are carrying water in great quantities they prefer to take the water directly from the surface of open water tanks or from along the edge of running streams. I have no proof for my theory but I am of the opinion that at this time of year the water which could be sucked from the mud would be a much higher temperature than that which is obtained from the large bodies of water and the bees prefer the cooler water for evaporation purposes.

In running a series of weights of hives containing hygrometers the following relation was found: as the mean relative humidity drops during the hot summer months the amount of water stored increases; as the mean relative humidity rises towards the end of summer the amount of water stored decreases. Another and a peculiar storage habit of the bees can be noted here during those winters when summer-like weather occurs throughout the winter months. There is a goodly force of worker bees in the hive. There is not sufficient low temperature to bring about clustering and there are no flowers in bloom upon which the bees can work. The workers have every stimulus to cause them to go to the field and collect something and they respond to this stimulus. The only two things that can be collected are propolis and water. Every beekeeper in the southwest is ready to verify the statement that during the very warm winters that the bees store immense quantities of propolis and that the storage of water is very frequent. During this time, however, the water is stored entirely within the empty cells, generally at the lower edge of the brood nest. The winter of 1922-23 was very warm and hives opened during January showed large amounts of water stored in the empty cells at the lower edges of the combs. In the writing of this article I am making no discussion of the storage of water but giving a description of what may be found in any apiary in southwest Texas during the year. To sum up this description I can say that the amount of water stored is proportional to the degree of humidity existing within the hives.

That the water storage during the winter time occurs in answer to the stimulus which requires the worker bee to collect and to store something. It makes very little difference what this something is. The peculiar one-half cells found on the top-bars and in brace comb are largely built for the purpose of water storage. The porous wax cappings to brood and of the walls of queen cells are so made to absorb water in order to maintain the correct relative humidity within the cell. The storage of water in the hive has three described purposes. The first as an ingredient of food, second as a vehicle by which a higher temperature and proper humidity can be obtained and third a storage article which is of no use whatever to the bee but is collected in response to the stimuli which causes all worker bees to seek to bring something to the hive under certain conditions of heat and moisture.

To explain the statement made that the misunderstandings relative to water storage comes from the local difference and that these local differences comes from the varying number of stimuli, it is easily seen from the statements given that the stimulus of excess heat within the hive calls for the collection of water and that in the hot semi-arid regions such stimuli occur in such quantities that the bees collect enormous quantities of water during the summer time. The collection of

water during the winter is due to the lack of anything else collectible. It is not only a supposition that these same bees in a locality of lower temperature would not collect such great quantities of water but is actually proven by the activities of package bees shipped from Texas into cooler locations. There is no difference whatever in the action of the Texas bees to that of the native bee of the locality.

The study of the per cent of relative humidity within the hive presents a number of very peculiar problems. A recording hygrograph placed within the hive will give the humidity outside of the living space of the bees. Every time the hive is opened there will be a break in the record as the humidity immediately becomes that of the outside area. The nearer the hygrograph or hydroscope can be brought to the brood nest the less is the variation in the relative humidity shown and while we have not been able to devise a hydroscope that the bees will accept within the brood nest or the cluster it is suspected that the relative humidity within this area varies but very little.

THE PACKAGE BEE BUSINESS

Morley Pettit, Georgetown, Ontario and Valdosta, Georgia

The late A. I. Root is given credit for being among the first to experiment with shipping combless packages by express. Like many other early experiments, nothing came of it until years afterward. My first experience was as a boy helping my father, the late S. R. Pettit, ship swarms at the end of the light honey season, to a buckwheat region about fifty miles away. It was a pioneer effort and for that short distance there was no feed problem involved. The "packages" were soap boxes with the tops screened; but an account of how it came about might be of interest, especially to comb honey producers of the present day.

Back in the nineties of the last century before manipulations for swarm

The central extracting plant

prevention were generally known, natural increase was considerable in the old home apiary where some of my earliest painful duties were to "watch the bees." I would rather have been working hard than to spend the long summer day at attention waiting for something to turn up. The method of management then was to super as needed during the spring with extracting combs then at the beginning of clover remove these from the best colonies and substitute supers of sections. All such colonies usually cast powerful swarms before work had advanced far

in the sections, and these were hived on the old stand and allowed to continue the work which they had begun before leaving home. The parent hive was left beside the swarm for five or six days, then carried to another part of the yard. It would there requeen itself without afterswarming and build up in fine shape for winter.

As the newly hived swarm was wanted for honey only and not for increase, its future was sacrificed in the interest of producing the largest number possible of well-finished sections. To this end the broodchamber was contracted by the use of "dummies," that is boards cut into the shape of combs on which the bees could cluster without using them for storing honey or rearing brood. Moreover the contracted space did not have even sheets of foundation but narrow starters only. This arrangement was calculated to discourage work in the broodchamber and crowd the bees up into the sections. It worked, too. In a short, sharp flow which was all over in three or four weeks after the hiving of the swarm a very maximum of comb honey was produced and a fair percentage of good combs were built below provided the starters were narrow enough to retard comb building, holding it back to the speed with which the queen could lay worker eggs.

During the first three weeks, of course the colony strength was going down and when the light honey came off it left a weakened colony with only a small percentage of good combs at best, since part of the "combs" were boards and part were drones, with practically no honey and an old queen. We had no fall flow in that locality and increase was not wanted so we practiced two things which are becoming common in present day beekeeping. We either killed the surplus bees or shipped them in the kind of combless packages mentioned above to beekeepers in the buckwheat region where they were hived on foundation, requeened, and built up for winter. This was the beginning in my experience of the shipping of combless bees, and of getting rid in the fall of colonies which it did not seem profitable to attempt to winter.

A lot of water has passed under the bridges since those faroff days; but bee nature has not changed and I often wonder if we did not lose something good when those "dummies" went for kindling. I have not produced comb honey since outgrowing the one-apiary, no-help system. The swarming problem and the perishable nature of the product were too much for me; but I have often thought that with package colonies which are less inclined to swarm, the old system might be revived to advantage. You would install your packages in the usual way with plenty of breeding space, build them up the best you can for sections, then for a short, sharp flow contract the brood nest and even leave them with only starters to force the work all into the supers. At the end of the season you would have the result of their whole effort in comb honey, and the weakened swarm with the old queen could go. Now we have cyanogas for a quick and painless death. We used to let them cluster in the combless hive until they grew tired of life. If it were put to a vote of the bees I wonder which they would prefer. I know that dead bees are the best fertilizer you can put on a garden.

Whether it is profitable to kill colonies of bees in the fall and buy packages in the spring is a much mooted question. I am not prepared to give a definite answer for too much depends on circumstances for anyone to decide that question for others. There is no doubt in my mind that for an uncertain spring and a short honey flow it is profitable to hold colonies together for all you can get out of them and then make desired increase by purchasing packages the following spring. It is also probably true that a well wintered colony may store more honey than a well installed package. The argument ranges around the cost of the well wintered colony as compared with the cost of a package which has been successfully installed and brought up to the honey flow. The statement that the writer killed twenty-five per cent of his colonies, two hundred in round numbers, at the close of the 1928 season with the intention of installing twice that number of packages before the 1929

season begins, will add zest to the argument. This was done to save the cost of requeening, of preparing for winter and the percentage of winter loss which seems inevitable. The writer with one experienced helper and a boy managed eight hundred colonies and produced over a hundred thousand pounds of honey so the work of management had to be simplified as much as possible. Requeening and swarm control are rather large items of the summer's work. The package has its young queen and is less inclined to swarm. Packing bees for winter may not be much more labor than installing packages in the spring; but packing some and installing some divides it up.

The wintered colony must be re-queened, properly built up in the fall, fed, prepared for winter, and brought through the spring. Expense is involved in every one of these items. Re-queening takes labor and loss if all done by the beekeeper, or expense, less labor and more loss if queens are purchased. Building up depends largely on the uncertainties of the fall flow. Winter feed also depends on the fall flow and is so much a matter of locality that it can hardly be discussed in general terms. Natural stores may be inexpensive and adequate—until a bad winter causes heavy loss. Then the whole wintering expense is gone and the package expense is added to it. In any case the cost of feeding a colony from the end of the light colony flow through the fall building-up period, through the winter and through the spring is probably as great as the purchase and transportation cost of a package of bees. I know that a package installed about the first of May takes less feed to bring it up to working strength late in June than a wintered colony of similar strength consumes in the same period, after we have already had the expense of requeening, building up in the fall and wintering.

There are always losses of colony strength and of whole colonies in winter. These vary so that one cannot even estimate a conservative average. The same may be said of losses of package bees. There have

Efficient production means profitable returns from the apiary

been heavy losses en route from the south; but I think those have been almost entirely overcome. Most reliable shippers guarantee safe arrival and satisfaction. There are still some losses of queens, both when being introduced and after they have started laying. Shippers are giving their best thought to this problem, are reducing it, and are replacing losses wherever possible. I do not believe the losses, all told on packages are as great as on wintered colonies. After we have done our best, success in wintering all depends on the winter and success with packages all depends on the spring. Personally, until I get more experience which may change my views, I am willing to do the most of my requeening with packages. That is, the colonies whose queens are not worth wintering will be allowed to die with the queen. Good, young queens coming north with packages in the spring should be able to build up the colony, carry it through summer and winter, and build it up for a second crop. Naturally some requeening will be done during the summer in the course of swarm prevention, and in the hive without the beekeeper's knowledge. So I shall count on wintering from sixty to seventy per cent of the colonies and making up the other thirty or forty per cent with packages.

The whole system will greatly reduce labor, both by dividing fall and spring work and by simplifying summer management. Given plenty of room at the right time there is far less tendency to swarm in package colonies. Then, once the honey flow is well under way, the loss of the colony queen is not such a vital matter as when the numbers must be kept up for winter. A story is told of a California beekeeper who gave his method of requeening as follows: He killed all his queens and then went hunting. That was a rough and ready way, but it might have some place in the system we are discussing. A colony that loses its queen toward the close of the honey flow goes on working just about as well while it is building cells. In fact the stoppage of egg laying begins in three days to cut down the consumption of larval food which allows more honey to be stored. Of course when the virgins begin emerging swarming may take place and the hive may be left weakened or hopelessly queenless. If the killing of the queen is so timed that surplus storing is past by then we may have a strong requeened colony or a queenless one, but in either case the present crop is slightly affected if at all. Now a check up will discover requeened colonies or broodless ones to be treated accordingly.

At the final count up all brood combs are brought to the central plant and sorted, their topbars are scraped and the hives thoroughly cleaned ready for use in the spring. Bad combs go to the melting pot and good ones are stored away with the honey and pollen right in them, ready for the packages. We find this system greatly reduces our outside work in the fall and gives employment to the permanent help in spring.

ULTRA VIOLET RAYED QUEENS

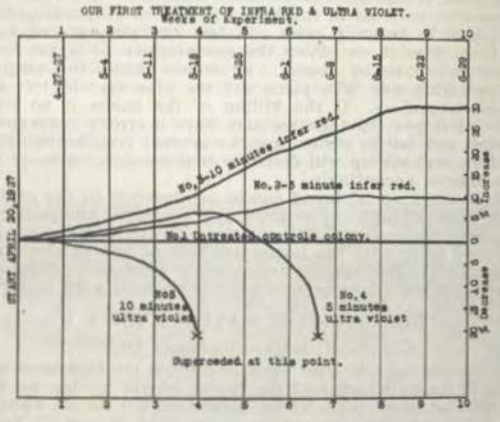
Clifford F. Muth, Cincinnati, Ohio

About two years ago the first experiments on treating bees with ultra violet rays began in Cincinnati, or in the world so far as we know. We knew nothing about ultra violet rays then, nor do we want to leave you with the impression that we know all about it now. I for one am still in the honey business and feel sure that if I knew all about ultra violent rays and their effect upon animals, insects, human beings, foods and plant life, I would have changed my occupation.

In order to have a full knowledge of our own particular line of work we must have an open mind in the achievement of science and work of others or we become old-fashioned. The moment that Mr. Balinkin inquired at our office about bee supplies I had a feeling that he was not an amateur beekeeper and it was but a matter of moments until we had gained each others confidence and he explained that his interest in bees was to see what scientific effect ultra violet rays would have on the colony. Mr. Balinkin is a graduate student of the University of Cincinnati working for his Ph. degree. Going briefly into his history he was born and raised in Russia and went to Turkey and graduated from the Roberts College at Constantinople, specializing in physics and more especially light radiation. A Cincinnati professor at the Roberts College at the time induced Mr. Balinkin to come to the United States and continue his research and study here.

