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Bee Culture

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800.289.7668
Executive Publisher – John Root
Associate Publisher, Senior Editor – Kim Flottum, Kim@BeeCulture.com, Ext. 3214
Assistant Editor, Design – Kathy Summers, Kathy@BeeCulture.com, Ext. 3215
Social Media, Event Specialist & Subscription Coordinator – Amanda DeSimone, Amanda@BeeCulture.com, Ext. 3255
Advertising – Jean Newcombe, JNewcombe@BeeCulture.com, Ext. 3216

Contributors
Clarence Collison • James E. Tew • Ann Harman • Kim Lehman • Phil Craft • Larry Connor
Connie Krochmal • Jessica Louque • Toni Burnham • Ross Conrad • Jennifer Berry • Ed Colby

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A manuka beeyard on top of a mountain in New Zealand. Photo by Kim Flottum

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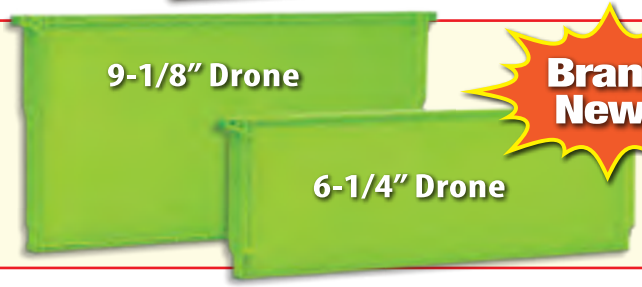

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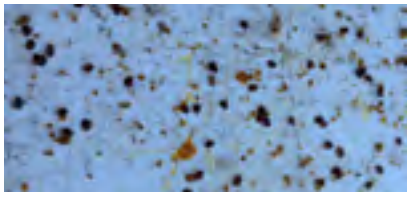

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Honey Tasting

The Honey and Pollination Center has been very interested in the series of articles about honey tasting that have appeared in *Bee Culture* over the past few years. We recognize the need to educate our beekeepers, packers and consumers in the unique characteristics of many of our more common mono-floral honeys.

In 2014, the Center convened a 26 member tasting panel to develop the UC Davis Honey Flavor and Aroma Wheel. The concept was to use the panel to taste a variety of honeys and to establish a series of terms that were used consistently to describe honey. The goal was to develop a tool to help consumers of honey have a broader and educated vocabulary when describing individual honeys. After several months of work with sensory scientists, the Center published its wheel to much acclaim. Over 99 words appear on the wheel divided into several traditional categories. The Wheel is copyrighted and proceeds from its sale go to graduate research in the Department of Entomology and Nematology. (*Bee Culture* – November 2014)

To quote the most recent article from *Bee Culture*, January 2018, Marina Marchese says: "We (the United States) have also not done the work here (as they have in Italy) on how honey conforms to particular floral sources – meaning, nobody has done the complete pollen and chemical analysis of enough samples of any particular honey to be able to definitively say 'This is goldenrod honey' or 'this is orange blossom honey.'

But finally this research has begun at UC Davis. This past year, 2017, working with UC Davis Departments of Food Science and Technology and Viticulture and Enology, the Center began the work of establishing sensory baselines for U.S. mono-floral honeys.

For the initial portion of the program, we trained and calibrated 10 professional tasters in the nuances of honey. We created the tools and protocols necessary for a formal program based on standard research procedures. The preliminary research uses three selected honeys with multiple samples of each. To back up this three month project, we had our palynologist meet with Dr. Vaughn Bryant at Texas A & M, Professor of Anthropology and an outstanding melissopalynologist, to learn how to analyze honey for pollen sources. In addition, we had graduate students run instrumentation analyses in both nutrition and gas chromatography for aromas on each of our honey samples. Finally, we hope to add nuclear magnetic resonance (NMR) to our study within this academic year.

We are writing our initial results for publication in a peer reviewed food science journal and hope to have an article ready for publication simultaneously. Once these articles are complete we will begin the longer process of searching for financial support from within the honey industry and applying for grants to cover the extensive costs associated with this type of in-depth research.

Once funded, we are looking towards some very sweet research.

Amina Harris, Director
UC Davis Honey & Pollination Ctr.

HAS 2018

The Heartland Apicultural Society's 2018 conference welcomes Dr. May Berenbaum, University of Illinois Champaign-Urbana, to the list of speakers at the will be at the July 11-13, 2018 annual conference at Washington University in St. Louis, Missouri.

Established in 2001 by several professional entomologists, the conference rotates through the Midwest offering basic and advanced beekeeping classes to make it easier for local beekeepers to attend sessions focused on the latest beekeeping methods and research.

Among the other speakers confirmed to date:

- Dr. May Berenbaum, Entomology department head at University of Illinois Champaign-Urbana, whose research focuses on the chemical interactions between herbivorous insects and their host-plants,
- Dr. Marla Spivak, a MacArthur Fellow at University of Minnesota's Bee Lab;
- University of Minnesota Bee Squad, a beekeeping instructional and public outreach program to encourage collaboration and public education about bees;
- Dr. Keith Delaplane, director of the University of Georgia Honey Bee Program;
- Jennifer Berry, University of Georgia Honey Bee program lab manager.
- Dr. Dennis vanEngelsdorp, University of Maryland Honeybee Lab, who directs the Bee Informed Partnership, the Tech Transfer Program and the annual national beekeeping management surveys, and
- Samuel Ramsey, University of Maryland PhD candidate and researcher.

To get notified when registration is open, **www.heartlandbees.org/2018/01/sign-up-for-updates-from-has/**
Online registration and more information will be available at **www.heartlandbees.org**.

Robert Sears
HAS 2018 President

Bee Culture
623 West Liberty St.
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mailbox@beeculture.com

World Bee Day

On 17 November, the resolution was unanimously adopted at the Economic and Financial Committee (Second Committee) of the United Nations General Assembly, with co-sponsorship of 115 countries, including the USA, Canada, China, Russian Federation, India, Brazil, Argentina, Australia, as well as all Member States of the European Union.

Bees and other pollinators are extremely important when it comes to ensuring the global safety of the food supply chain. Every

third spoonful of food depends on pollination. By pollinating crops, they also provide a significant source of jobs and income for farmers, which is particularly important for developing countries. An international study of IPBES estimates that the annual global food production which depends on pollination is worth between USD 235 and 577 billion. In addition, bees also have an important role in nature conservation. Studies of UN Agencies and the International Union for Conservation of Nature show that bee populations and the populations of other pollinators have significantly decreased, making them more and more endangered.

Therefore, the Republic of Slovenia, on the initiative of the Slovenian Beekeepers' Association, initiated procedures in the Food and Agriculture Organization of the United Nations in 2015 to declare World Bee Day, and proposed a resolution which would emphasise the importance of bees and other pollinators.

On the occasion of the adoption of the abovementioned resolution, Slovenia will host a reception, on the margins of which the Minister of Agriculture, Forestry and Food Mr. Dejan Židan will deliver a press statement and will be available for an interaction with the press.

Furthermore, please find below an invitation to visit an exhibition and interactive pavilion "The World of Bees" that will run from 11 to 22 December 2017, at the United Nations Headquarters (Delegates' entrance).

WAS 2018

The dates are August 3-5 and the place is Boise, ID.

Here's a list of just some of the speakers that will be there – Jennifer Berry, Sarah Red-Laird, Melinda Jean Stafford, Randy Oliver, Ramesh Sagili, Jerry Bromenshenk, Ron Bitner (we'll also do a locavore Banquet out at his Winery on Sat evening), Jamie Strange, Dewey Caron, Jerry Hayes, Ellen Topitzhofer, Dick Knapp, Marc von Heune and Ken Sonnen.

Hope to see you there!

Steve Sweet
WAS 2018 President

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BEECOSYSTEM

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In deliberately differing BEEcosystem from existing styles of hives, we celebrate a fusion of old and new ideas in apiculture: an emergent hive form, with a familiar top bar functionality. With a slim wall-mounted profile that can be incorporated into nontraditional beekeeping spaces, each BEEcosystem HexHive contains six top bar style frames to produce foundationless comb. Other hive features include our window unit (for non-invasive indoor hive setups), a physio-logical (red light filtering) nighttime viewing cover, a practical below-bottom-board cleaning drawer, a spring-loaded safety closure system, and a simple hive-top mason jar feeder. For more information or to place an order, please visit our website at **www.BEEcosystem.BUZZ** or send us an email at **Hello@BEEcosystem.BUZZ**!

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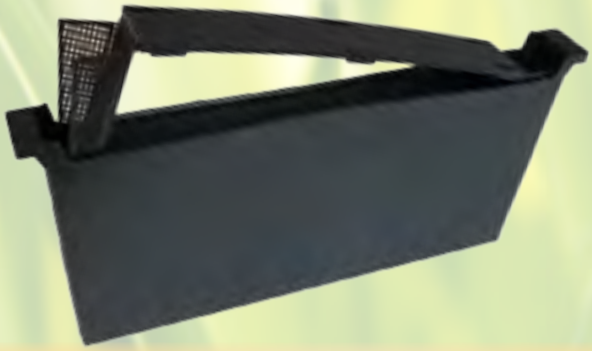

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– More That's New

Parsons' Gold Apiaries DVD Set

Bob Parsons is owner and operator of Parsons' Gold Apiaries located in Forest, OH.

The main spring board to a life time of honey bees came in 5th grade when a beekeeper brought in an observation hive to his class. During a visit to family members in Indiana he watched his uncle tend his hives. He got his first four hives in 1965 and has been involved with bees ever since – 52 years.

He sells package bees and nucs and all sorts of bee equipment to beekeepers all over. He has been shipping bees for about 10 years. His website is geared mainly to new and returning beekeepers. It helps them in getting started by telling them the equipment they need, cost, etc. What customers really want is to 'see' how to do things. So Bob decided to show them how.

Below are the developed DVD's to date:

DVD #1. – Beekeeping Simplified! This DVD shows the beekeeper how to put a bee hive together. How to assemble a frame. How to light a smoker and keep it lit.

DVD #2. – Hiving Packaged Honey bees Successfully! This DVD is very helpful to new beekeepers. It shows what equipment they need and how to go about getting the bees out of the box and into the hive.

DVD #3 – Honey Comb Production and Bee Pollen Collecting! This DVD shows the equipment needed, how to put it on and how to make comb honey and collect pollen.

DVD #4 – Catch a Swarm/Work the Bees! This DVD demonstrates Bob and Deborah Parsons catching a swarm in their own backyard. All is not successful at first, so alternative measures are taken. Next, Bob shows how to work the bees. What does that mean and what do you do and what are you looking for once you get inside the hive?

DVD #5 – Extracting Honey for the Small Beekeeper! Once you have made honey, how do you get it away from the bees and how do you get it out of the frames? Using a hot knife to cut the wax and the use of a small extractor shows you how to do it.

DVD #6 – The Prescription! - Helping honeybees survive cold times of the year. This outlines a step by step over wintering process. Also use these steps during rainy seasons.

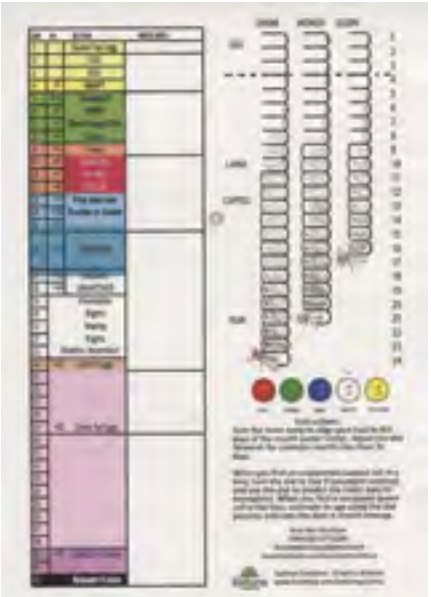
DVD #7 – Split a Package/Make a Nuc/Split a Nuc – Teaches the beekeepers how to split packages and Nucs.

My desire is to make more DVDs as questions and need for instruction are presented to me. It was a lot of fun and we all had lots of laughs making them.

For information visit **www.parsonsgold-honeybees.com**

Queen Disk. I ran across this while in New Zealand and was pleased to see how easy it is to use for record keeping and just knowing what to do when, when raising queens. It is 8" wide, 12" tall and two-sided and laminated so you can write notes on it for future reference, then remove and use again. Side 1 has a wheel, that circle shown here with colors. You turn the wheel, starting with the yellowish area and day one when the queen lays the egg, and put it on the day of the month on the outside wheel. After, that simply follow the directions given on the inside wheel for each day until your queen is mated. The reverse side is for taking notes, instructions for using, and diagrams on life cycles. It's a clever tool to have, even if you already raise queens on a routine basis. Created by Deborah Hambly, you can reach her at buzzbeebotique@gmail.com for more information.

Kim Flottum



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INNER COVER

I guess I'll blame it on Sunspots maybe. Or the crush for time before our trip to New Zealand. Maybe just a too-long Winter. I'm not sure what happened in the March issue's Inner Cover, or other parts of that issue either. Certainly it wasn't me that caused the following problems.

Let's see. Start with the math. I'm not a mathematician by any stretch, but numbers are an important part of what we do here, and it's the numbers of the beekeeping industry that are important every year when we look at per capita honey consumption, coming in May, and our monthly honey report stats and more every month. But last month I goofed up on something I don't usually goof up on. I was looking at urban land use. And I figured it wrong.

To set the record straight. Between 1945 and 2012, urban land use increased 363%, (not 78%) from 15 million acres to just about 70 million acres, while the population increased from 140 million people to 314 million, or 124% (not 54%). So land use more than tripled, while population more than doubled. I did get the jist of it right though – there are more people, and we are taking up more space per person.

And Frank's article on Ventilation. That got messed up too. Some of it actually was my fault, but I can honestly say, some of it happened after we signed off on it. Nevertheless, we'll fix it on the web page, so if you want all of his article, look for it on **BeeCulture.com**.

•

I mentioned New Zealand, because we were hosted for 12 days in that fabulous place by a whole lot of good people. They were ambitious in their planning, and efficient, too, in that we landed at the northern end of the North Island, and worked our way south, stopping in four places to meet with beekeeping groups before heading home. Each place we stopped was as different from each other as they were different from Ohio, so there was an overwhelming array of weather (it's summer down there) landscapes, cultures and vegetation, all alien but somewhat similar, yet all different and unique. If you've seen the Hobbit movies, or the Avatar movie you have a feel for the landscape. Huge trees, towering steep volcanic hills, rich lush vegetation, sweeping meadows – it's all there. And the ocean on all sides, constant wind and rushing clouds.

I was invited there to address, primarily, the issues they are facing with the gold rush of manuka honey. The manuka plant is native to both New Zealand and Australia, and it is a weed, growing in places no other plants can or will grow. It's found on steep volcanic mountain hillsides, between rocks on cliff sides, almost anywhere that nothing else can grow, or be used for. It is a shrub, three to five feet tall or so, depending on the soil, the wind and taller foliage cover.

The issues stem from the value, and the quality of the manuka honey that's harvested. If hives are placed in locations where only manuka grows, are moved in just after bloom begins and honey harvested just before bloom ends, and the variety of the manuka plants are right (there is more than one variety and occasionally they intermix), the finished crop can be worth more than $20 per pound. On a good location, with the right number of hives, you can make 50 – 60 pounds/hive in about two weeks, and you can put a lot of hives in a dense planting.

Some, me included, have compared it to the California Gold Rush in the late 1840's. Thousands of people rushed west to find gold and fame and while some did, many didn't and went bust, many were swindled out of their claims, many were murdered and their lot stolen, and most barely broke even. Those who did the best were often the smartest, the luckiest, or those who got away with the crimes. But the winners, after all the dust had settled, were the folks selling food, picks and shovels and gold mining gear. They didn't go for the gold, they went for the sure thing. And most of them won.

This manuka rush has led to an incredible increase in the number people keeping bees in that country, and an even more incredible number of beehives being used to harvest this crop. When you look at New Zealand's topography, you will note there are only so many places you can put beehives because the terrain only provides just so much flat space. Volcanic in origin, the whole of the landscape is extremely hilly, with steep, rocky hillsides dominating the land. Given that, a couple of untoward behaviors have arisen that New Zealand beekeepers are concerned about.

First, it's been essentially an invasion of beehives with all the new beekeepers. More dramatic has been the expansion of existing commercial operations. It's more common there than here for large honey packing operations to run their own hives, or

Ethics.

at least a lot of them, and then buy in what they need. That practice has expanded exponentially to the point that these large, well-funded, deep pocket operations are moving into more and more manuka areas. This in turn is doing a couple of things. First, it is saturating an area that was supporting a given number of hives with now five and 10 times the number it can handle. The bigger companies can support short crops for a bit, while smaller operations will fold, leaving the future, and the location, to the big guys.

Second, in the past, smaller operations would put their hives on places a land owner couldn't use for crops or sheep or cattle grazing, and pay rent in honey. Now, smart land owners are not only asking for huge fees for rent, but also a portion of the harvested crop. Big guys can pay, little guys can't.

A similar trick is to simply set down a dozen pallets on a likely piece of land. Don't ask, don't pay and don't tell. It works mostly because lots and lots of land there is simply not used for anything. Volcanic mountains, dry, dry hillsides all work for a helicopter landing and pickup when ready. Nobody knows, except the pilot and the beekeepers.

And third, outright theft. Hives disappearing in the night. Especially hives full of manuka honey. Why do the work, when you can simply steal the crop? Maybe the whole hive, but often, just the honey. Take it home, extract and it's all yours. Electronic devices planted in some of the remote hives have helped slow this trend, but there are parts of this island where there is absolutely no digital communication so that stops some of the preventive efforts.

Of course there is some suspicion that there's a lot more manuka honey sold than is harvested. Early on that was a given I was told, but the science behind identification has gotten a lot better, fast, and it's not quite as easy to pawn off a barrel of honey with manuka on the label. If it is the good stuff, it's thixotropic, like heather honey, and sets up like jelly. You need special equipment to harvest it, which we'll look at next time. But other NZ honeys do the same, so that's not the deciding factor, either.

Another side of this is the wave of new beekeepers who don't know how to keep bees yet. They are learning, but you know that story. Of course they have *Varroa* there, and now, with so many more beekeepers, and beehives, spreading that beast has become so much easier. So that's an increasing problem, but AFB is an even more talked about issue. There are no antibiotics used there. None. Zero. Zip. It's burn, baby burn. Not a bad choice in my opinion, but there are no options. You can't scorch the boxes and covers either. It all gets burned.

Of course with the influx of all these new hives, by both experienced and inexperienced beekeepers the incidence of these pests occurring, and spreading, has increased as much as the number of hives, so that's a troubling issue too. *Varroa* bombs in the cities, crashing hives in the wilds, and AFB always waiting in the wings.

That was the venue I was invited to address. What a challenge. What an opportunity. What a trip. But the request, actually, was more in the line of "let's talk about beekeeping ethics in general". Which, I learned, came from a talk I'd done at an EAS meeting not long ago that the good people from New Zealand had heard, and thought needed a wider audience.

Beekeeping ethics? Well, yes. Let's explore that should we?