With Mr. Balinkin's knowledge of ultra violet rays and mine of bees we agreed to do some experimenting together. I will give you the summary and results of our first experiment. You must understand before we go any further that we had many failures but our successes outnumbered our failures so that we were always making some progress with each change of treatment. Sometimes we would go quite far before we would have a slip and we would slide back but not all the way. Now we have our treatment to the point where we can say without fear of contradiction that a queen bee treated by these methods that we now use show an **average increase** in egg-laying between 10 and 40 per cent above the normal untreated queens and that the offspring from these queens are **extremely gentle.**

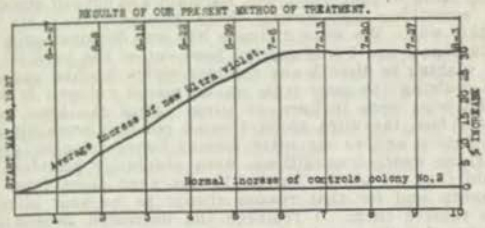
Our first experiment was to take five new hives with full sheets of foundation and placed in each hive a two-pound package of bees and an untested Italian queen. The colonies were fed equal amounts of syrup. The queens were sisters, being raised from the same breeding queen. The length of treatment was a matter of guess at first. They all received three treatments except the first one which was kept as a control queen and colony for comparison. Two of the queens received five and ten minute treatments of ultra violet rays, the other two queens received five and ten minute treatments of infra-red. Carbon arc lamps were used



with impregnated carbons which the manufacturer, National Carbon Company, manufactured for the purpose of creating the maximum amount of ultra violet rays and still another carbon to transmit the maximum amount of infra-red. These two rays are the opposite invisible rays on either side of the spectrum. Picture in your mind the rainbow with its red, orange, yellow, green, blue, indigo and violet. The explanation of the rainbow is that sunlight is split up or divided by passing through millions of rain drops which act as prisms. Ultra violet is invisible beyond the indigo, the infra-red is invisible beyond the red.

Ultra violet is today used by many physicians in the treatment of children who have rickets. Ultra violet produces red corpuscles and increases the amount of calcium formed in our bodies. Infra-red on the other hand is a stimulating light, it is used by physicians on patients who have low blood pressure or a weak heart, or where there is a condition of improper circulation of the blood. If you take a treatment of infra-red you get up feeling "full of pep." To receive a treatment of ultra violet rays gives you a feeling of restfulness.

With weekly inspections these results were noted on our first experiment. The untreated queen laid beautiful full frames of brood and lots of it. The two ultra violet treated queens were a big disappointment. The one receiving three ten-minute treatments fell way below normal in her egg-laying and at the end of the fourth week was superceded. The five-minute ultra violet queen showed an increase in egg-laying up to about the fourth week and then began falling off until shortly before the seventh week she was also superceded. The two infra-red treated



queens showed much better results. The five-minute infra-red had an increase in egg-laying of 10 per cent at the end of the sixth week. The ten-minute infra-red queen showed a 30 per cent increase in egg-laying at the end of the eighth week.

My suggestion to Mr. Balinkin was to pursue the infra-red treatment and drop the ultra violet but Mr. Balinkin had a more thorough knowledge of ultra violet rays and said that it was just a matter of finding the limit of the ultra violet radiation which was beneficial and filtering out the balance. It was also a matter of exposure, it may have been too long. You are no doubt familiar to some extent with the X-ray. X-rays are another form of light radiation but of a much shorter wave length than ultra violet. For an example let us think in terms of radio. If your radio is built like mine we receive the stations broadcasting on the shortest wave lengths near zero and as we increase the turning of our dial we get stations of higher wave length to the maximum of 550 meters. Now in light radiation X-ray is on a definite wave length of only six angstrom-units (which is a different way of measuring than in meters). This you will see is very short waves. Ultra violet rays are limited between 2,700 and 3,000 angstrom-units. Then above 3,000 A. U. these comes the series of violet, indigo, blue, green, yellow, orange and red up to 8,000 A. U. where infra-red begin. As Mr. Balinkin suggested we had a filter made which measured 6x6 inches and approximately a quarter of an inch thick, in fact it looked like a very poor piece of glass because it has numerous air bubbles in it. This was to shut out the wave lengths less than 2,700 angstrom-units because we felt that we were getting some radiation which was approaching the X-ray which were sterilizing our queens. The filter worked most satisfactorily. Ultra violet rays cannot penetrate through window glass, but it can pass through quartz.

On our next experiment we changed the source of light, using instead of the carbon arc, a quartz mercury lamp. With the radiation of this lamp for three minutes upon your skin you can receive a burn without having felt heat which will mark you for a long, long time.

With our next experiment worthy of note we decreased the time of exposure from five and ten minutes down to a matter of seconds, the first day, the queens received fifteen seconds, the second day was a day of rest, the third day thirty seconds treatment, fourth day a day of rest and on the fifth day ninety seconds. Remember that the quartz mercury lamp was used with the filter eliminating the short waves. These queens were given to colonies on the same basis as the first experiment, always keeping an untreated queen and colony as a control. With this experi-

ment there was a steady increase in egg-laying on all of the treated colonies until at the sixth week there was a 30 per cent increase in egg-laying over and above that of normal.

To check upon this, 200 treated queens were sent out to almost that many beekeepers, several beekeepers receiving two or more queens, and they were given a chance to see for themselves the increase in egg-laying if any. Just about this time when Guy LeStourgeon, the editor of Beekeepers' Item, (who had been publishing our experiments during this period), came to Cincinnati, Mr. Balinkin and myself simultaneously discovered something else among these treated bees. My discovery happened this way. We were giving a live bee demonstration at a food show in Cincinnati and I was getting bees out of the yard for that purpose. Not wishing to disturb any colonies which we had under observation I was drawing the bees from an untreated colony. It was a bad day and the bees were inclined to sting. After the bees were safely in a shipping box, the ultra violet treated colonies were given another weekly inspection and to my utter dismay these colonies, even in the face of adverse weather conditions, were absolutely harmless. Let me repeat again that all of the queens in our yard came from the same breeding queen and for that reason should be as near alike as it is possible to receive them. I replaced the untreated bees with frames of treated for the shows. During the course of the week twenty-one demonstrations were given and with most of these I was assisted in the cage by my son, who at that time was four and a half years old. Remember, this was last August a year ago. Neither he nor myself received any stings except those stings which I actually caused the bee to part with its stinger in order to convince the people that they really were bees and capable of protecting themselves.

Immediately we sent out questionnaires to the beekeepers having these 200 treated queens. They had been divided into five lots and each receiving a different treatment. Among the numerous questions that were asked these were the results of the best lot which treatment we have since adopted. Eighty-one per cent of the queens showed an increase in egg-laying from 10 to 40 per cent and the offspring were extremely gentle. The remaining 19 per cent either increased egg-laying or extreme gentleness. Any that were doubtful as to the results of either were included in this 19 per cent.

Realizing that so large a claim would be difficult to convince thousands of beekeepers many of which were older in bee experience than myself, I realized that further proof would be necessary.

I had know that the Cyprian bees had a reputation of being wonderful honey gatherers but not used to any extent in this country because of their disposition. I attempted to import some from the Island of Cypria in the Mediterranean Sea through the Department in Washington but Mr. Hambleton was out of town at the time, and before we were in communication again I found that I could secure some pure Cyprians from a queen breeder in Oakland, California. This arrangement was made and they were sent to me at Cincinnati by aeroplane mail, arriving at our office in thirty-eight hours from the time they were placed in the postoffice. The offspring from one of these queens were the bees which I had used in my demonstration at Xenia, Ohio, in August and at five other conventions prior to that through the state of Michigan and you have my word for it that with these Cyprian bees flying promiscuously in the open yard, in the schoolroom and on the lawn at the different places, there was not one of the audience nor myself who received a sting. These Cyprian bees were not baby bees, the queens were introduced into these colonies in early June and at the time of the demonstration in August it was a rarity to find an Italian bee in the colony.

Part 2

Question No. 1—One of the most common questions asked is: What effect has the ultra violet upon the second or third generation?

Answer—Our observation is little or none. That is to say, a queen raised from a treated queen does not inherit these qualities which we inject or subject, if you please, into the parent queen.

Question No. 2—The next question usually brought up is: Are the bees prolific in honey gathering?

Answer—Yes, through numerous reports from beekeepers this season and we have at the present time some six thousand treated queens among beekeepers, we have endless letters on file where they say that because of the shortage of honey this season due to the excessive rains during the month of June the crop is from 25 per cent to 75 per cent short and colonies producing the largest amount of honey were from the ultra violet treated queens. I can explain this in this way and I believe you will agree that strong colonies will have more field bees than the weaker colonies and naturally with this increased number of field bees it is bound to show an increased production in these colonies. There is a proportion which in my opinion is safe for beekeepers to work on and that is, if you double the number of bees in the colony you quadruple the amount of surplus honey. Then in this same proportion if you increase your number of bees in a colony 30 per cent you practically will double your crop of honey.

Question No. 3—Have we ever treated larvae or eggs or pollen with ultra violet rays?

Answer—We have and intend to do more work along this line in 1929. We treated a young queen cell all during its period of development, keeping the frame which contained this queen cell in our office. You have seen a peanut that had three kernels in it. This is as accurate as I can explain the size of this queen cell. When the queen emerged and as I write this article I am running my finger back on the lead pencil trying to estimate the exact length of this virgin queen and in order to stick entirely to the truth and not be tempted to exaggerate, let it be sufficient that I say she was without doubt the largest queen that my father, several beekeepers who have seen her, and myself have ever witnessed in our lives. She and the observation hive were taken out to our beeyard and opened but she never returned to the hive after going on her flight and Mr. Balinkin and myself have made a solemn promise that we are going to devote some of our time in 1929 to go further into this particular experiment.

Question No. 4—In what other lines, if any, do they use ultra violet rays?

Answer—The poultrymen for the past two or three years have been experimenting with using quartz mercury lamps in their hen houses during the winter period and the information that you can receive from their bulletins is that the hens show a much increased egg-laying with the use of these lamps. Bear in mind that ultra violet rays is a calcium builder. Calcium is lime which is necessary for the development of the egg. Dairymen are using lamps in the barns and their result is an increase in butter fats.

Question No. 5—Would exposing the queen bee to sunlight be beneficial?

Answer—No, because the quantity of ultra violet rays is so small in the ordinary sunlight that the queen would be cooked from heat before she would receive the amount of ultra violet rays that she received under a lamp over a period of fifteen seconds.

Question No. 6—What effect, if any, has the ultra violet on drones.

Answer—Well, this is I suppose as important as treatment to the queen. We have not had time to do very much experimenting along this phase but since Dr. Watson is successful with his artificial mating we expect to subject the male germ to the ultra violet before impregnating the queen artificially. If we can secure Dr. Watson's co-operation on this the experiment will be carried on in 1929.

Question No. 7—Have there been any other experiments besides yours on bees with ultra violet rays?

Answer—Last summer we read an article in American Bee Journal

of some Austrian scientist treating the entire population of the colony with ultra violet rays. His report is that the bees show an increase in comb building from 150 to 200 per cent.

Question No. 8—Has there been any work done in treating honey to ultra violet rays?

Answer—Yes, at the Michigan State Agricultural College last winter I secured some data on their method of treating different foods to ultra violet rays. They kept record of the effect of these foods on white rats which had rickets and the foods that were treated with ultra violet rays cured the rats of rickets, while the others which were given the untreated food remained in this deformed condition. My experiment was carried on in Cincinnati through the assistance of Dr. Greenebaum, one of the leading child specialists. He put several children of rickety condition in the free clinic on a part honey diet. He used both the unradiated honey and the radiated. He was compelled to take all of the children off of the honey due to causing looseness of the bowels, which is more likely the result of the honey than of the radiation for this result was noted through both the treated and untreated honeys.

Question No. 9—If it is possible to increase the production of honey by means of these ultra violet treated queens, will not this be a detriment to the beekeepers in flooding the markets still further?

Answer—While this is still far-fetched as a manufacturer I know that profits increase as overhead decreases. If you can cut the cost of producing a hundred pounds of honey in half or nearly in half, or even 25 per cent you will still be ahead even though the selling price of that hundred pounds is reduced. If we can cut the cost of honey low enough to give syrups an equal break and have our cost of production sufficiently lowered so that we can afford to do this we will increase our per capita consumption tremendously and make honey a staple profitable industry.

Question No. 10—Can anyone treat their own queens?

Answer—In the first place the cost is an outlay of over a thousand dollars for equipment. Then again Mr. Balinkin and myself are applying for a patent process on this, not to make it a commercial affair but to keep someone who might have in mind of capitalizing upon this and excluding others from the benefit.