This centered on honesty, safety and common sense of being in the bee business. Treating fairly customers, consumers, the uninformed and unprotected public, growers, other beekeepers and even yourself.

So, customers. Do you sell queens, nucs, packages, colonies? Are they what you say they are? Are your queens well mated? Did you keep them long enough to know they are good layers, or sell them just as fast as you could get them out of their cells? Clean wax in your nucs, or the old stuff you want to get rid of? Pest free hives, or, whatever, because they don't know the difference anyway? Guarantee those queens or tail light guarantee?

How about your honey? Sell a varietal? So a varietal is classified as the 'predominant' variety in the mix. So, a honey could be a mix of 10 blossoms, with one, at 11%, the predominant variety. Is that what you are going to call it? And do you filter your honey, and is honey, honey if it doesn't have pollen in it? Or do you have a good varietal crop, and dilute it with an unflavored variety (or worse), so it still looks and kind of tastes like fireweed, but it's only, now, the predominant variety, sold as pure? That's never happened.

And then there's the unknowing, and unprotected public? Ever get a robbing situation going in your backyard and simply retreat, leaving everybody else to fend for themselves? Or travel with a 'oh that's good enough' unsecured load of bees, or honey, or equipment, or whatever?

How about pollination contracts? You promised eight frames, but most are only six, so only show the eights, right? You don't have anything written down promising eight, just a phone call a couple weeks ago from the grower. Who's to know? He never comes out to look, anyway.

And the most recent one I ran into. I delivered magazines to give away at a beginner's class. Got there just as the class was getting underway so stayed a bit to see how it was going. First slide up was from a talk of mine that was on the internet, as were all the rest. No credit given, no mention of where it came from, not even an embarrassed speaker. I'm going to guess that's not the first time that's happened, either.

So, ethics. You don't have to go all the way to New Zealand to see issues with this. They are right next door.

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1 - Nasr et al, Efficacy of Apivar on the Varroa Mite, Varroa destructor in Alberta, Canada. 2012 Canadian Pest Surveillance Branch, Research and Innovation Division, Agriculture and Rural Development
2 - National Management Survey Bee informed partnership 2015 (USA)

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It's Summers Time –

In The Hands Of Strangers

If you have read *Bee Culture* for very long you know that Kim and I travel a lot. We have been so blessed to be a part of the beekeeping industry and get to meet and know so many interesting people who just happen to love the honey bee as much as we do. Thank you to all of you who over the years have invited us to your locations – we deeply appreciate it.

This latest trip was quite an adventure – New Zealand. It wasn't on my bucket list, only because I'm not that adventurous with my list! But it was an amazing trip.

When Kim and I travel my main job is to take care of all of the details – airfare, hotel rooms, rental cars, where and when we're supposed to be there – all of that. Well this time others were in charge, so this was a little out of my comfort zone at first. But I quickly realized that we were having the trip of our lives. We put ourselves in the hands of strangers and it worked perfectly. From the time we arrived we were handed off from one beekeeper to another to another working our way from Auckland up north to Wellington down south. Then back up to Auckland and back home.

I was very concerned about the amount of time we had to spend on airplanes. We went from Cleveland to Chicago to San Francisco, 4½ hours and then San Fran to Auckland, 13 hours. Prior to this we've gone several times to England and Northern Ireland and that's about a seven hour flight, so this was double that. I tend to be a very fidgity person – I can't sit still for too long a time. But we did Okay. Neither of us slept much. But they have movies and I always take lots to read. I think Kim watched six movies on the trip over. And every now and then they come along and feed you something, so it wasn't too bad.

Of course we arrived somewhat sleep deprived and wondering what day it was really. But Fiona was right there to pick us up and got us fed and then the adventure began. Kim and I will talk more about all of the beekeepers and beekeeping we saw. And so much more.

I have to admit I knew very little about New Zealand before we went on this trip. It is an amazing place. It's peaceful and green and not heavily populated and – no snakes – a wonderful place to visit or live. I'd recommend this trip to everyone.

A big thank you to all of the folks who took care of us – Fiona and Jeremy, Kim and Aaron, Deanna, Gary and Karen, Carol and especially Frank and Maryann.

We've known Fiona and Jeremy O'Brien for about 10 years. They've been coming to the U.S. to the EAS conference every Summer for about that long. Frank and Maryann Lindsay also have been coming over for EAS for several years. So we had some familiar faces that were guiding us along. Frank and Maryann spear-headed the schedule and line up all of the people along the way. Kim gave eight talks at different locations as we worked our way down the country.

Back home in Medina daughter Jessica held down the fort taking care of all 20 chickens and the two fat cats. She did a great job. A huge thanks to her. We are lucky to have a good support team – at home and at work – which allows us the luxury of travelling and not having to worry about things back home. So thanks to all of those people too.

After spending an unexpected night in Chicago because of a snow storm in Cleveland, we made it home safely just in time to get ready for the Tri-County meeting in Wooster. It was a fantastic turnout as usual, about a thousand beekeepers from all around northeast Ohio and even the surrounding states.

It's always good to see those old friends and get reacquainted. All in all it was a good day. We sold lots of books and subscriptions and gave away a bunch of magazines and calendars. Kim made it this year after missing the last two, so folks were excited to see him there. We took almost the entire *Bee Culture* team.

As I write this we've been home about a week and a half, so still getting caught up but glad to be back in the swing of things.

Don't forget all of the exciting meetings coming up this Spring, Summer and Fall.

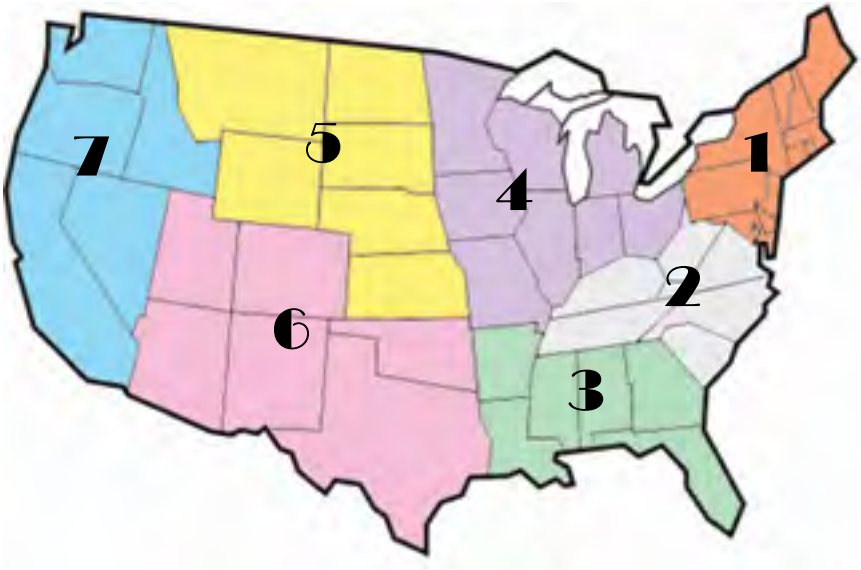
Bee Culture's Pollinator Day, right here on Root Company property is July 21. If you're close by or passing through please stop and see us.

Our annual big event will be October 19-21. We're calling it 'My Story' and four well-known commercial beekeepers will be here in Medina giving you their individual stories of how they got where they are – Ray Olivarez, Brett Adee, John Miller and Mike Palmer. You don't want to miss this. See page 38 for more of the details. Hope to see you there!

I hope you all have a happy and sunny Easter and that Spring arrives quickly wherever you are. We're hoping this weekend to get in the bees (mid-March). We were out there about a month ago and had lost two of our nine colonies. Hopefully the rest are doing Okay. Good luck with your bees and have a great Spring!

More on the New Zealand beekeeping adventure next month!

APRIL – REGIONAL HONEY PRICE REPORT



Winter So Far

In late Feb we surveyed our reporters to see how winter was going so far, what they had done last fall to get ready and where they thought they'd end up when summer finally arrived.

We started with feeding. Over all regions, almost exactly a third didn't feed anything, a third fed both protein and carbs and a third fed carbs only. 79% applied some form of mite control, with Apivar by far the most commonly used, followed distantly by Apiguard, with oxalic a close third.

We asked about moving to a better place, and, as expected, almost nobody does, and the same with wintering in a building of some sort. We expect that to become more popular as time goes by, but so far it isn't taking off with our reporters. Region 1 and 4 do some wrapping, with 1 more than the rest, but still in the single digits percentage.

Given it was February, we asked reporters to guesstimate how they thought their bees were doing. 22% thought better than expected, 55% about what they expected, 14% worse than expected and 4% with essentially total losses.

And what were those losses? Region 1 averaged 30% loss, region 2, 21%, 3 lost 19%, region 4, 27%, region 5, 25%, region 6, 28% and region 7, 27% loss. Of course individuals ranged from 0 – 100% losses, with region 1 and 4 the most diverse.