Question No. 11—How did you count the increase in egg-laying and count it accurately?

Answer—That is a very good question to bring up and I do not take it as a challenge. The method is simple—using a T square with ruled inch divisions. The solid brood was a matter of arithmetic, the number of square inches times 25, which is the number of cells to one square inch. Then with the T square the remaining brood outside of the solid block of brood was subdivided into square inches again and multiplied by 25. This sounds like a big job but with two working, one with paper and pencil and the other with the square we would figure a colony in fifteen minutes.

THE PROPER TEMPERATURE FOR WINTERING OF BEES

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The question of the proper or best temperature for cellar wintering of bees is one that has caused a great deal of discussion in the bee journals of the past sixty years. Even at this time, with more emphasis being placed upon outdoor wintering, a review of the literature upon cellar wintering may be of value in solving some of our ever present wintering problems.

Many theories have been advanced for the different temperatures claimed to be desirable for cellar wintering, but the great variation in most cases, no doubt, would have been greatly decreased had the various observers been working and observing under similar conditions in all respects. Much of the evidence presented herewith is that of practical beekeepers who have reported their results in wintering at different temperatures, while not being entirely scientific in all cases, must be considered in determining the approximate correct temperature for wintering of bees in cellars or other types of compartments.

As previously stated, differences in temperature stated by various observers were due to varying conditions, hence an attempt will be made to include a statement of the conditions along with the temperatures reported where possible. So far as the observations of the writer extend about the first definite statement as to the proper temperature for wintering bees was made by Carey writing in Volume 3 of The American Bee Journal in 1863. He said that the cellar should be dry, dark, well ventilated, with the temperature as near 36 degrees Fahrenheit as possible, since high temperatures cause restlessness. He claimed that bees consumed only half as much stores when wintered in unprotected places, but have the advantage of not breeding as early in the latter part of the winter and early spring. Our present day conception will be found to differ greatly from the ideas of Carey.

Then followed a period of six years until 1869 before the question of cellar temperatures was revived. Lattner in giving the results of wintering in the American Bee Journal, suggested that the cellar temperature should not go below 40° F. while at 45° F., the bees appeared restless, which could be remedied by ventilation. Pierson* advised keeping bees in a dry, even temperature of 36 to 42 degrees Fahrenheit. A. J. Cook, in making a report of the Michigan Beekeepers' Association convention of 1869 said that all the beekeepers present thought that the best method of wintering required a dry, uniform temperature of 32 to 45 degrees Fahrenheit with good ventilation. In the same issue of the American Bee Journal, Thomas declared that bees winter best in a semi-dormant state, best secured in a large cellar at a temperature of 35 to 40 degrees Fahrenheit, in which condition the least amount of food is required, hence the bodies are less distended and excrements more easily retained; the waterly substances from the bodies being carried off by evaporation at such a temperature, thus securing a more healthy condition of the stock. Under such temperature conditions, he said that the bees are able to reach any part of the hive to obtain food and the bees always come out in the spring healthy and vigorous.

In 1870, Dayton reported that for best success, he tried to maintain a temperature of 35° F. in a dry, well ventilated cellar. Briggs reported a standard of 40 to 45° F., preferably as near 45° F. as possible for December to February, followed by 50° F. to promote brood rearing. He claimed that temperatures as low as 32° F. caused too much consumption of stores with probable loss from dysentery. Two years later in 1872, Briggs contradicted his previous statement somewhat when he said that if bees are kept at 32 to 45° F., they will remain almost dormant for the next three months and often for five months.

In 1873, Ronald recommended about 38° F., not below 32° nor above 42°. In 1874, Quinby reported good results at 42 to 50° F., and plead for beekeepers to make known their records on the proper cellar temperature. Scientific gave his standard as about 45° F., because the bees were very quiet at 40 to 45° F. Salisbury insisted on 45° F. in a good, dry cellar. Both Gleanings in Bee Culture and the American Bee Journal for 1874 have many references to the use of hot beds for purposes of giving the bees a chance to fly to void feces when necessary under cellar wintering conditions.

In 1875, P———, in commenting upon the observations of Newport given in Philosophoical Transactions, published in London in 1837, said that he considered that a cellar suitable for fruit or as low as 28 to 30° F. was too low for bees, as his bees with upward ventilation were most quiet at 41° F. then when it was either several degrees above or below

*Unless otherwise stated, all references are from the American Bee Journal or Gleanings in Bee Culture. When no year is mentioned, the last previous one stated in the paragraph applies.

this point. He removed his bees from the cellar in the spring when he could not keep the temperature below 48 or 49°.

In the prize essay read before the National Beekeepers' Association in 1876, Cook said that the first requisite of safe wintering was keeping the colonies at a uniform temperature not below 35° or above 45° F. He expressed the same idea in 1879. In 1882, Cook said that successful cellar wintering required a uniform temperature of 45° F. Again in 1889, Cook indicated 38 to 45° F., preferably the latter for successful wintering.

At the North Eastern Beekeepers' convention in February, 1881, Dadant read an essay upon the successful wintering of bees in which among other things he recommended that the cellar temperature should be 45 or 43° F. when the bottoms are nailed on the hives. Newman reported that at the close of Dadant's essay the following resolution was offered and adopted by the beekeepers present:

> "Resolved, that as bees are natives of warm climates, that in wintering them in cold climates, the requisites to do it successfully are a dark, quiet, and even temperature, and plenty of good honey."[a]

In 1894, Dadant reported that 42 to 46° is best for wintering; at 40° or less, activity causes consumption of stores with resultant diarrhea, while at 48° or above the bees are uneasy and the queen starts laying if this high temperature is continued for a few days. For these reasons he preferred outdoor wintering.

In 1882, Dzierzon, in his Rational Beekeeping, said that the cellar need not be frost-proof since 10° R. (9½° F.) does no harm to the bees, yet at another point he suggested that a temperature kept about the freezing point might be best for the bees. Frith reported good results at 40 to 48° F.; Jones gave 43 to 46° as desirable, saying that in no case should it fall below 42°. Train in 1883, preferred 44 to 50°, never below 40° which he said is sure to cause dysentery.

Thielman in 1885, reported successful wintering in a cave at temperature of 40 to 42° Fahrenheit, while most colonies left on their summer stands perished during a winter when the outside temperature dropped to as low as 35° below zero. The next year Thielman warned against wintering at high temperatures of 65 to 90° Fahrenheit and again stated his ideal of 42° Fahrenheit. In 1892, Thielman gave 40 to 45° F. along with pure air as the requisite of a good bee cellar.

Heddon in 1885 and later in 1891, expressed the idea that when the temperature falls below a certain point, usually 45° F. in the hive, the bees add to the heat-producing method of consumption of oxygenized food that of producing heat by exercise, which means waste of tissue and the consumption of tissue making good, nitrogeneous food or pollen which clogs the intestines and produces disease where long confinement follows. For successful wintering he suggested honey free from pollen or sugar syrup and a temperature of 45° F.

In answer to a query in the American Bee Journal in 1885 as to the proper temperature for bee-houses and bee cellars, various beekeepers gave the following answers:

Heddon—Such ventilation, temperature and humidity as the bees remain most quiet;

Miller—My cellar indicates about 40° F., but that temperature will vary, being the temperature at which bees remain the most quiet;

Tinker—Somewhere between 40 and 50° F., where the bees remain the most quiet;

Doolittle—43 to 45°.

Hutchinson—That temperature at which bees are most quiet;

Dadant and Son—At 42 to 45° F.

Writing the same year, Alley quoted Barber who said that if he were compelled to winter in a dry cellar, he would drench the bottom thoroughly with water before the bees went in and not allow the temperature to go above 50° F.

[a]Newman, T. G. 1881. Preparing Bees for Winter. A. B. J. 17:285.

In 1885, Doolittle suggested a cellar temperature not lower than 43° F. In 1892, he wrote that he preferred outdoor wintering in chaff-packed hives unless a cellar maintained an even temperature of 41 to 47°. In 1894, Doolittle reported successful wintering in an underground repository with a temperature of 44 to 46° F. In 1902, Doolittle gave 42 to 50° F. as desirable for cellar wintering. That Doolittle varied his statements of the limits of the proper cellar temperature is shown by the fact that in another article, published the same year, he suggested 44 to 48° F. Writing in 1906, Doolittle said that cellar wintering had proven to be the best plan because of the even temperature maintained which means little consumption of food to keep up the warmth during the winter period of partial activity, the small amount of waste materials being easily contained in the bee's body.

In 1886, Tinker gave results of his observations on clusters of bees and concluded that 41° F. was the right temperature for wintering bees or for perfect "hibernation." Hewitt reported results of varying the temperature of the cellar in which he decided that 42° F. was the best point for "hibernation," with a range of 40 to 44° F.

Cheshire in his book published in 1886 recommended 40° F. as most favorable for wintering since the bees exert the least effort when the surrounding air is at that temperature. Hatch preferred not much over 45° F., but not lower than 40° nor higher than 50° F. Hatch later reduced his limit somewhat for in 1895 he recommended a controllable temperature of 40 to 45° F. Again in 1906, Hatch said that an even degree preferably 45° is best for cellar wintering, although a rise to 50° toward spring seems to do no harm, as well as a drop to 40° if the latter does not continue longer than 24 hours.

In 1886, Woodward indicated good results at 65° F., yet his conclusions have not been born out by actual experimentation. McLain, from observations previously quoted, approved a temperature of 44° F. for cellar wintering.

In 1886, Miller suggested a cellar temperature of 43 to 45° F. Miller, in 1895, in answering the question as to why bees could stand lower temperatures outside than in the cellar said he thought that it was due to the occasional opportunity for flights. While 38° is considered as a danger point in the cellar, Miller said that we think it is all right if the temperature drops to 15° or 20° or occasionally zero. He reasoned that since where air is close and impure the thermometer must stand higher to keep human occupants warm than in a room with fresh, pure air, that the same was probably true of the bees. In 1898, Miller explained that 45° F. is a desirable temperature for cellar wintering because of the temperature of individual bees of 80° F. or more which warmed up the air near the cluster to supposed desirable temperature of 50° F. necessary for safety to individual bees.

Miller, writing upon the question of cellar wintering in 1913, pointed out some of the reasons for variance of desirable or successful cellar temperatures as reported by numerous writers. Among them are imperfect reading of thermometers, judgment of degree of quietness even by the same writer on succeeding days, difference in temperature at different levels in the cellar, and possibly the number of colonies that were "waking up." He reported that on succeeding visits to his bee cellar, different colonies were noisy, and the number varied from time to time, suggesting that noisy spells were only natural and might not indicate anything wrong. Miller was sure that the bees were quieter at 45° than 64° and that the point of greatest quietude was somewhere near 45° F. In 1919, Miller said that the latest investigations appear to show that about 50° to 55° is best temperature for cellar wintering, probably basing this statement upon the report of Phillips and Demuth mentioned later. However, he again stated that the particular degree is not as important as that the temperature is that at which the bees remain quiet in a particular cellar.

In 1888, Boardman placed the proper cellar temperature at 32° to 50°

or 55° F. as a maximum, and 60° as the extreme of high temperature. In 1895, Boardman wrote that he preferred a temperature slightly below 40° F. until brood-rearing was evident in the spring when he wanted the cellar temperature raised to 50 or 55° by artificial heat.

Tyrrel, in 1888, gave 32° to 38° F., never over 40° F., as the desirable cellar temperature. In 1888, Holterman stated that bees appear to winter well at 45 to 50° F., but he admitted that it might not be the best. Pearce wrote that he regulated the cellar temperature at 42° F., as at that point the bees came nearest to hibernating. At the Michigan convention in 1891, Mason recommended for proper cellar wintering an abundance of food, a dark, dry cellar, with a temperature of about 45°, to be maintained from the beginning of settled cold weather in the fall to the beginning of settled warm weather in the spring. Hutchinson wrote that a temperature of about 45° enabled bees to bear a much longer confinement than does a temperature below freezing. In his book, Advanced Bee-Culture, published in 1905, Hutchinson considered 40 to 44 degrees best for his particular cellar, if the bottom boards were removed. He referred to an article in an early number of the Bee-keeper's Review by Taylor who expressed the opinion that no one can determine, other than approximately, the best temperature of another man's bee-cellar. Hutchinson then related various factors which had to be considered in determining the proper temperature. However, he thought that every normal colony could be wintered in an ordinary bee cellar in which the temperature ranged from 32° to 50° F.

The American Bee Journal for December 24, 1891, page 808, gave the answers of various beekeepers to the question, "At what temperature should a cellar be kept when the bees are in it?" The answers briefly condensed with the temperature expressed in degrees Fahrenheit were as follows: Mahin—at about 45°; Dadant and Son—42 to 46°; Hambaugh— 38 to 45°; Doolittle—42 to 45°; Taylor—42 to 45°; Brown—45 to 50°; Cutting—if a dry cellar, 38 to 40°, if damp, 42 to 45°; Pond—bee books give 35 to 50°; Dibbern—45°, if dry, 40°, if damp, 50°; Mason—45° in a dry cellar, higher preferable in damp; Secor—40 to 45°, 48 or 50° for a short time if dry will not hurt; Harrison—the temperature at which the bees are most quiet; Miller—the temperature at which bees remain quiet, 35 to 50°, 45° is orthodox point; Heddon—40 to 50° depending on humidity, the point at which bees are most quiet; Cook—40 to 45°; Tinker—41 to 45°, never below 41°, except with warm cushions over the brood nest when 38° for a few days does no harm; the editor, Newman—at about 45° or as keeps the bees in quietude.

In 1892, Brose said an even temperature of 45 to 50° F. was desirable for wintering, without unnecessary disturbances, and the hive in condition to absorb all moisture generated by the bees. Johnson said that every experienced beekeeper will advise keeping the cellar as warm as possible or from 40° to 45°; Lower said that winter quarters must not have a temperature higher than 47° to keep bees quiet.

Baldridge, in 1894, was satisfied with a temperature of 40° to 60° in his perfectly dry cellar. Elwood, in 1895, thought that 42 to 45° was about right for the average cellar although he said the temperature named by different authors varied from 38 to 50° F., which he suggested was probably due to difference in humidity. Griffin, in 1898, recommended an even temperature of 40 to 45° for successful wintering, or a temperature at which bees could be kept quiet without artificial heat.

In 1907, Alexander wrote that the best success that they ever had in cellar wintering was in cellars where there was running water at a temperature kept at 45 to 48° F. He said that at beekeepers' meetings many years before, it was generally agreed that bees would winter well at a temperature just above freezing, if the colonies were well protected in double-walled hives, but in single walled hives with bottoms removed and only a cloth over the top of the frames, then the cellar should be kept at 45 to 48° F.

In 1911, Byer reported successful wintering by a Mr. Davidson in a dry cellar at a temperature of 35° F., this being secured by window ventilation until spring, when the temperatures ran somewhat higher. In reply to Byer, Miller suggested that Davidson's thermometer might be reading low or that the abundant supply of fresh air might be making the big difference or some particulars in the management. He cautioned beekeepers to stick to the orthodox 45° F. as testified by thousands of beekeepers.

Root in 1910, stated that "our theory," apparently that of the Roots', was that, "When the temperature is between 40 and 45° the bees go into a state of semi-hibernation, during which respiration is very low. When it goes above 50° they become active, consume more oxygen, which soon becomes vitiated, and uneasiness follows which is manifested by roaring. Unless the cellar temperature can be held steadily within a degree or two of 45°, there must be ventilation."[1] Root in 1917, said that formerly the proper temperature of a bee-cellar was 45° F. but that there was a tendency toward a higher temperature—"say 50 degrees." He says that 50 degrees requires plenty of fresh air, while 45° F. is better with less ventilation. The interchange of bees from the outside to the inside of the cluster is also described by Root in this same article. Root in 1918 quoted Running as saying that best results in cellar wintering are obtained where the cellar varies from 43 to 47°. Root concluded from other interviews with beekeepers that an average of 45° F. was about right since the temperature of the bees approached nearly the temperature of least activity or 57° F. He says that in later years there has been a tendency towards 50 to 55° F. because a lower temperature cannot be maintained in house cellars. In their own experience, with a temperature variable from 40 to 65° F. he found that a larger amount of ventilation was necessary especially at the higher temperature, but he reported excellent results at temperatures of 55 to 60° F.

In the 1923 edition of A B C and X Y Z of Beekeeping, Root and Root say that a temperature of 57° F. in the cluster is the ideal. They say also that the average temperature recommended for bee cellars is about 45° F. but it may be as low as 40° or as high as 50° F. depending on conditions in the cellar, even up to 60° F. if the cellar is constantly ventilated. They suggest that a temperature 52° F. which will result in a cluster temperature of 57° F., should be maintained on the bottom boards by increasing or decreasing the size of the entrance, probably basing their conclusion from interpretations of the observations of Phillips and Demuth, reported in U. S. D. A. Farmers' Bulletin 93.

Phillips and Demuth in "The Preparation of Bees for Outdoor Wintering" (U. S. D. A. Farmers' Bulletin 1012) suggest that a temperature of 50° F. on the bottom board is desirable and that the entrance should be so arranged as to prevent drafts so that at no time should any part of the hive fall as low as the freezing point. In "Wintering Bees in Cellars" (U. S. D. A. Farmers' Bulletin 1014) they claim that the commonly stated temperature of 40 to 45° F. is colder than is usually best for finest results. They declare that a temperature below 40° F. in the cellar is invariably bad for the bees and that freezing temperatures are not fit for the bees. These authors found that the bees did the least amount of work when they were immediately surrounded within the hive by a temperature of 57° F., which is best obtained when a temperature of 52° F. is registered by a thermometer just inside the hive entrance with the cellar at about 50° F. or slightly higher. They say that if the temperature of the cellar drops to 45 or less, it will be best to have the covers of the hives sealed on tightly and the entrance reduced to three-eighths inch by 2 inches, while at temperatures of 50 and above the entrances may be left open the full width. At 45° F. the tops at least of the uppermost hives in a pile may be protected by cushions of chaff.

[1]Root, E. R. 1910. Editorial on Temperatures of Cellar. Gleanings 38:715.

Phillips in his 1919 edition of "Beekeeping" expresses the same idea in part, but in the latest or 1928 edition, he says that it would be advantageous to raise the cellar temperature to 50° F. or above were it not for the fact that at higher temperatures, the relative humidity of the cellar is usually too low causing activity and excitement of the bees.[2]

In 1918 Demuth suggested that behavior of the bees is a better indicator than a thermometer to determine the proper temperature for the cellar. This writer suggested that while 45° F. is considered all right for the early winter, the temperature should be kept lower in the latter part of the winter when the bees are generating heat because of discomfort. The best temperature for cellar wintering was given by Demuth as that just below the temperature at which the bees form a rather loose but definite cluster, varying between 55 and 45° F., according to the time of the winter, the degree of quiescence, the cellar, styles and sizes of hives, and size of the colonies.

M. G. Dadant, in "Outapiaries and Their Management," indicates 42 to 50° F. as suitable for cellar wintering. C. P. Dadant in "First Lessons in Beekeeping," suggests 40 to 45° F. for a ventilated cellar, with 25 to 30 pounds of good stores per colony. In his "Dadant System of Beekeeping," Dadant gives 42 to 45° F., but suggests that it is best to find the temperature at which the bees are most quiet. In 1922, Dadant gave the limits as 42 to 48° F., and again suggested that the quietness of the bees is the best indicator for the proper temperature for cellar wintering.

Abshudy in the "Bee World," 1919, suggested maintaining a temperature of 45° F. in the air chamber of an "Incubation Hive by means of electricity, since this will mean less food consumption to raise the air to the desired cluster temperature of 65° F.

An anonymous writer in the American Bee Journal for September, 1919, reported the loss of all but about 20 colonies of 109 colonies, fall count, when he attempted to winter at high temperatures as suggested by the results of some previous investigation. However, the temperature of his cellar was at 62° F. when he discovered that the bees had practically all deserted the hives.

Miss Wilson of Marengo, Illinois, in answering questions in the American Bee Journal, 1919, regarding cellar wintering said that Phillips had shown that 57° F. was the temperature in the hive that the bees liked best for good wintering. Miss Wilson suggested that the temperature should be kept not below 50°, although bees have wintered well at 45° F., allowing in enough cool air to keep at a temperature of 50 to 55° F., perhaps occasionally running up to 60° F.

In 1919, in Bee World, Manley indicated that a temperature of 35 to 42° is favorable for wintering. In an edditorial of Gleanings in Bee Culture for February, 1921, Demuth stated that the exact temperature for the bee cellar depends upon so many things that it may range from 40 to 50° F., but the cellar should be kept at that point at which the bees are most quiescent. In another article in the same issue Demuth suggested that since the bees maintain a higher cluster temperature in the later part of winter they become more and more susceptible to higher cellar temperatures as the winter progresses, which sometimes make it necessary to lower the temperature of the cellar as spring approaches.

Wilson reported that "During the winter 1917-1918 it was noticed that wherever the cellar temperatures were below 40° F. nothing could be seen of the bottom of the cluster, but when the temperature was above 50° F. the lower edge of the cluster would extend below the frames to the bottom board and bees could be seen moving about more or less freely. If the cellar temperature rises to 60° F. or above the bees may be driven to cluster outside the hive. If bees in storage are kept in absolute darkness and the temperature is held at a constant range of

[2]Phillips, E. F. and Demuth, Geo. S., 1918. Wintering Bees in Cellars. U. S. D. A. Bulletin 1014. pp. 4-5, 14.

from 45 to 50° F. the size, shape, or location of the cellar makes little difference. With a few exceptions, Wisconsin beekeepers who have the lowest winter losses keep the temperature at from 45° F. to 50° F. If the temperature is kept at 50° F. bees are not greatly affected by changes in humidity although the importance of humidity in the cellar and its effect on the bees is not well understood."[3]

Armbruster in his book "Der Warmehaushalt in Bienenvolk," published in 1923, attested that theory and practice indicated that a temperature of 7° C. (44.6° F.) is desirable for cellar wintering in order that the reactions indicated by Lammert's tables might be set up. Jaeger reported that he wintered at 40° F. since at higher temperatures, the stronger colonies broke their cluster and many bees flew out of the hives and were lost in the cellar. Again in 1925, Jaeger wrote that 42 to 43° F. is a good average for cellar wintering, 40° for strong colonies and 46° for weaker colonies. Above 46° F., he said that bees break the cluster; below 40° F., they eat too much.

Cale called attention to the investigations of Phillips and Demuth concluding that 57° F. is an optimum temperature for wintering bees since at that temperature the bees are apparently the quietest and the cluster produces little heat.

Atkins and Hawkins in the 1924 edition of "How to Succeed with Bees" recommended a cellar temperature within a few degrees of 50° F., never below 45° F.

Crane in a discussion in 1925 of the proper temperature for cellar wintering said that reports of successful wintering gave varied temperatures from 32 to 45° and of late years 50° and even 60° F. was recommended, but the important thing was to keep the bees quiet at whatever that temperature might be. He suggested putting the stronger colonies in the colder part of the cellar and the weak colonies in the warmer part thus adjusting them to their needs.

Milum in an article published in the 24th annual report of the Illinois State Beekeepers' Association in 1925 suggested a dark, dry cellar, where the temperature ranges from 45 to 50° F. as being suitable for wintering.

This review of the literature on the best temperature for the wintering of bees shows considerable variation of standards for practical beekeepers and other observers during the past sixty-five years. This range has varied from 32 to as high as 60° F. or more due in part to personal theories, differences in conditions of observation and misunderstanding of published reports of temperature readings of cluster temperatures and other observations.

However, the older school of practical beekeepers years ago had almost all decided that the best temperature for cellar wintering was that at which the bees remained the most quiet. In general, they have concluded that temperatures of 42 to 50° F. were about right for best results, with about 45 or 46 being the ideal. Variations above or below this point may have been due in part to faulty registering thermometers, the location of the thermometer in the cellar, the number of the colonies in a cellar of a particular size, the amount of ventilation provided, the type of hives, quality of stores, any disturbing factor, and the general conditions of the bees. Among the latter which may be mentioned are strength of colonies and proportion of young and old bees, as well as the time that the bees were placed in the cellar in relation to their last good cleansing flight. Likewise the method of handling the bees when placed in the cellar with the amount of excitement caused is no doubt an important factor influencing the condition of the bees and the consequent temperature at which the bees can be safely wintered.

With the discovery of the famous 57, there was a considerable increase in the temperature thought best for cellar wintering and consequently recommended until actual experience had proven the conclusions faulty.

[3]Wilson, H. F. 1922. Winter Care of Bees in Wisconsin. Wisc. Agr. Expt. Sta. Bul. 338, pp. 5-6, 14-17.

Phillips and Demuth said that when the coldest point among the bees reached 57°, the bees formed a compact cluster, after which heat was generated by various forms of activity and body metabolism. These authors did not say that 57° F. was the temperature of the cluster, as their records will clearly indicate a higher temperature. This last fact has been substantiated by various other observers preceding and following their reports.