	REPORTING REGIONS							SUMMARY			History	
	1	2	3	4	5	6	7	Range	Avg.	$/lb	Last Month	Last Year
EXTRACTED HONEY PRICES SOLD BULK TO PACKERS OR PROCESSORS												
55 Gal. Drum, Light	2.47	2.19	2.12	2.63	2.23	2.19	3.50	1.80-3.50	2.29	2.29	2.34	2.24
55 Gal. Drum, Ambr	2.31	2.16	1.99	2.48	2.31	2.04	3.00	1.35-3.50	2.19	2.19	2.14	2.10
60# Light (retail)	210.37	183.50	190.00	199.00	159.00	195.18	220.00	155.71-280.00	202.88	3.38	203.57	208.78
60# Amber (retail)	201.23	194.20	185.00	192.33	201.23	188.14	220.00	140.71-260.00	202.10	3.37	207.71	207.88
WHOLESALE PRICES SOLD TO STORES OR DISTRIBUTORS IN CASE LOTS												
1/2# 24/case	90.60	75.30	84.10	65.00	90.60	84.00	90.60	57.60-134.40	85.19	7.10	80.90	83.36
1# 24/case	136.57	106.85	119.17	118.23	148.00	124.88	128.40	86.00-211.20	124.55	5.19	124.39	121.98
2# 12/case	120.31	95.25	113.35	103.54	97.44	98.40	114.00	78.00-182.40	110.42	4.60	108.45	108.17
12.oz. Plas. 24/cs	108.98	87.65	89.40	83.80	108.98	104.02	97.20	66.00-172.80	98.57	5.48	96.59	102.15
5# 6/case	127.40	108.05	142.90	112.67	102.30	115.50	127.40	71.50-186.00	126.05	4.20	128.11	124.47
Quarts 12/case	149.19	134.39	128.84	141.40	155.32	130.62	132.00	109.20-204.00	141.78	3.94	146.90	143.83
Pints 12/case	98.08	88.33	78.40	96.00	111.00	75.98	84.00	65.00-144.00	91.65	5.09	97.17	87.65
RETAIL SHELF PRICES												
1/2#	5.01	4.19	4.70	4.60	3.60	3.69	5.01	2.38-7.95	4.86	9.71	4.94	4.64
12 oz. Plastic	6.09	4.98	5.46	5.13	4.76	6.11	5.60	3.79-9.00	5.78	7.71	5.64	5.67
1# Glass/Plastic	8.20	6.52	7.09	6.66	6.43	6.66	8.00	4.00-14.00	7.40	7.40	7.42	7.13
2# Glass/Plastic	13.72	10.50	11.97	10.74	11.51	10.07	14.50	6.92-23.00	12.47	6.24	12.69	11.98
Pint	10.79	8.75	8.71	12.95	10.00	10.58	9.20	6.00-17.00	10.08	6.72	10.16	9.85
Quart	19.30	15.62	15.51	18.17	17.60	16.95	16.73	11.00-32.00	17.10	5.70	17.43	16.95
5# Glass/Plastic	28.68	23.24	31.80	24.33	24.32	23.49	28.68	17.99-43.25	26.74	5.35	27.73	26.14
1# Cream	9.91	8.24	9.12	7.85	6.99	5.50	9.00	5.50-16.00	9.07	9.07	8.68	8.91
1# Cut Comb	12.87	10.06	8.75	10.17	10.00	6.50	14.00	6.50-22.00	11.48	11.48	11.26	11.31
Ross Round	8.26	6.83	8.26	4.00	4.00	10.56	12.49	4.00-12.49	8.27	11.02	9.60	9.62
Wholesale Wax (Lt)	7.08	5.11	5.00	6.83	6.00	4.96	5.50	3.00-12.50	6.41	-	6.36	5.81
Wholesale Wax (Dk)	6.32	4.73	4.01	5.90	6.32	4.25	6.32	2.00-12.00	5.64	-	5.49	5.20
Pollination Fee/Col.	93.54	77.50	55.00	81.25	93.54	125.00	160.00	30.00-165.00	89.58	-	79.81	85.40

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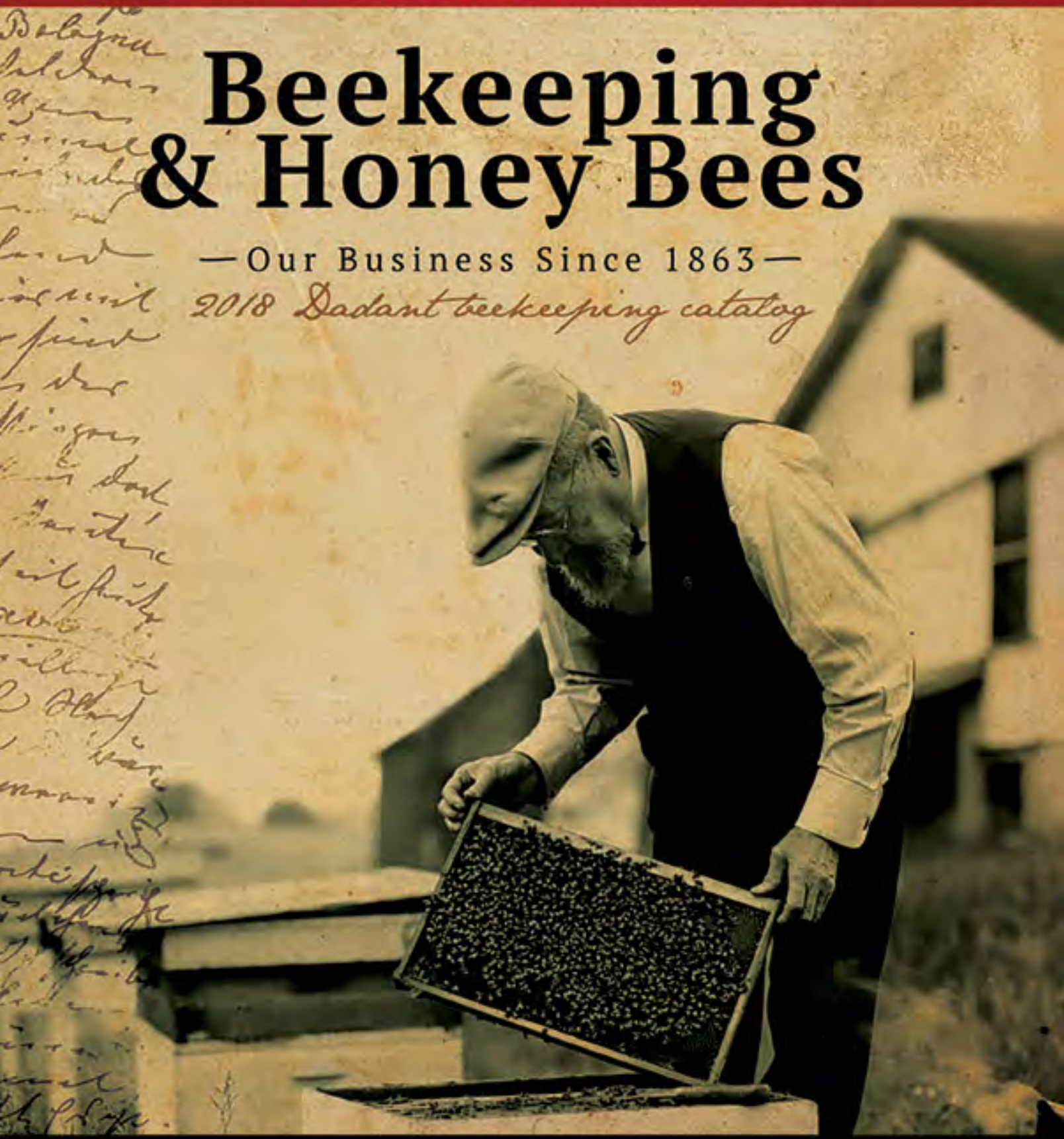

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FOUND IN TRANSLATION

C-C-Decade – Reflections On 10 Years Of Chasing A Curse

Jay **Evans**, USDA Beltsville Bee Lab

We in the scientific world can bask in many battles won through the identification and treatment of honey bee challenges, and we do so. Still, it is hard for anyone to claim that we are winning the war for bee health. I am just off the phone with another long-suffering commercial beekeeper who reports tremendous losses by himself and his beekeeping colleagues this Winter, just as their bees are needed in California for their most important pollination event. This call comes more than ten years after he and others reported what became labeled Colony Collapse Disorder (CCD). Some of the forensic signs are the same; colonies with a laying queen but few foragers, or a forager force that declines sharply in a week or two, plenty of stored food, and a serious lack of dead bodies. In other cases colonies simply don't build up, despite having all the eggs and brood needed to explode. The common thread seems to be a dearth of older bees. As a middle-aged researcher I feel a bond with middle-aged bees that drop dead just when they have a chance to bring treasure to their sisters. I am optimistic beekeepers, scientists, and others who care for bees will win this war (note my #Beeoptimism challenge from January) – but why does it have to be so hard?

As was the case in 2007, pests, pathogens, and chemical insults are the most likely suspects. But which of these, and why do they push some colonies and entire operations over the cliff and not others? Much has been written about synergies and compounded effects, and scientists are making progress tackling those synergies. However, as Ross Conrad wrote in this magazine (February, 2018), we will never have the time or resources to march through and test each and every possible combination of living and non-living factors that impact honey bee health. This fact leads to two possible strategies. The first strategy is to continue on with experimental tests after winnowing down the number of suspects and their toxic twins based on exposure, predicted interactions, or lucky forensic breaks. This strategy works and has been the basis for some insightful studies in the past year. For one, USDA researcher Yu Cheng Zhu and colleagues measured the impacts of the common pesticide imidacloprid when alone or in conjunction with a set of seven compounds most likely to co-occur with imidacloprid in the environment (**https://doi.org/10.1371/journal.pone.0176837**). The results help predict which compounds are most damaging when delivered in concert. Zhu coupled these survival assays with enzymatic screens to determine which bee defenses were effective against each compound. Such studies are excellent for explaining the world and specific risks, and fall within the comfort zone of us scientists, but they are painstaking and therefore cannot address every biological and physical threat to honey bees. It has been argued that a more experiential, rather than experimental, approach is needed.