But many writers and speakers upon the subject of wintering immediately assumed, and only recently such incorrect statements have been made, that 57° F. is the temperature of the cluster and that which the bees attempt to maintain. With this as a basis, recommendations started to come thick and fast that temperatures from 50 to 55 or even 60° F. would be desirable and even practical. As a result many beekeepers were led to attempt cellar wintering at temperatures above 50° F. but found that disastrous results usually followed. It has been the writer's observation that with temperatures up to 50° the bees in a cellar remained comparatively quiet but became restless and noisy at higher temperatures even of short duration. This was especially true toward the close of the wintering period. These observations were made on colonies wintered in modern hives with the full depth entrance without upward ventilation, the inner covers being tightly sealed.

In spite of all that has been said in favor of higher cellar temperatures, beekeepers will do well to stick to the old standard of approximately 45° F., maintaining the cellar at or as near this temperature as possible.

Along with this temperature, other factors are maintenance of a dry atmosphere with adequate ventilation. The cellar should be completely darkened and all other disturbing factors eliminated.

The bees should be provided with winter stores of good quality consisting of white honey saved from the early part of the honey flow. Years ago it was advocated and is still recommended that the winter stores should be as free from pollen as possible. Likewise, honeys having a high dextrin content or containing honeydew are usually not safe for wintering in cellars or even with outdoor wintering, except in warmer climates where good flight weather occurs at regular intervals. Poor winter stores should be eliminated by the feeding of sugar syrup.

Colonies should be so manipulated as to have a large supply of young bees. This can best be accomplished by young queens and plenty of room and stores to accommodate broodrearing after August 1-15. The beekeeper should study the weather reports for his particular locality and make arrangements to place the bees in the cellar after the last good flight in late October or early November. The colonies should be placed in the cellar with as little disturbance as possible. After they have quieted down, the full entrance should be given in cellars whose temperatures range near the old reliable 45° F.

This temperature of 45° F. in bee cellars will undoubtedly give good results in future years as it has in the past if beekeepers will take due attention of other contributing factors.

"MR. BEEKEEPER AND HIS MARKETS"

Helen Harrison, Ames

"John, why on earth don't you get rid of those bees? They just cause an extra amount of work, and you aren't getting a thing out of them. You know you don't have time to peddle that honey around to the neighbors and even at that you can't sell all that surplus honey you've been getting at a profitable price."

"Now, Ma, I don't blame you for gettin' kinda provoked but I like to work with those bees and I still think that if we paid a little more attention to it when we were sending it, we'd make more money on our honey. Let's go see Mr. Paddock next time we go into town and maybe, since he's state apiarist, he can help us."

This conversation took place between Mr. and Mrs. John Beekeeper one night after John had come in tired out from his work with the bees. Their home was just a few miles from Ames and for several years they had been using their very small farm as an apiary.

The next day John went to town and having done all the necessary shopping, he drove out to the college. Luck was with him and he found F. B. Paddock in his office. John put his problem before him and waited for an answer.

"I've been interested in that phase of beekeeping myself and you've come at just the right time. Where have you been sending most of your honey?"

"To Chicago. Can't say as I know why I did. Just seemed the most natural, I guess."

"Well, I'll show you what I can from the material I have at hand. The United States Bureau of Agriculture sends out a semi-monthly report so I've taken an average of the prices quoted there and made graphs showing the fluctuations in price. The prices vary so much in just one year that it is almost impossible to arrive at any conclusion. I have noticed, however, that for light or white extracted honey in 1926, 1927 and 1928, Kansas City has paid about one or two cents more per pound. Minneapolis and Chicago have run the lowest and St. Louis has almost equalled Kansas City. For the year 1928 as far as reports had come in, September 15th, Kansas City averaged 10 3-5 cents per pound while St. Louis averaged 9½ cents per pound. This does not necessarily mean that Kansas City is the logical place to send your honey. Freight rates must be taken into consideration.

"Another noticeable feature has been the marked decline in prices for each succeeding year. Each market except Chicago has dropped at least one cent each year. Chicago dropped two cents from 1926 to 1927 but came up one cent in 1928."

"In comb honey there hasn't been such a difference in markets nor any noticeable falling off in price for the successive years as there was in extracted honey. But here, as in extracted honey, Kansas City has the highest, most staple market. For 1928 the average price per 24 section case has been $4.00, with St. Louis running a close second, paying $3.60. These prices are all averages taken from sales on fancy white or No. 1 comb honey, but a fair idea of the price may be obtained."

"In looking up freight rates I have found that from Ames, which is about the center of Iowa, the rate to Kansas City is 69 cents per hundred, and to Chicago it is 73 cents per hundred pounds. St. Louis is high with 78⅛ cents per hundred pounds, and the Minneapolis rate is 76 cents. That, of course, is the second class freight charge if honey is sent in glass or earthen containers or combs in pasteboard boxes. If the honey is shipped in any other way, two times the first class rate is charged."

"Supply and demand may be a factor causing the difference in price paid at the various markets, but the reports would lead one to believe that Kansas City is the best market."

SOME FACTORS CONCERNING THE VALUE OF BEES TO FRUIT GROWERS FOR POLLINATION PURPOSES

R. H. Kelty, East Lansing, Michigan

Throughout the fruit belt of Michigan there is a rapidly growing interest in bees, not primarily for honey production, but for pollination purposes. Several years ago the Department of Horticulture, Michigan State College, undertook a study of the reason why some of the best orchards of the best varieties of apples, peaches, pears and sweet cherries, were giving unsatisfactory yields. In most cases these orchards had every reason to bear—they were properly located, tilled, fertilized and pruned. Various specialists had prescribed various treatments for further care, and yet the trees did not set profitable crops. Mr. H. D. Hootman, extension specialist for the Horticultural Department, noticed that these orchards were often composed of solid stands of one self-

sterile variety, say twenty acres of McIntosh apples, or; the orchard might be composed of large blocks of two or three varieties which were either self-sterile or inter-sterile. An old home orchard of four or five acres of several varieties might give a fair crop, even in the absence of careful management, within a short distance of these other orchards. In some cases, hives of bees had been brought into these orchards without marked improvement of yield, except possibly on the side of the orchard near a block of mixed varieties.

A study of these conditions by the horticultural department resulted in an experiment in pollination. In one eleven-acre orchard set solid to Northern Spy, in which the greatest yield any season for eight years past had been 1,500 bushels, a truck load of "bouquets" of Ben Davis, Roxbury, Russet and Tolman Sweet blossoms were placed in tubs of water in an apiary of 40 colonies, right in the orchard. Also, about 40 half-barrel tubs were filled with additional "bouquets" and distributed through the portion of the orchard in which practically no crop had previously been harvested. Still other "bouquets" were placed in buckets and hung in the trees. Six more colonies of bees were moved out into the orchard for the blossoming season and large "bouquets" were placed about ten feet in front of them. By bringing into the orchard the pollen from other varieties, which was carried to the Spy blossoms by the bees, a fine set of fruit was obtained. As compared with the previous high yield of 1,500 bushels, that year the crop was 5,200 bushels.

In a ten-year-old ten-acre peach orchard at Coloma, Michigan, which was originally planted to J. H. Hale only, cross-pollination was provided by replacing dead trees with Elberta or South Haven. However, the crop had never been satisfactory, and in 1926 the total yield for the ten acres of orchard was about ten bushels of peaches. In 1927 twenty colonies of bees were moved in and the orchard harvested a one thousand dollar crop.

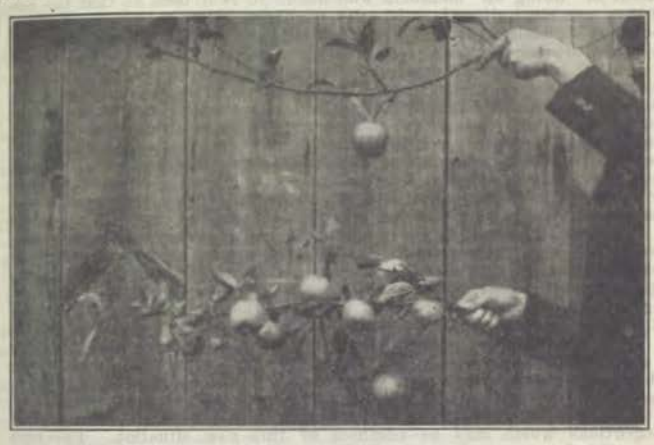
Near Ann Arbor, Michigan, Floyd Markham, Ypsilanti, placed an apiary near an orchard of pears which had been blooming regularly for years, but which had never harvested more than eighteen bushels. The bees set a crop of nearly one thousand bushels of pears in that orchard.

These experiments were carried on in 1927. As these results became known to fruit growers throughout the fruit-belt, some were skeptical, saying that they had produced many crops without bees, and could get along without them still. Others believe that wild insects were as useful as the bees for pollination. Several at their own expense, erected cages of cheesecloth or screen around branches or whole trees. The matter was gaining much attention. Some fruit growers bought bees for their orchards. Many rented colonies from beekeepers. In fact, it is estimated that approximately six thousand colonies were rented for pollination in the spring of 1928.

An outstanding example of renting bees on a large scale is that of the W. R. Roach Company orchards at Hart, Michigan. This company rented two hundred colonies from Mr. C. J. Freeman of Mesick. The Roach Company furnished three of their own trucks and men to move the bees the distance of eighty miles to their one hundred fifty acres of apples and cherries. Mr. Freeman brought another truck load, and it was an impressive sight to see the four large trucks well loaded with screened colonies on the way. A good testimonial of Mr. Freeman's ability is the fact that the hives were so well screened that even the "green" help did not get stung once in the operation.

A "caged" cherry tree in this orchard produced four pounds of cherries. Another cherry tree of the same age, in the same orchard, not caged, produced forty-four pounds of cherries. A "caged" apple tree in the orchard set twenty-five apples, while an uncaged tree, forty feet away, yielded over 1,200 apples. The total crop of cherries was approximately two hundred sixty-five tons in this orchard. And, although the 20-acre block of apples, solid McIntosh, has never yielded more than 1,600 bushels, this year Mr. Hootman's "bouquets" of other varieties of apple blooms, together with the bees for pollination, gave a crop of four thousand bushels of nice apples. Naturally, the W. R. Roach Company, are convinced of the value of bees in orchards.

Now, up to this time, this article has presented the fruit grower's side of the question. It seems probable that there will be more interest in the use of bees in orchards this spring than ever before, and there



Top Limb—1 spur out of 12 blossoming set fruit 8 1-3%
Lower Limb—7 spurs out of 20 set fruit 35% set

will very likely be a demand for rental bees that cannot be met by the beekeepers. The Horticultural Department estimates that about 250,000 colonies of bees would be necessary in Michigan's fruit belt orchards, to properly pollinize the fruit bloom of those varieties which need fertilization to properly set and grow salable fruit.

But there is some hesitancy on the part of quite a few beekeepers, who are approached on the bee-rental question. In the first place, the rental price is not clear profit to the beekeeper by any means, as it might seem at first glance. The arrangement made by the W. R. Roach Company with Mr. Freeman is very satisfactory. In this case the consideration was two dollars per colony rental, and the bulk of the expense of moving the bees to the orchards and home again, was borne by the Roach Company. In the bargain, Mr. Freeman's hives collected about three tons of fruit bloom honey, mostly from cherry, during the eleven days spent in the orchards. Mr. Freeman is well satisfied, the Roach Company is well pleased with the bargain, and it would seem that this type of an arrangement is a good basis for consideration of price for rental.

The beekeeper must be certain that damage from spraying and danger of contamination from foulbrood is reduced to a minimum before he can afford to move bees into a new district at any price. In this connection, the fruit growers, through their state organization, the Michigan State Horticultural Society, has been of great assistance in obtaining sufficient funds to carry on our foulbrood eradication campaign, for it so happened that the foulbrood situation was the worst in the fruit belt. And, now that the orchardists are coming to realize the value of bees for pollination, the danger of spray poisoning is being reduced to a negligible point.

The demand for rental bees may provide a new source of income,

of considerable proportions, for those beekeepers who will prepare to supply the requirements. Obviously, there must be a standard of colony population for rental purposes. There should be some basis for calculating rental prices, under the many varied conditions to be met, for the mutual benefit of the beekeeper and the fruit grower.

In some cases the local fruit growers' exchange has assisted to the extent of "lining up" members who desire to rent bees so that the beekeeper can deal directly with the exchange, distributing the bees to members as desired without the added effort of making separate arrangements with each grower.

Another interesting feature of this rental proposition is the fact that blooming dates in the northern part of the fruit belt, especially along the shore of Lake Michigan, are about one month later than for the southern portion. Therefore, those equipped to move bees in quantity, could rent their bees three times in the same season, starting in southwestern Michigan and moving northward with the season at ten-day intervals. The colonies could then be returned to the original location or could be operated in northern Michigan for surplus clover, milkweed and sweet clover honey, as desired.

The difficulty experienced in finding a reliable supply of rental bees has forced some fruit growers to buy bees outright. These individuals realize that they can afford to replenish the bees, in the form of packages, year after year, better than to get along without sufficient pollinating service. These new recruits to the ranks of beekeeping will have little effect on the supply of honey, however, for the type of soil which is most compatible for fruit growing is in many cases nearly devoid of nectar producing plants. At least there is a long period in summer when little or no nectar is available. The rapid increase of sweet clover acreage will correct this condition ultimately, however.

In conclusion, relatively few beekeepers are yet aware of the great proportions which may be assumed by this new situation. The very fine attitude of co-operation already displayed by the organized fruit growers is sufficient evidence that a satisfactory arrangement can be worked out to meet the demands of the occasion to the mutual benefit of both orchardists and beekeepers.

GRANULATION OF HONEY

Setek Ling, Ames

On account of the prejudice many people will not eat granulated honey regardless of its purity and, in many cases commercial bottlers suffer great loss. With this view in mind experiments were begun in the fall of 1927. In addition, the purpose of the experiments described herein was to determine the effect of agitation, addition of granulated honey, storage temperatures, the presence of air in the honey, blending and heating on granulation.

The comb and extracted honeys used consisted of 1927 crop of sweet clover honey from A. I. Root Company, Council Bluffs, Iowa. The comb honey was cut into strips of 3 by 1 inch. The extracted honey was heated to 158° F. The heating was accomplished by placing the bottles of honey in a water bath, gradually raising the temperature to 158° F. and allowing to cool immediately. It was cooled to 100° F. when it was bottled. The one-pound glass bottles with metal screw tops in which a chunk of comb was placed, were filled to the top with the heated honey.

Thirty bottles were thus prepared, of which 3 were used as control and the rest were heated over again in a big pan with a wooden board of one-half inch thick on bottom. The filled bottles were then set on the block and the water was brought up to the top. Three thermometers, one with the bulb in the center of the pan, one in the middle of the bottle containing the comb honey and the last in one without any comb, were used.

The water in the pan was heated to 110° F., and held at that temperature until both inside and outside temperatures were identical. It was from this time on that 6 bottles were heated for 2, 4, 8, 10 and 12 hours respectively. The same experiment was repeated at 115° F., 120°, 125°, and 130° F.

All the samples were stored in the basement of Science building where there is a wide range of temperature from 35° to 70° F. The results were tabulated in the following table.

Agitation: Two samples of honey were obtained by uncapping the comb and drained through the cheese cloth, and another 2 samples were secured by ordinary extracting. Both sets of samples were placed in glass containers, covered and kept in the laboratory.

Addition of granulated honey: Four samples of the same honey were taken, of which 2 had granulated honey added, and were subject to the same conditions as under agitation.

Various storage temperatures: Two samples of honey were placed on a shelf of an interior store room in the basement of Science building, which has a range of temperature from 37° to 75° F. and might be considered as cellar storage temperature. Another two samples were placed on a shelf in the apiary laboratory in which the temperature did not vary more than 5 degrees from day to day so that this might be termed "room storage temperatures." Still another two samples were placed in the laboratory of which two were moved from outside the building to the laboratory alternating every other day.

The presence of air in the honey: Four samples were placed in the laboratory, of which two had air admitted by opening the covers once in every other day for 5 minutes.

Blending: Blending was only done with two honeys—sweet clover and sage—which were blended in the following proportions: Sweet clover 75 per cent to sage 25 per cent; sweet clover 25 per cent to sage 75 per cent; sweet clover 50 per cent to sage 50 per cent.

Observations were made on the honeys at frequent intervals. Granulation was judged by outward appearances. The first signs were usually evidenced by cloudiness of the sample or the settling of small granules.

Results

In six weeks the extracted honey began to have granules appear while the strained honey remained liquid and clear. On December 15, the former granulated almost solid while the latter had granules scattered through the container.

Three weeks after the samples were prepared the one with granulated honey added started to crystallize long before the other had hardly begun.

The difference in the beginning of the granulation of the various samples under the three storage conditions, did not vary markedly. This was probably due to the fact that the temperature conditions of the three places were nearly alike during the early part of the test. The honeys that started to granulated late under cellar conditions required a longer period to complete granulation than under variable storage temperatures, and the samples under room storage temperatures required the longest period of the three.

Under variable storage temperatures the samples became solid, granulation being started on October 2nd. Under cellar conditions, the samples were in various stages of granulation, but neither of them were solid by the end of the test and both had started to granulate at later dates than the corresponding samples under variable storage temperature, granulation in this case started on October 29th. Under room temperature only one sample started to granulate but started on December 3rd later than the corresponding samples under variable storage temperatures and cellar conditions.

When the different places of storage were fairly similar in temperatures, the corresponding samples of honey granulated at similar rates but when the storage temperatures changed markedly the rates of

granulation also changed. Granulation made the most rapid progress under frequent changes in temperatures; it went on at an intermediate rate under the cellar conditions which was second in regard to low temperatures and made the slowest progress in room storage temperatures which was the last in regard to low temperatures.

Probably the main effect of blending is to change the ratio of sugars. The blend of 75 per cent sage to 25 per cent sweet clover remained liquid for a longer period than either with 50 or 75 per cent sweet clover.

The samples with air admitted began to granulate on November 14th while the corresponding samples did not start until January 5th.

The set heated at 110° F. from 2 to 12 hours started to granulate on December 4, at 115° F. on January 4; at 120° F. on March 10; at 125° F. on July 12 and 130° F. on July 28.

The controls began to granulate in December and were heavily specked like snow flakes on March 10th and solid on bottom 1 inch thick on June 9, 1928.

Date	Temp. at 110° F. Duration, Hours						Temp. at 115° F. Duration, Hours						Temp. at 120° F. Duration, Hours					
	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12
September 10..			(hea	ted	)				(hea	ted	)				(hea	ted	)	
October 14....	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
November 19..	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
December 27...	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
January 21....	x	x	x	x	x	x	x	x	x	x	x	x	----	----	----	----	----	----
	Grn	nul	es a	ppe	are	d v	ery	few	spe	cks	in a	ll b	ottl	es o	f th	e se	ries	
February 18...	x	x	x	x	x	x	x	x	x	x	x	x	----	----	----	----	----	----
March 10.....	x	x	x	x	x	x	x	x	x	x	x	x	----	----	----	----	----	----
	x	x													Clo	udy		
	Co	arse		Fi	ne													
April 14.....	x	x	x	x	x	x	x	x	x	x	x	x	----	----	----	----	----	----
	x	x	x												Clo	udy		
	Co	arse		Fi	ne													
May 12.....	x	x	x	x	x	x	x	x	x	x	x	x	----	----	----	----	----	----
	x	x	x	x	x	x	x	x	x	x			----	----	----	----	----	----
	x	x	x															
June 9.....	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	x	x	x	x	x	x	x	x	x	x	x	x	----	----	----	----	----	----
	x	x	x				x	x										
July 7.....	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	----	----	----	----
	x	x	x	x			x	x	x									
August 1.....	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	----	----	----
	x	x	x	x			x	x	x									
	Gra	nul	es c	olle	cte	d o	n b	ott	om	Fe	w g	ran	ules	coll	ecte	d o	n b	ot-
													to m					

Date	Temp. at 125° F. Duration, Hours						Temp. at 130° F. Duration, Hours						Control Samples		
	2	4	6	8	10	12	2	4	6	8	10	12	1	2	3
September 10..			(hea	ted	)				(hea	ted	)		(Unheated)		
October 14....	----	----	----	----	----	----	----	----	----	----	----	----	Cloudy		
November 19..	----	----	----	----	----	----	----	----	----	----	----	----	Granules appeared		
December 27...	----	----	----	----	----	----	----	----	----	----	----	----	Coarse specks appeared		
January 21....	----	----	----	----	----	----	----	----	----	----	----	----	Coarse specks appeared		
February 18...	----	----	----	----	----	----	----	----	----	----	----	----	Coarse specks appeared		
March 10.....	----	----	----	----	----	----	----	----	----	----	----	----	Coarse specks appeared		
April 14.....	----	----	----	----	----	----	----	----	----	----	----	----	Heavily granulated		
May 12.....	----	----	Clo	udy	----	----	----	----	----	----	----	----	Heavily granulated		
June 9.....		Fe	w g	ran	ules		-	-	Clo	udy					
		app	ear	ed									Granules on bottom; 1 inch thick		
July 7.....	x	x	x	x	x	x	x	x	x	x	----	----			
	Gra	nul	es o	n b	ott	om	Gra	nul	es a	ppe	are	d	x		
August 1.....	x	x	x	x	x	x	x	x	x	x	x	x	Granules on bottom; 1 inch thick		
	x	x	x	----	----	----	x	x	----	----	----	----			

Note: x—Slightly granulated.
xx—Moderately granulated.
xxx—Heavily granulated.
Blank—No granulation.

DISCUSSION

Honey is placed on the market in four different forms: comb honey, extracted honey, bulk comb honey, i. e. both comb and extracted honey together in bulk and granulated honey, i. e. extracted honey that has been kept until it solidifies. Granulation occurs in all of these forms.

Granulation in no way affects the quality and if honey granulates it is one of the proofs of its purity. To prevent granulation heat is often applied, and, in so doing some of the valuable properties of honey are destroyed. Natural, unheated honey taken from the combs is an anti-scorbutic of no mean value as being proved by Dr. Goss[1] in feeding rachitic children and is often tolerated by them better than is cod liver oil. He also states that the part played by honey in a properly balanced ration cannot be replaced by any sweet that he knows of in the world.

According to Caillas honey is the only sweet that contains the mineral contents as phosphate of iron, of lime, carbonates and sulphates. These minerals are in a form that can be directly absorbed into the blood stream but when honey is heated the form is so changed that they are precipitated or became inert. Thus heating really lowers the food value of honey.

The theory of granulation is not fully known but it is known that in granulation certain factors are involved. The length of time required for the granulation of honey depends upon certain factors, with a knowledge of which it is possible to control, to a large extent, the length of time the honey will remain liquid, and the rate of granulation. All honeys do not look alike when granulated; light colored honeys such as clover, as a rule, assume a white lard-like appearance while dark honeys, such as buckwheat, become a straw to amber color. In granulation there is a difference in the texture of honeys which is influenced by the size of crystals, and which may be fine or coarse. Most honeys do not all granulate at the same rate and the length of time for honey to complete the process varies accordingly.

The main effect of heating on the honey probably is in the removal of the excess of air which it contains. The amount of air expelled depends upon the temperature to which the honey is heated, and so the highest temperatures cause the greatest amount of air to escape, because heating decreases the specific gravity of the air and also lowers the surface tension of the honey, thus enabling the air particles in the honey to rise more readily.

It is true that dextrose is an easily crystallizable sugar, while levulose tends to remain liquid and as it occurs in honey probably never crystallizes. In all honeys, as the percentage of dextrose increased, the number of days for the completion of granulation process decreased. But as the amount of dextrose decreased, the number of days for granulation began to increase. Honeys that contain a large amount of dextrose granulate more readily than where the reverse is true. This is confirmed by the analyses made by Browne and the writer in the laboratory.

The probable factors which influence granulation of honey are (1) agitation, (2) addition of granulated honey, (3) storage temperatures, (4) the presence of air in the honey, (5) blending, (6) changes in temperatures in storage, (7) honey with a heavy density will granulate earlier than the same variety of honey with a lighter density, (8) dry and moist storage place, (9) ripe and unripe honeys, and (10) heating.

Conclusions

From the data thus far secured the following conclusions may be drawn:

(1) Agitation hastens granulation and shortens the period required for its completion.

(2) The addition of granulated honey starts and hastens the granulation process.

[1]Goss, R. J. Granulated Honey. American Bee Journal. 67:297.

(3) Storage temperatures influence the rate of granulation; the wider range of temperatures the quicker the granulation.

(4) Low temperatures combined with extreme variations in daily temperatures not only hasten the beginning of granulation but also shorten the time required for its completion.

(5) The presence of air in the bottle hasten the beginning of granulation and also shorten the period required.