Farmers of all sorts tend to fall more into the experiential, or intuitive, fold. I was reminded of this by the recent death of my wonderful stepfather Melvin Getz, a long-term and very successful Colorado rancher. Mel was retired from ranching when I met him twenty years ago but he had endless stories of the trade and they were fascinating. He could rope and throw and brand them, for sure, but rather than try to understand cattle he clearly succeeded through an innate ability to understand the external forces on cattle and their human keepers. Most of his working days were spent on non-livestock challenges including water and grazing rights, community connections, economics, and snowstorms. He and those in his extended family spent as much time studying these external issues and advocating for them as they did riding herd, and that was a requirement for staying successful. In my limited experience as an outsider, commercial beekeepers who have survived more than a few years are the same way. They are super intuitive and aware that their livelihoods depend as much on their intuition for economics, outside challenges, and sociology as on their knowledge of bees.

Dr. Sainath Suryanarayanan from the University of Wisconsin has put together an important set of writings describing how scientists and intuitive beekeepers think differently about the challenges at hand. Sai has studied both entomology and societal forces and he presents compelling arguments that both sides can be blinded by their biases, resulting in over-predicting (more often on the beekeeper side) and under-predicting (more often by those adhering to the standards of modern science) the degree to which the above stresses impact bees. One example he describes that struck home for me was the description by beekeepers and more intuitive scientists of 'spotty' brood patterns. A beekeeper with years of experience will know in their heart that something is wrong (and they are right) and will be tempted to associate this syndrome with something/anything out of the ordinary in their recent past. In contrast, many scientists will take

this as an opportunity to reduce the fates of individual larvae to singular causes and might spend a lifetime, or at least a PhD, tackling a handful of potential causes. This doesn't necessarily mean that either side has bad intentions, just different ways of approaching a crisis. Sai, along with Daniel Kleinman, has presented these and more arguments in a stimulating book, *Vanishing Bees: Science, Politics, and Honey Bee Health* (Rutgers University Press). In the open-source spirit of this column you can also immerse yourself in some of Sai's thinking for free, via youtube at (**https://www.youtube.com/watch?v=UlxCXa4DgjY**).

While I will mostly stay in the comfort zone of established science and its culture, Sai and Mel, although they never met, have taught me there is another path toward our common goal of healthier bees. I told Kim Flottum when I asked for the opportunity to write this column that it would not be Shakespeare, but I think a quote from Hamlet fits nicely:

"The time is out of joint.

O cursed spite, That ever I was born to set it right!

Nay, come, let's go together." BC

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Bring Those Packages Home!

Tina **Sebestyen**

Sometimes tragedy strikes beekeepers and bee clubs. One fellow I know had an emergency that demanded immediate attention just as he was arriving with his clubs' packages of bees from California one year. He made it home with the bees in the trailer just fine, dropped the sides, and left the bees on the trailer in the shade for just a short time. When he returned, all the bees were dead, every package had over-heated. I heard another horror story about a group whose bees all drowned because the change in altitude as they drove over the mountain passes pushed the sugar syrup out, covering the bees. Transporting bees is not for the faint of heart, but an important service provided by courageous people for your bee club.

We may not save the world with jello, but it might save your bees if you cannot avoid driving over mountain passes. Some suppliers are putting a jello-like substance in for bee food instead of sugar water. This could be the answer for you. The best solution for our bee club was to find a supplier located where driving mountain passes is not required of us to get home with our bees. Another awful thing that can happen when altitude removes the bee food is if the recipients don't hive the bees right away, and they starve waiting for a nice day. Here in Southwestern Colorado, it has snowed on bee delivery day for the past five years or so. We have learned that we can hive bees just fine in cold or snowy weather, though we sometimes wait a day or two if the weather is going to improve and we are sure there is plenty of bee food in with that package. You can feel the weight of the can if you pry it up a tiny bit with your hive tool, and determine if the can is empty, full, or somewhere in between. If the weather really dictates waiting to install the bees, it is possible to feed them by lightly spritzing the outside of the package with one-to-one sugar water. Do not soak the bees, or you bring tragedy home with you.

Bee Wranglers from left, Tina Sebestyen, Carrie Jenkinson, and Carol Tyrrell with a trailer load of bees. Ed Young photo.

The biggest threat to packages of bees in transit is heat. Bees overheat very quickly. We regularly bring in 190 packages of bees now, and that is a very tall stack of bee packages in a four horse trailer. The taller and more densely the bees are packed in the trailer, the hotter they will be. If you are transporting more than 200 packages, it would be wise not to pack them tighter or taller, but to find a longer trailer. A horse trailer usually has sides that open up high, so that wind does not blow right on the bees, but draws hot air off the top, and a breeze circulates through the packages as long as the trailer is moving. Some horse trailers have sides open over halfway down. This is too much wind, and the sides need to be closed up about three quarters of the way up with plywood, or even duct tape and cardboard. Box trailers have no openings and are too hot.

We hang a remote temperature sensor in the middle of the stack of bee packages, with the receiver in the cab. This has the interesting effect of keeping our blood pressure down, since rather than just imagining what may be happening in the bees, now we can see. If the temperature begins to rise too much, it is time to take action. A pump type weed sprayer that has never been used for anything but bees and never had anything in it but water is the perfect answer. Just mist the bees and the air over and around them, do not soak them. This cools them down nicely and gives them a little drink, too. Be sure to check your sprayer before you leave home. Discovering a broken sprayer or bad gasket when the bees are already hot is definitely stress inducing.

We also hang old fashioned mercury thermometers by strings at different places and heights in the stacks as a no-fail back-up, with one right on top. It is also possible to tell if the bees are hot by their behavior. If the bees are hot, they run in the cages rather than clustering nicely around the queen. One of the rules of bee transport is ***Never Stop***. You cannot afford to stop for a meal, even if it is your favorite place. The bees start getting hotter the minute the air isn't circulating through them from the motion of the vehicle. Brief stops for gas can be fun, though. There are always bees on the outsides of packages, and lots of packages means lots and lots of flying bees during a stop. While one person fills the tank, the other mists the bees, and you both

Four Corners Beekeepers Assoc. members matching bees and beekeepers (we offer different races of bees; Russian, Italian, and Carniolan). Ed Young photo.

Tina hiving the bees at 40 degrees. Neil Sebestyen photo.

enjoy super-hero status with the lookers-on, who think you are amazingly brave to stand there with all those bees flying around your head. Little do they know. Try not to smirk.

Living in the high desert has its challenges, and the weather is one of them. Some years we have transported the bees through the Utah desert at 80°, and we are panic-stricken about them over-heating. Lately, as I said, it is usually cool weather, and we thankfully drive through 65° temps. And a few years, it has been snowing as we drove in temps of under 40°, and we worry about the cold. As always, the bees can handle cold pretty well, but if temperatures of 40 or below are expected, it would be good to have a way to decrease the amount of wind going through the bees and the trailer. A tarp is a good thing to have along in case you need to cover the bees or the air vents in the front of the trailer.

Cold weather is the reason we use a horse trailer exclusively. Horse trailers have springs to cushion the ride, making it less bumpy. In a plain old behind-the-truck trailer, there are no springs. In cold weather, the bumps in the road knock the bees out of the cluster, they are paralyzed by the cold and cannot get back into the cluster, and they can die. Even if it is fine weather, constantly being bumped out of the cluster is very stressful to the bees. They are stressed already, and we need to minimize stress as much as possible. We beekeepers love the smell of the bees in the hive, that nice flowery, lemony smell. When the bees are stressed, their scent is sharper and more lemony. Bee packages always smell strong and sharp.

Another rule of bee transport is Get the Bees Out of the Trailer Immediately upon arriving. Since it has been snowing on bee day the past few years, we have found a warehouse that will allow us to use their space to stack the bees inside while we match bees and beekeepers. Breweries often have a space like this, and it is nice for our beeks to sit inside, talk bees with one another, and have a nice drink while they wait for us to arrive. It is possible to pass out the bees in an empty parking lot, but before you do anything else, get the bees out of the trailer. Stack them on the shady side of the trailer, and work from there.

We bring several huge tarps to cover the floor, since bee packages are inevitably sticky. We bring a fan and extension cord, in case the bees get hot and are running in the cages. There is nothing more stressful to beekeepers than stressed and unhappy bees. Some suppliers provide extra queens in case some of the package queens have died. We keep them in the truck cab as much for ourselves as for them while we drive. It is very pleasant to watch the queens and attendants lick up the occasional drop of water we place on the screen as we move them to shady spots on the seat. These queens can be kept in the cages for a week, if water is given two or three times a day. A drop of honey is welcome, as long as you know it came from healthy bees. I think they do better with a bit of previously frozen bee bread pushed into the screen, too. I've had them last two weeks, but never wanted to risk a queen's life to see if they could be kept longer. Be careful of the queen's tiny feet when applying water, honey, or bee bread to the screen. A cool, dark place like a windowless bathroom is the perfect temporary home for these girls while you enjoy their company.

The last piece of successful bee delivery is insuring their survival by educating recipients about how to install their bees properly. Along with the bee packages, we provide a list of instructions to try to help people avoid those "exciting" moments in hiving, and to help them enjoy their first date with their girls.

I have read that it is important to make sure there is not more than an inch of dead bees on the bottom of the package. My hope is that with these tips on transporting bees, you will have the same success we have had, rarely more than five or six dead bees in the package, and bees calm enough to settle into their new homes quickly and peacefully. BC

Tina has been hooked on beekeeping since 2007 in top bar, langstroth, and more recently, the long langstroth hive. She is founder of the Four Corners Beekeepers Assoc, and is vice president of the Colorado State Beekeepers Assoc. *She would like to thank her many mentors who take the time to listen and advise.*

A Closer Look

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Clarence H. Collison

Garden Time

Garden catalogs are timed to arrive about the first of January. You search the pages (or online) for the vegetables and flowers marked "NEW!" For many people just leafing through a seed and plant catalog is inspirational. January is when the gardening companies present seeds and plants for the most beautiful new flowers and the most delicious new vegetables from their breeding gardens. The seed and plant companies are hoping you will try the new ones and find them just what you wanted.