(6) Granulation of a blend of two or more honeys is influenced by the ratio of dextrose to levulose which it contains.

(7) Heating retards granulation to a greater extent than any of the factors already mentioned.

(8) In commercial comb honey bottling heating extracted honey to 158° F., cooling to 100° F. and then bottling as in the usual practice; reheating the filled bottles to 120° F. for 6 to 8 hours seems to obtain the best result, and the commercial bottlers will find little trouble with granulation.

(9) The comb in bottles cannot be heated higher than 135° F. for any length of time without being deformed.

STUDIES ON THE SUGAR CONCENTRATION OF THE NECTAR OF VARIOUS PLANTS

By O. W. Park, Ames, Iowa

Nectar is the raw material from which honey is made and, as such, the beekeeper is interested in the various factors which influence its production. Bonnier (1) found that the quantity of nectar secreted varied directly with relative humidity. Ostashenko-Koodryavzeva (6) of Russia, and others have found that nectar usually is secreted most abundantly during periods of high humidity, but, in most cases, investigators have failed to determine whether, or to what extent, the sugar concentration was altered under such conditions.

An increase in nectar secretion is generally looked upon as favorable for honey production; but, since nectar may contain much or little sugar, increased secretion is not necessarily advantageous for honey production, unless there is an increase in the amount of sugar made available to the honeybee. Kenoyer (5), following the lead of Haupt (4) showed, under experimental conditions, that, although flowers of buckwheat, *Fagopyrum esculentum*, and of touch-me-not, *Impatiens Sultani*, kept in air having 100 per cent humidity, secreted larger amounts of nectar than did those exposed to the rather dry greenhouse air, the total amount of sugar produced was not increased thereby. It is quite possible, therefore, that increased secretion may be a disadvantage at times, so far as the production of honey is concerned.

Historical

In the past there have been two great difficulties in the way of securing data on nectar and the factors influencing its production. First, the difficulty of obtaining sufficient quantities for investigation, and second, the lack of methods of analysis adapted to such small quantities as could be secured. Analyses made prior to the last few years, with few exceptions, have been accomplished by extracting the sugar from a given quantity of flowers by means of water or alcohol. Chemical determinations then showed the total amount of sugar, from which the average amount per flower was easily computed. This procedure probably extracted more or less sugar from the tissues of the plant in addition to that of the nectar. And, since this method was not well adapted for determining the sugar concentration, very few such determinations have been made heretofore. It is largely due to these facts that our knowledge concerning the concentration of sugar in the nectar of various plants and under different conditions, has been so very meagre.

The classic reference to nectar analyses is that which gives the results obtained about fifty years ago by the Swiss chemist, Planta (7), who determined the per cent of sugar in fresh nectar from four different sources, as follows:

Source	Per Cent Sugar
Protea mellifera	17.1
Hoya carnosa	40.6
Tecoma radicans, trumpet creeper	15.3
Fritillaria imperalis, imperial crown	6.6

In 1916, Kenoyer (5) reported that the nectar of the touch-me-not, *Impatiens Sultani*, in an atmosphere saturated with moisture, contained 23.4 per cent sugar; while in the drier greenhouse air, the same species yielded nectar containing 45.3 per cent sugar.

Caillas (3), in 1926, determined the sugar content of nectar from orange blossoms, *Citrus aurantium*, as 26 per cent.

According to Vansell (9) the recent work of Miss Beutler of Germany reports comparative data for three plant species from samples obtained under normal conditions and during rain. The following results are given:

	Per Cent Sugar	
	Normal	During Rain
Plum	32.5	15.6
Milkweed	27.9	7.9
Horse Chestnut	75.2	49.1

There appears to be an entire absence of published data showing the wide range of variations in the sugar concentration of nectar, from a given source, under varying degrees of humidity.

Purpose

The purpose of this paper is twofold: (1) To set forth a method of determining sugar concentration, which, the writer believes, has never before been used for finding the sugar concentration of nectar. (2) to present data which show a close negative correlation between the humidity of the air and the sugar concentration of nectar in certain flowers.

Methods

Studies on the sugar concentration of nectar from various plants were begun by the writer in June 1926. Since that time, hundreds of samples from numerous species of plants have been collected and analyzed for sugar content. The percentages of reducing sugars and total sugars were determined in a large number of samples, but in a still greater number, only the total sugar content was determined.*

For collecting the nectar, specially designed pipettes were blown from pyrex glass tubing. These had very slender tips and were constructed with a bulbous portion which received the nectar as it was drawn in through the slender tip. As soon as samples were secured they were taken to the laboratory and analyzed at once.

Records of temperature and humidity were kept at all times by self-recording instruments housed in the usual type of weather shelter.

Various chemical methods were used during the first two seasons, and considerable amounts of valuable data were secured. But all the chemical methods tried required laboratory facilities and consumed considerable time. It was not until the beginning of the third summer that a thoroughly satisfactory method was discovered for making rapid determinations of the sugar concentration of nectar.

In casting about for a simpler method, the writer hit upon the idea of using an Abbé refractometer for the purpose. Such instruments are used extensively in sugar refineries for finding the concentration of sugar solutions. This instrument superficially bears some resemblance to a microscope, although its use is entirely different.

*The writer desires to express his sincere appreciation of the cordial cooperation received from the Department of Chemistry of Iowa State College. Special thanks are due Dr. R. M. Hixon, Plant Chemist, for his valuable assistance and guidance in the analysis of nectar.

The principle, upon which it works, is based upon the fact that a ray of light, in passing through any transparent material, is bent or refracted. In passing through a layer of distilled water, a ray of light is refracted only a little, but if a soluble substance, such as sugar, be dissolved in the water, the ray is refracted to a greater extent, the exact degree being dependent upon the amount of sugar present.

Strictly speaking, the angle of refraction is determined both by the kind and the amount of dissolved solids in the solution. Instruments constructed upon the above principle may then be used to determine the total dissolved solids in many different kinds of solutions. The solution to be tested should, for accurate results, contain only one kind of dissolved solid. For practical purposes, however, the refractometer often gives good results for solutions which are only relatively pure. For instance, Sheppard (8) has reported satisfactory results from the use of the Abbé refractometer in determining the solid contents and specific gravity of honey.

An Abbé refractometer was obtained, and after being subjected to various tests, was found to give results which checked with those obtained by chemical methods. In fact it is believed that the refractometer readings are more reliable than those secured by chemical means.

Confidence in the reliability of the refractometer method is increased by a consideration of the chemical composition of honey and of the relationship between nectar and honey. To the best of our knowledge, the bees remove nothing from nectar except part of the water; and whatever substances may be added by the bees, are present in negligible quantities so far as the present discussion is concerned.

Browne (2) has shown that the percentage of ingredients in honey, other than sugar and water, seldom comprises more than 5 or 6 per cent of the whole. It is to be expected, therefore, that they rarely compose more than 2 to 4 per cent of nectar, because nectar commonly contains 50 per cent or more of water, while, after being changed to honey, only 15 to 20 per cent water remains.

Analyses of nectar bearing on this point are all but lacking. Planta (7) found that nectar from *Protea mellifera* contained 0.6 per cent of substances other than sugar and water, and Caillas (3) found 1.34 per cent of such materials in nectar from orange blossoms.

Sheppard (8) has demonstrated that refractometer readings on honey give satisfactory results. The writer took refractometer readings on honey and found that they checked with those obtained by means of a Baumé hydrometer. Since nectar contains a smaller percentage of ingredients other than sugar and water, than does honey, refractometer readings should be even more reliable for nectar than for honey.

Since refractometer readings give results in total dissolved solids, it was to be expected that results obtained with this instrument would run slightly higher than those secured by chemical analyses. Such has been the case. As a rule, refractometer readings have run from 1 to 3 per cent above chemical determinations, which is well within the expected range already indicated. In a very few cases, refractometer readings dropped slightly below chemical analyses in comparative tests. It was found that in practically all such cases, the nectar contained an unusual amount of pollen. Duplicate tests, made after filtering out the pollen, showed that the pollen had caused the chemical analyses to run too high, but that the refractometer readings were unaffected thereby.

In addition to simplicity, accuracy and speed obtained by the refractometer method, other advantages may be obtained. A satisfactory determination can be made on less than a drop of ordinary size. Laboratory facilities are not needed. The instrument is easily transported and can be used right in the field.

It is concluded, from the foregoing considerations, that determinations of sugar concentration in nectar, made by the use of the Abbé refractometer, are at least as dependable as those obtained by any of the chemical methods used. Moreover, a maximum number of samples may be determined by this method with a minimum of labor.

Results

The work of the first two seasons showed a considerable variation in the sugar content of nectar from a given source obtained at different hours of the day. Plans were made to secure more extensive data along this line during 1928. Discovery of the refractometer method early that season made it possible to make determinations so easily and so rapidly, that on various occasions, determinations were made at frequent intervals from morning until night, or during that part of the day during which samples could be obtained. Only a brief summary of some of the outstanding points will be given. Data secured from basswood, *Tilia americana*, milkweed, *Asclepias syriaca*, and trumpet creeper, *Tecoma radicans*, will serve to illustrate most of the points to be discussed here.

Figs. 1, 2 and 3 are graphic representations of the variations in the percentage of sugar found in nectar at different hours of the day, together with temperature and humidity conditions existing at the time the various samples were gathered. Most of the points plotted in the sugar curves for basswood and milkweed, represent the mean of several samples, sometimes as many as ten. Statistical studies of the data at hand are being made and will be published in the near future.

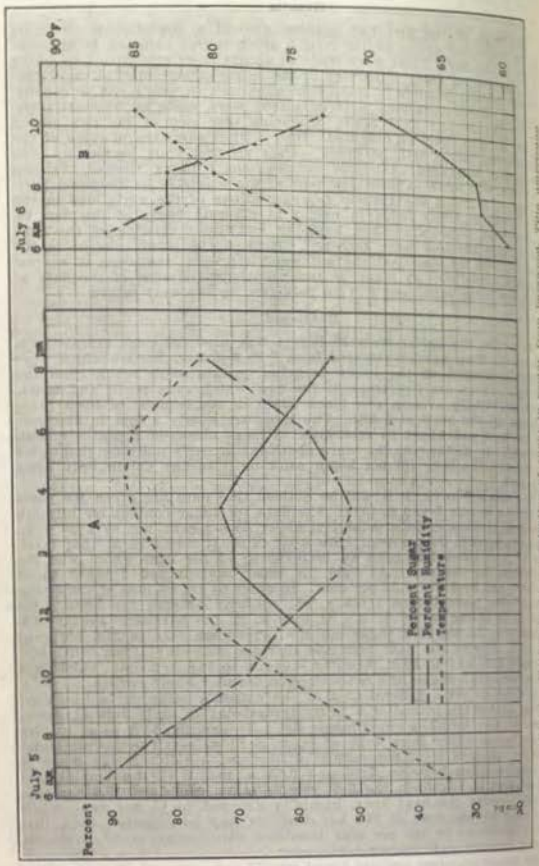
Basswood

As a rule, the nectar from 25 florets was used for each sample from basswood. This usually required from 2 to 4 flower clusters which were generally located on the lower branches, within one's reach from the ground. There are five trees in the row which runs north and south, bordering Welch avenue, one block south of the campus of Iowa State College, on the brow of a hill. The trees are nearly a foot in diameter at the base and about 25 feet high. It was observed repeatedly that, although the nectar was far more abundant in early morning than later in the day, the bees did not begin work on it to any extent until after 8 o'clock.

By referring to fig. 1, it will be noticed that data are given for parts of two days, July 5 and 6, 1928. The data for sugar content on July 5th began at 11:30 a. m. at a point just under 60 per cent, but by 1:30 p. m. had advanced to 70 per cent. An hour later, it was still at that level, but by 3:30 there had been an increase to 72 per cent which was the maximum for the day. At 4:30 the sugar content had dropped to 69 per cent and by 8:30, to 54 per cent. In order to get an idea of variations which take place before 11:30 a. m., we may observe the results for July 6, as shown in fig. 1, B. At 6:30 a. m. the basswood nectar contained only 22 per cent sugar but the percentage rose to 27.5 per cent by 7:30. During the next hour the increase was only 1 per cent; but, between 8:30 and 10:30 it mounted steadily to 45.5 per cent, which is a little more than double the concentration found 4 hours earlier.

In order to get a general idea of the extreme variation in basswood nectar during the course of a fairly typical day in early July at Ames, Iowa, we may mentally superimpose fig. 1, B upon fig. 1, A so as to give a continuous curve from 6:30 a. m. to 8:30 p. m. The lowest sugar content indicated is 22 per cent at 6:30 a. m., but this is the mean of 8 samples taken between 6:00 and 6:59 a. m. With the humidity at 94 per cent at 6 o'clock, the first sample taken contained 19.8 per cent sugar. During the next hour, humidity dropped to 85 per cent, while the sugar content rose to 23.4 per cent. It may be expected, then, that under conditions of 100 per cent humidity, this nectar would have contained approximately 18 per cent sugar.

The maximum sugar content found was 72 per cent at 3:30 p. m., when the humidity was 51 per cent, the minimum for that day. Had humidity dropped to a lower level, it seems probable that the concentration of the sugar would have gone still higher. An extreme variation covering a



range of 50 per cent was found between the maximum and minimum sugar content of basswood nectar during the two periods shown in fig. 1. And a pound of basswood nectar gathered between 3 and 4 p. m., July 5th, would have contained more than 3 times as much sugar as a pound gathered between 6 and 7 a. m. July 6th. The mean of all eleven sugar percentages plotted in fig. 1 is 50.3.

An inspection of the temperature and humidity curves for these two days, shows that the relative humidity and the sugar content curves bear an inverse relationship to each other which is very striking. On July 5th, the maximum sugar concentration and the minimum relative humidity both occurred at 3:30 p. m. following which, the sugar concentration fell at a rapid rate. Between 1:30 and 2:30 p. m., both sugar and humidity remained unchanged.

While in general, the sugar concentration varied directly with temperature, the relationship between these two factors is not very close as is shown by the fact that between 1:30 and 2:30 p. m., the sugar curve failed to rise, whereas the temperature curve continued its upward progress. Furthermore, the maximum sugar concentration was reached a full hour before the maximum temperature, and the decline of the sugar curve was more abrupt than that of the temperature. In brief, the sugar curve did not closely resemble the temperature curve, but was almost exactly the reverse of the relative humidity curve.

Milkweed

The common milkweed has been grown for experimental purposes on a plot of ground approximately 25 by 75 feet, located near the campus of Iowa State College, for several years. The ground is about level but is well drained. The soil is fertile, having been used previously for truck crops for some years. During the spring and summer of 1928, rains were sufficiently frequent to produce vigorous growth and the rows of milkweed plants stood about 6 feet high. Nectar usually was very abundant in early morning, but by noon little if any could be obtained, which explains the absence of afternoon data for this plant. During the early part of the morning, an adequate sample was usually obtained from 25 florets, but as the nectar became less abundant, toward noon, greater numbers of florets had to be used. It was noticed that in the blossoms were large numbers of very small insects called thrips. It is believed these and perhaps other small insects were responsible for the disappearance of a large part of the nectar because the number of honeybees at work there was far too small to account for its rapid depletion.

Data obtained on July 24, 25 and 26 appear in fig. 2. Much as in the case of basswood, the sugar concentration curves for milkweed nectar are almost the reverse of the relative humidity curves, although the correlation may not be quite as close. But the sugar concentration shows a much closer correlation with relative humidity than with temperature. In general, minimum concentrations were found when humidity was highest and maximum sugar concentrations were found when the humidity was lowest, but a slight discrepancy appears in fig. 2, C. Although humidity continued to decrease until noon, and we should have expected sugar concentration to be higher at 11:30 than at 10:30, the contrary appears to have been the case. There is, however, at least an even chance that some unusual circumstance was responsible for this discrepancy. So long as humidity curves maintain a fairly constant decrease, sugar and temperature curves both take upward, but seldom parallel courses. On the other hand, when the humidity curve becomes irregular, as in fig. 2, C, while the temperature continues a regular course, the sugar curve for milkweed nectar is found to be very nearly the reverse of the humidity curve, just as was found for basswood nectar.

Trumpet Creeper

Trumpet creeper yields nectar in large quantities as compared to most plants. This was one of the four sources of fresh nectar used by Planta

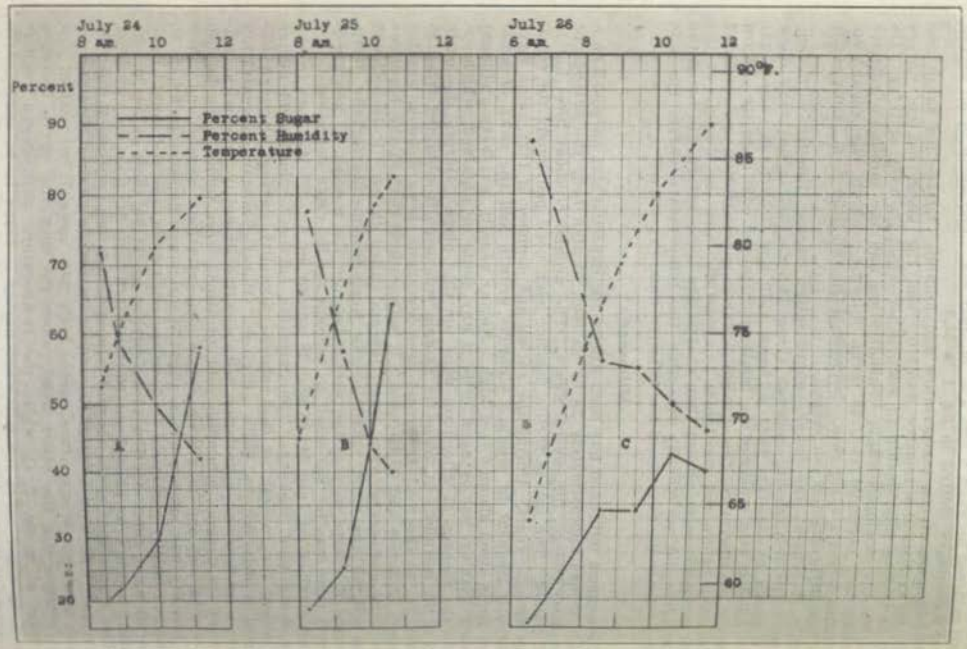


Fig. 2. Variations in concentration of sugar in nectar from milkweed, *Asclepias syriaca*

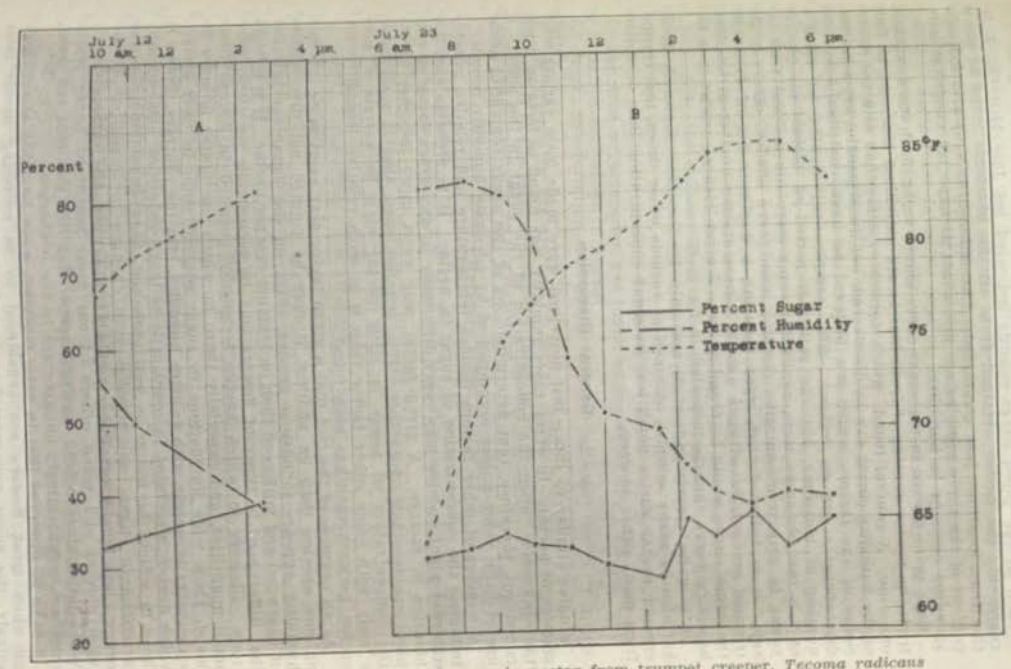


Fig. 3. Variations in concentration of sugar in nectar from trumpet creeper, *Tecoma radicans*

in his pioneer work on nectar analysis. The samples used in the present work were obtained from five large vines, growing in three different locations but in similar situations.

Each of the three sugar records indicated for July 12th (fig. 3, A), represents the nectar obtained from all the blossoms found at one of the three locations just mentioned. The differences shown in the sugar content of the three samples are just about as expected under the corresponding changes in humidity.

Each point plotted in the sugar curve shown in fig. 3, B was determined from the nectar content of from four to six individual blossoms, all from one vine. A general trend which correlates somewhat with the reverse of the humidity curve, can be discovered, but discrepancies are numerous. Some of the factors which are believed to have contributed to these discrepancies are as follows. The samples represented too small a number of blossoms, but the principal period of bloom was past so only a few blossoms were available; some were too old and some too young to give representative results; some were shaded, others in the sun. It is believed that, upon securing a duplicate set of data from trumpet creeper, based upon a truly representative number of blossoms, the sugar curve would be found to have a much closer correlation to the humidity curve than is indicated in fig. 3, B.

It is quite clearly indicated, not only by the data shown in fig. 3, but also by many samples obtained at various other times, that trumpet creeper nectar varies much less in sugar concentration than do nectars from many other sources.

General Discussion

Studies similar to those just described were made upon various other sources of nectar. In every case, humidity was found to have an important influence upon the concentration of the sugar in the nectar. It is evident, therefore, that determinations of the sugar content of nectar are of little value unless accompanied by adequate humidity records.

A number of other factors besides temperature and relative humidity influence the concentration of sugar in nectar. It is probable also, that different plant species may react differently to any given factor or combination of factors. A given factor may exert more influence on one plant species than on another. It is possible then, that in some plants the concentration of sugar in their nectar may be correlated more closely with some other factor than it is with relative humidity; but, so far, no such case has been found.

As an example of the fact that a given factor may exert more influence on one species than on another, it may be pointed out that relative humidity appears to have a greater effect on the sugar concentration of basswood and milkweed than on trumpet creeper nectar. It is believed that differences in types of flowers may be responsible for these variations. Flowers in which nectar is usually secreted in comparatively small quantities, and especially those in which the nectar is much exposed, show wide fluctuations in sugar concentration in their nectars, which vary inversely with relative humidity. On the contrary, flowers in which nectar is secreted in comparatively large quantities, and especially those in which the nectar is well protected, show considerably smaller variations in sugar concentration with changes in humidity. To the former class belong basswood, raspberry, milkweed, the various clovers, sweet clovers and many others of our most important honey plants. To the latter class, belong trumpet creeper, day lily, gladiolus and canna, which are comparatively unimportant to the beekeeper.

It is to be observed that in early morning, when humidity is very high and when most flowers are considered to be secreting nectar most actively, the sugar concentrations for all three of these sources were quite similar, ranging in the neighborhood of 20 to 30 per cent. As relative humidity decreases, evaporation of water from nectar increases. Thus the exposed nectars of basswood and milkweed become concentrated

much more rapidly than does that of trumpet creeper, which is much less exposed. Nectar, being hygroscopic, may be expected to absorb moisture from the air with an increase in relative humidity, and the more concentrated the nectar, the faster will it absorb moisture. Other things being equal, the larger the amount of nectar, the more slowly will variations in humidity affect its concentration.

If the increase in quantity of nectar under humid conditions is due entirely to an increase in water content, as shown by Kenoyer (5) and others, it must result in reduced honey production in many cases for two reasons. The nectar is less attractive to the bees because of its greater dilution, and a larger amount of it must be handled for each pound of honey produced. This not only involves additional labor on the part of the bees, but also tends to reduce the incentive for gathering it.

On the other hand there probably are instances in which the honey crop is augmented by an increased water content in nectar. In the case of flowers, such as red clover, *Trifolium pratense*, which have corolla tubes so deep that the honeybee's tongue, under normal conditions, cannot reach the nectar, an increase in the water content of the nectar may enable the bees to secure a portion of the sugar by filling the corolla tube with nectar to such a depth that honeybees can reach some of it. In such cases, the increased water content may make all the difference between honey production and no honey production.

Summary

1. The Abbé refractometer was found highly satisfactory for determining sugar concentrations in nectar.

2. Sugar concentration in nectar varies inversely with relative humidity.

3. An increase in the amount of nectar secreted is not necessarily advantageous to the beekeeper, unless there is an increase in the amount of sugar made available to the honeybee.

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