Those of you in the warm climates have already made your selections and have planted and possibly harvested something. With your long growing season you still have time to order more. Those living in the large temperate band across the U.S. may have started some seeds in frames or under lights and planted some in tunnels and may have already planted some cold-tolerant plants. In the cold North you are just putting in your orders while hoping for a good growing season.

Hybrid vegetables (even sweet corn) and flowers are being bred for growing in containers for decks, patios and even on rooftops. The selection of containers is huge as are the selection of suitable vegetables, fruits, berries and flowers! Apartment dwellers with a balcony can find both vegetables and flowers suitable for growing in shade or partial sun. The catalogs do indicate what the plants prefer. Your deck can have a mini-greenhouse. Various styles of supports, trellises and raised beds can make growing plants very easy in small spaces.

If you have lots of space for a garden you can indulge in some of the heirloom vegetables. These are ones that have been favorites for many, many years. Some of them need plenty of room to grow and are not bred for growing in containers.

What is a "double-duty" plant? It is one that you can enjoy visually or is edible, and also benefits pollinators of all kinds. Some catalogs indicate those double-duty plants with a tiny butterfly; other catalogs mention bees, butterflies and humming birds in the plant description. Sometimes pollinators are not mentioned but you can discover for yourself what pollinators come to visit. However one difficulty with that project is the time of day pollen and/or nectar are produced by a particular flower. It is amazing how many plants can be classed as double-duty ones.

Before you get carried away with the photos in seed catalogs you need to become familiar with the USDA Plant Hardiness Zone Map of the U.S. This map is important for growing perennials that need to live through the Winter. With vegetables, the growing days, from planting seed to harvest, are important. Remember that everyone lives in a microclimate that can be a bit different from other nearby areas. If you have lived in your home for several years you know what the usual weather is like. However Mother Nature sometimes likes to surprise you.

I think the number one plant anyone wants to grow is the tomato. I once saw a rose bed in a formal garden with several lovely tomato plants in it. There is nothing better to eat than a ripe tomato just plucked from your garden. You can admire the color and shape and size – but it is the flavor that you appreciate the most. When a large commercial tomato farmer was asked why the tomatoes lacked flavor, the reply was "they don't pay me for flavor." Since a ripe or almost ripe tomato is soft and can be squished easily, the ability to be picked and transported is the most important quality. However it seems that tomato breeders are trying to put flavor back into the supermarket tomato.

Well, are tomatoes double-duty? Actually yes, in spite of their listing as wind-pollinated. Tomatoes, along with peppers (sweet and hot), potatoes and eggplant, all belong to the Family Solanaceae. Although considered wind-pollinated, bumble bees visit the blossoms and do their buzz-pollination routine. They hold on to the blossom with their mandibles and vibrate their muscles letting the pollen fall onto their hairs. When these vegetables are raised in greenhouses bumble bee colonies are rented for pollination.

Although you may prefer honey bees, bumble bees are fascinating. Various species are found all over the United States and Canada, some living in quite cold climates. Bumblebees come in different sizes (small, medium and large) and with a variety of color patterns. Take some time to see if bumble bees are visiting your tomato and pepper plants.

Here is how you can identify the ones you see. You will need a copy of *An Identification Guide, Bumble Bees*

Ann **Harman**

of North America, by Paul Williams, Robbin Thorp, Leif Richardson & Sheila Colla. Princeton University Press. This book shows the color patterns of each species and gives its size.

In addition to a map and a detailed species description, the section labeled "Occurrence" is valuable. Here you will find a description of its habitat and also its status – abundant or threatened. You will also find if the species prefers underground or aboveground nests. That information can help you provide shelter for their nests – and possibly prevent you from being stung if you disturb a nest in a corner of your land. Perhaps the most valuable part of this section is the one labeled "Example Food Plants." Here you will find the flowering plants that particular species likes to visit. You will see those are also honey bee plants! And they are also plants for other pollinators! Make use of the flowering plants named with each bumble bee since they would be ones that would grow well in the area inhabited by the particular species.

It is nice to have some cucumbers and a sweet delicious watermelon to eat on a Summer day. These two, along with other melons, squash and pumpkins belong to the Family Cucurbitacea and require pollination. In this group the plants have separate male and female flowers on the same plant so it is essential that the pollen is transferred from the male to the female. Honey bees and bumble bees do visit the flowers and do pollination. However the most important pollinator is the squash bee. Two genera carry out the pollination, *Peponapis* (the most common one) and *Xenoglossa*.

You could have seen *Peponapis* and thought it was one of your honey bees since they appear similar in color and size but this squash bee has lots of hair and no pollen basket. Mating takes place in the flower. Furthermore since the flowers open early, honey bees are not awake and foraging yet. The flower is closed by noon with the sleeping squash bees inside. They will be released when the flower wilts. If you are careful you can gently open a closed blossom to see if any squash bees are inside. They will not sting. They are solitary bees and make their nest in the ground, frequently under the plants they just pollinated. Tilling the soil after harvest could ruin the nest with the prepupae inside. Look for holes about the size of a pencil in the ground near where the plant grew. Each hole would indicate a nest.

If you planted some sweet corn you will have honey bees visiting the plants when the tassels appear. Our bees do appreciate corn pollen even though the plant does not need their help. Corn is in the same family, Family Poaceae, as other grasses, including the grasses in your lawn or pasture. Wind takes care of the pollination of grasses. Since our bees collect and use the pollen we can consider corn as a double-duty plant.

We do eat a number of other vegetables that do not need pollination to produce the edible part. On the other hand, commercial growers of these vegetables for the seeds that you plant in your garden do need pollinators. Carrots, beets and lettuce are just a few of those. However honey bees really do enjoy collecting pollen and possibly nectar from broccoli, one of the brassicas. All you need to do is just leave one plant, perhaps at the end of a row, that is allowed to bloom. We normally cut those flower buds and eat them before the flowers actually open. You will have a group of small yellow flowers eagerly visited by your honey bees. You are really providing forage for them but you will not be eating the blooming broccoli.

Various fruits and berries need pollination. Some of then need a large garden area but some have been bred as dwarf for small spaces and others are suitable for containers. Some, such as apples and pears and even peaches can be espaliered on a wall or fence in small spaces. A crabapple tree that you planted as a pollinator for an apple tree you have is definitely a double-duty plant. Crabapples make delicious jelly and relishes as well as other foods. Honey bees do not find pear blossoms very interesting. The sugar content is low but other bees will help with pollination. Osmia bees, small solitary bees, are common visitors to apple and blueberry. The blueberries are another of those plants with "upsidedown" blossoms and benefit also from bumble bee buzz pollination. Sweet cherries must have bee pollination but the sour cherry trees really do not need insect help.

To have beautiful, well-shaped (and totally delicious) strawberries, pollination is essential. Fortunately strawberries can be grown in beds or in a wide variety of raised beds and containers. Citrus fruits, plums, currants and gooseberries all benefit from pollinators. Honey bees and bumble bees will be hard at work to provide large, well-shaped fruit and berries. Throughout the growing season you may have noticed some of the small pollen bees visiting vegetable, fruit and flower gardens. Identification of these tiny bees can be difficult. However if you wish to use an identification key for these, open up **www.discoverlife.org** and click on the bee to open that section of the key.

Many gardeners also plant herbs to accompany the various vegetables and fruits from their gardens. Some herbs are annuals and some are perennials. Although gardeners, and cooks, may pluck some leaves to use, those plants allowed to bloom will be eagerly visited by bees. The gardeners who wish to harvest dill seeds will want blossoms even if they are not a rich source of pollen and nectar. Lavender is eagerly visited by bees and the dried flowers can be used in many ways. If you have a cat, you need to grow some catnip. Although you may be cutting stems with leaves for drying, allow some plants to bloom since the blossoms are rich in nectar for our bees – making catnip definitely a double-duty plant.

Can we consider plants that just bloom but do not produce food for us as double-duty plants? Yes, I think so. We appreciate the colors, the shapes, the aromas of such plants. They cheer us up.

Life would be a little dull without them. BC

Ann Harman is getting ready for her garden in Flint Hill, Virginia.

A Closer Look

PHEROMONE REGULATION

Clarence **Collison**

Primer pheromones affect the physiological state of the individual resulting in longterm changes in behavior which may take days to manifest, that are likely produced by restructuring neural networks in the brain, potentially by modifying gene expression.

Pheromones are defined as chemicals that are released by one individual of a species that alter behavior or physiology of another individual of the same species. Honey bee pheromones are classified as releasers or primers. Releaser pheromones stimulate a rapid response within seconds or minutes that are short lived, a behavioral response mediated by the nervous system (Pankiw 2004a). Primer pheromones affect the physiological state of the individual resulting in long-term changes in behavior which may take days to manifest, that are likely produced by restructuring neural networks in the brain, potentially by modifying gene expression (Grozinger and Robinson 2007). Depending on adult worker response state and social context, primer pheromones may change reproductive, endocrine, and neuro-sensory systems and associated behaviors. Primer pheromones are relatively nonvolatile, acting within a short-volatile space and primarily moving through the colony by inter-individual contact (Pankiw 2004a).

The best-known and characterized releaser responses to honey bee pheromones are stinging (alarm pheromone) and orientation behaviors (Nasonov pheromone). Pheromone regulated defensive behavior is a classical mass-action response to a releaser pheromone demonstrating individual and colony level decision-making (Pankiw 2004a).

Queen mandibular pheromone (QMP) elicits multiple distinct behavioral and physiological responses in worker bees, as both a releaser and primer pheromone, and thus produces responses on vastly different time scales. Grozinger et al. (2007) demonstrated that releaser and primer responses to QMP can be uncoupled. First, treatment with the juvenile hormone analog methoprene leaves a releaser response (attraction to QMP) intact, but modulates QMP's primer effects on sucrose responsiveness. Secondly, two components of QMP (9-ODA and 9-HDA) do not elicit a releaser response (attraction) but are as effective as QMP at modulating a primer response, down regulation of foraging-related brain gene expression. These results suggest that different responses to a single pheromone may be produced via distinct pathways.

Queen pheromones elicit a combination of releaser and primer effects. Retinue response of workers to the queen is a releaser effect of queen pheromones from the mandibular and tergal glands (Pankiw 2004a). Queen mandibular pheromone (QMP), as a primer pheromone inhibits worker behavioral maturation (Pankiw et al. 1998), increases worker fat stores (Fischer and Grozinger 2008), and alters worker brain gene expression (Grozinger et al. 2003). It also increases foraging activity (Higo et al. 1992), attracts workers to a swarm (Winston et al. 1989), and inhibits rearing of new queens (Pettis et al. 1995). Lastly, QMP inhibits worker ovary development (Hoover et al. 2003), as well as the associated production of queen-like esters in the Dufour's gland of workers (Katzay-Gozansky et al. 2006).

Grozinger et al. (2003) demonstrated that queen mandibular pheromone (QMP) causes changes in expression levels of many genes in the brain of adult honey bees, and that these changes correlate with some of the downstream behavioral effects of the pheromone. QMP effects on gene expression were detected both in a controlled laboratory environment and in bee colonies in the field, which represent a more natural environment. QMP causes transient changes in expression of several hundred genes, but causes chronic changes in only a small subset of genes in the brain. The effects of QMP on brain gene expression changed over time.

To evaluate the hypothesis (that pheromone regulated changes in gene expression are correlated with pheromone-induced changes in behavior), Grozinger et al. (2003) focused on one function of QMP: delaying the

transition from working in the hive (e.g., brood care or "nursing") to foraging. They compared the list of QMP regulated genes with the lists of genes differentially regulated in nurse and forager brains generated in a separate study. QMP consistently activated "nursing genes" and repressed "foraging genes," suggesting that QMP may delay behavioral maturation by regulating genes in the brain that produce these behavioral states. The fact that many QMP-regulated genes were not found to be associated with nursing or foraging behavior may reflect the fact that QMP also is involved in the regulation of several other behavioral and physiological processes besides age-related division of labor, such as inhibiting ovary development in workers and the rearing of new queens.

The influence of the queen and her pheromonal signal on comb construction has also been examined. Ledoux et al. (2001) tested four treatments with newly hived packages of bees containing: 1) a mated queen, 2) a virgin queen, 3) no queen but with a dispenser containing synthetic queen mandibular pheromone (QMP), and 4) no queen and no pheromone. After 10 days, the comb produced by each colony was removed, comb measurements made, bees from the comb-building area collected, the size of the scales on the wax mirrors of the collected bees ranked on a scale of 0-4 and the queens removed and analyzed for QMP components. Queenless workers built substantially less comb and the comb they did build had significantly larger, drone-sized cells than for the other three treatments, indicating that both cell size and the quantity of comb built are mediated through the queen, particularly QMP. The observations of wax scale size suggested that QMP influenced comb building behavior rather than wax scale production. These results support the idea that queenless honey bees can adopt a strategy of constructing drone-sized cells in order to increase reproductive fitness through male production following queen loss.

Honey bees are social insects and one of the characteristics of eusociality is cooperative brood care. Brood rearing labor is divided between individuals working in the nest tending the queen and larvae, and foragers collecting food outside the nest. To understand brood rearing division of labor, Sagili and Pankiw (2009) investigated the relationships between individuals in the nest engaged in brood care and colony growth.

Wax scale size is influenced by QMP

Brood pheromone influences egg laying by the queen.

They examined responses of the queen, queen-worker interactions, and nursing behaviors to an increase in the brood rearing stimulus environment using brood pheromone. Colony pairs were derived from a single source and were headed by open-mated sister queens, for a total of four colony pairs. One colony of a pair was treated with 336 µg of brood pheromone, and the other a blank control. Queens in the brood pheromone treated colonies laid significantly more eggs, were fed longer, and were less idle compared to controls. Workers spent significantly more time cleaning cells in pheromone treatments. Increasing the brood rearing stimulus environment with the addition of brood pheromone significantly increased the tempo of brood rearing behaviors by bees working in the nest resulting in a significantly greater amount of brood reared.

Alaux et al. (2009) studied the effects of brood pheromone on brain gene expression. Brood pheromone (BP) caused changes in the expression of hundreds of genes in the bee brain in a manner consistent with its known effects on behavioral maturation. Brood pheromone exposure in young bees causes a delay in the transition from working in the hive to foraging, and they found that BP treatment tended to upregulate genes in the brain that are upregulated in bees specialized on brood care but downregulate genes that are upregulated in foragers. However, the effects of BP were age dependent; this pattern was reversed when older bees were tested, consistent with the stimulation of foraging by BP in older bees already competent to forage. These results support the idea that one way that pheromones influence behavior is by orchestrating large-scale changes in brain gene expression.

In contrast to primer pheromones, it is not known whether the quicker-acting releaser pheromones can also affect brain gene expression. Alaux and Robinson (2007) found that isopentyl acetate (IPA), a releaser pheromone associated with the stinger, that communicates alarm, not only provokes a quick defensive response but also influences behavior for a longer period of time and affects brain gene expression. Exposure to IPA affected behavioral responsiveness to subsequent exposures to IPA and induced the expression of the immediate early gene and transcription factor *c-Jun* in the antennal lobes. Their findings blur the long-standing distinction between primer and releaser pheromone and highlight the pervasiveness of environmental regulation of brain gene expression.

Retinue response is a releaser effect.

Queen mandibular pheromone and e-beta-ocimene (eß), emitted by young worker larvae, have both releaser and primer effects. Both QMP and eß have been shown to affect worker physiology and behavior, but it has not yet been determined if these two key pheromones have interactive effects on hypopharyngeal gland (HPG) development and ovary activation, components of worker reproductive physiology. Experimental results demonstrate that both QMP and eß significantly suppress ovary activation compared to controls but that the larval pheromone is more effective than QMP. The underlying reproductive anatomy (total ovarioles) of workers influenced HPG development and ovary activation, so that worker bees with more ovarioles were less responsive to suppression of ovary activation by QMP. These bees were more likely to develop their HPG and have activated ovaries in the presence of eß (Traynor et al. 2014).

Pankiw (2004b) demonstrated how substances extracted from the surface of foraging and young pre-foraging worker bees regulated age at onset of foraging, a developmental process. Hexane-extractable compounds washed from foraging workers increased foraging age compared with controls, whereas extracts of young pre-foraging workers decreased foraging age. This represents the first known direct demonstration of primer pheromone activity derived from adult worker bees.

Leoncini et al. (2004) reported on the identification of a substance produced by adult forager honey bees, ethyl oleate, that acts as a chemical inhibitory factor to delay age at onset of foraging. Ethyl oleate is present in highest concentrations in the bee's crop. These results suggest that worker behavioral maturation is modulated via trophallaxis, a form of food exchange that also serves as a prominent communication channel in insect societies. Their findings provide critical validation for a model of self-organization explaining how bees are able to respond to fragmentary information with actions that are appropriate to the state of the whole colony.

Le Conte et al. (2001) reported that the blend of 10 fatty-acid esters found on the cuticles of honey bee larvae (brood pheromone), are already known to be a kairomone (a pheromone emitted by an organism which mediates interactions that benefit an individual of another species that receives it, i.e. *Varroa* mite), a releaser pheromone and a primer pheromone, also act as a primer pheromone in the regulation of division of labor among adult workers. Bees in colonies receiving brood pheromone initiated foraging at significantly older ages than did bees in control colonies in five out of five trials. Laboratory and additional field tests also showed that exposure to brood pheromone significantly depressed blood titers of juvenile hormone. Brood pheromone exerted more consistent effects on age at first foraging than on juvenile hormone. These results bring the number of social factors known to influence honey bee division of labor to three: worker-worker interactions, queen mandibular pheromone and brood pheromone. BC

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Clarence Collison is an Emeritus Professor of Entomology and Department Head Emeritus of Entomology and Plant Pathology at Mississippi State University, Mississippi State, MS.

Bee Culture

Magazine Of American Beekeeping

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Mike Palmer – Mike specializes in the Sustainable Apiary using production colonies, nucleus colonies and mating nucs. That strategy gives him enough bees to produce Vermont's prime comb honey and sell queens and nucs to others in the area. He isn't one of the largest but he is one of the best. Learn the how's of this northern, non-migratory beekeepers success story.

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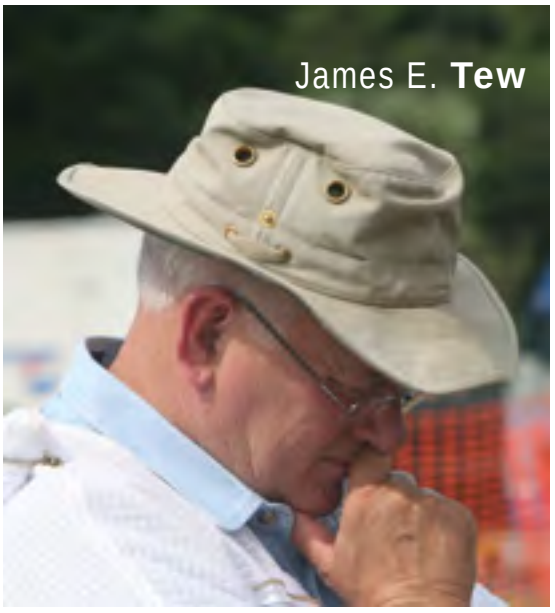
John Miller - John owns Miller Honey Farms which is based in Blackfoot ID but also has locations in Gackle, ND and Newcastle, CA. Like many commercial beekeepers, John trucks his bees to several states for pollination but what John does differently from most is he winters his bees in advanced wintering buildings in North Dakota; something which is virtually unheard of in the commercial beekeeping industry. Come listen to how he makes it all come together into a successful operation.

Ray Olivarez – Carefully chosen locations in Northern California, Montana and Hawaii's Big Island allow Olivarez Honey Bees to offer customers premium-quality queens and bees year-round. OHB is surely one of the largest package and queen providers in the US with specialty climate controlled trailers that allow them to truck packages across the country. In addition to selling queens and packages, Ray's team also provides almond pollination and produces honey. To top it all off they offer a retail store to die for and host a large "Hobby Day" every spring. Sure to be a fascinating 4 hours hearing just how they do it the OHB way.

Beeyard Thoughts, Observations, and Updates



The angst of making package bee decisions.
Guessing and fretting.

Guessing about buying packages

Guessing at upcoming package needs is primarily an issue for established beekeepers who are trying to maintain colony numbers or even grow their colony numbers. For some of you, the planning and guessing began as long ago as last November, but I put off making my package decision until mid-February, 2018. At some point most of us must guess about how many packages we will need for the upcoming Spring. Estimate might be a better word to use here. The Winter of 2018 in Ohio was truly cold. In fact, it was truly cold in many states – even southern states.

Bees can withstand cold if given food and shelter, but as we all know, our bee stock has not been healthy for the past decade or so. Our Winter losses have soared. We must guess – often with limited information – at how many more will die before Spring. Packages and queens are expensive. We need to guess right.

Once the packages arrive, then we must begin to guess about the weather and installation procedure. It seems to never end.

"Google" it

Go ahead, Google *"Package Bee Installation"* and you will get a crazy number of hits. One of the many segments that I randomly reviewed reported that one could learn to install a package by watching a two minute video. Across the internet, beekeepers are bouncing and shaking 3# packages into awaiting equipment. How difficult could it be? If you spend two-three minutes per hit, there are enough videos and instructions to keep one reading for a short four years. In general, releasing the bees is a simple process, but there are a couple of variations.

The Traditional Five-Step Process

In general, installing package bees is about a five step process. (1) Remove the outer lid and feeder can, (2) Remove the queen cage and check her out, (3) remove the cork from the candy plug end and insert – end-up – between frames in the colony, (4) Bounce and shake bees on the queen cage. (5) Place the empty cage in front of the hive and close things up. Yes, I know there are all kinds of variations on this general procedure but this is the typical way. Then return in a few days (seven days or longer?) to be sure the queen is out and – ideally – laying eggs. Have some kind of feeder on the colony, keep it full, and then just watch the bee colony develop.

The slow release procedure

Releasing packages slowly requires more time and equipment, but this procedure is not so dramatic. On top of the empty frames, place an empty deep – no frames. Open the package, remove the caged queen, and lay the cage on top of the empty frames. Place the open package near the caged queen and close the colony. The bees exit much more slowly and without all the random flying. As with the traditional release method discussed earlier, there are variations on the slow release method, too. Even so, with either technique, there can be hurdles. It makes package handling a bit exciting or possibly worrisome.[1]

When all goes well, either technique is an easy process that probably could be learned from a two minute video, but long-term memories are made when things go in directions that are not typical or traditional. Please know that I am not complaining about these variations,

Shaking bees from a package.

[1]I made a short movie of the first time I used this slow release method. It is posted at: **https://vimeo.com/256084852**

but writing about the stress that comes from having to deal with aberrant package-bee situations.

The Weather

In package bee issues, the weather is nearly always involved. Too hot, too cold, too rainy, too anything. When it comes to weather issues, beekeepers are difficult to please. In a radio interview in the Spring of 2016, a beekeeper complained that the mild Winter would result is high colony mortality due to starvation. I was struck by the oddity that the guy was complaining about mild weather. Would a harsh Winter have been better for our bees? As a group, we appear *unpleasable* when it comes to weather issues. We need our bee weather to be *"jusssst right."*

Rain

I specifically remember the Spring of 2012, where rain was the culprit. It was raining when the packages came into Ohio resulting in a battlefield appearance at the pick-up site. I put the bee packages in a quiet, darkened, cool, room and waited for the rain to stop. It didn't. Several days passed. The steady hum of the living packages and the ever rising number of dead/dying bees on the cage bottom caused me high levels of package anxiety. Yet releasing bees into the rainy weather would result in all flying bees being drowned. When do things tilt? When does it become dire enough to release bees in rain rather than hold them in the cages another day? It is not an easy call to make.

I used a slow-release method, in which the bees are not shaken, but rather the cage – full of bees – was in put inside a hive box shell. The technique worked reasonably well. Actually, I have begun to use the slow method nearly all the time – unless there is a pressing reason to use the fast release method.

Wind

The 2015 Spring, the issue was wind. I'm not talking about gentle Spring breezes that blow bees off course, but a high-wind advisory with gusts strong enough to blow bees to the next county. I used the same technique for releasing bee packages into high wind situations that I used to release during excessive rainy situations. Again, it worked as well as could be expected.

Why did I not just wait until the weather improved? Because the high wind weather front was bringing a cold wave of air behind it. To have waited until the high passed would have meant that I would have to install the bees during weather that was in the 40sF.

Arrangement of package components for a slow-release technique.

Good points/bad points

There were only a few bees that got caught in the gusty wind and they seemed able to deal with it. Otherwise, over time, the bees came out and accumulated on the caged queen and onto the drawn comb that I had provided. While that is a ***big*** good point, I must admit that it was about the only good point to this procedure.

In a few packages, the bees came out and clustered beneath the package lid where they immediately began to build small comb pieces. In other instances, they clustered in various other places other than the comb on which I wanted them. As the bees took flight from various package colonies, apparently, they drifted around to other colonies. Consequently, some clusters were clearly larger than others. I equalized these new colonies during the early Summer.

This procedure required extra hive equipment and the displacement of a single frame. I hung it in the upper shell just to give it a temporary home until I could put it in the hive. The extra equipment required may not sound like much of a problem until I remind you that I had to buy and assemble all this equipment. Cost, labor, and time was involved – my cost, labor and time. There is a noticeable difference in hauling ten deeps and hauling 20 deeps when you are the hauler.

Package Queens

Several years ago, I stopped puncturing the candy plug when positioning the queen cage. Why? My reasons are not crystal clear but are primarily one of replacement queen availability and costs. Many years ago, extra queens were available for replacing dead or lost queens. On some occasions, they were even free. Those days are gone. Presently, queens are difficult to get in short order. If a package goes queenless, that package will probably have to be combined with another colony. So over time, I began to feel more comfortable having more of a part in the actual queen release process. After six-seven days, I either

Notice the bees with abdomens curled down. They are trying to sting the enclosed queen. Other bees are viciously clinging to the cage. The enclosed queens will be killed if they are released at this point.

remove the cork end that allows the queen to immediate escape, or I peel the screen back and release the queen on the combs. If anything does not look right – anything at all – she goes back in the cage for a few days.[2]

Problems or challenges? Occasionally a queen is silly and flies away. That event is always good for a *Bee Culture* article. If I only open the non-candy cork end of the cage and lay it on the top bars, worker bees crowd into the cage preventing the queen from immediately emerging. I really don't know how long it takes for her to leave the cage, but I know she was kept in the cage a couple of days longer than if I had punctured the candy plug.

In the past few years, package queens have gotten a bad rap. Maybe they deserve it. In fact, in quiet circles of beekeepers, I have heard it said that present-day package queens are merely placeholders to get the colony established. Soon thereafter, a queen of better quality should be installed. Hmmmm. Let me think about that one. I will admit that some package queens are better than others – even a lot better - but I am not sure I want to spend even more money on that package until it has survived the first Winter.

Feeding the Package Colony

At this very moment, my biggest concern is feeding these small, immature package colonies. I know, I know, use top feeders or whatever. I do have a few of these, and I have a few division-board feeders. These small colonies ***might*** be able to learn to use these feeders and to make trips up to the them, but the bees need to quickly learn how to use these devices.

These are very small colonies with essentially no food existing in marginal weather. These colonies should be fed. How? Several years ago, I wrote about using fondant as a fast food supply for needy colonies. It requires no real equipment modification and no mixing, but it does require availability and money for purchasing. I also learned that it does not keep well after opening. Oh, the bees like the harden stuff well enough, but it is like feeding them hardened cement pieces. While I have not taken this technique out of contention, it is not presently high on my list.

Dry sugar on the inner cover is interesting and fast, but inefficient – plus the bees need to get to water to deal with the dry sugar. Okay, this is where I am. I have preliminarily tested a procedure that has been in the beekeeping literature for many years, but one that I had not recently tried – zip-lock plastic bags. I just could not believe that these bags would not leak everywhere, but they didn't. Normally, gallon bags are used, but since the colonies are so small, I have been using sandwich bags. They are sticky to fill, but that stickiness lets the bees know something good is within. The bags are filled with syrup, laid on the top bars and slit with a cut or two. Oddly, unless pressed, they do not leak.

The other oddity I plan to try this Spring is to put these bags on at night so the bees won't fly, and I will not have use smoke. So I will need empty equipment, granulated sugar, sandwich bags, and a scraper razor – all of which I have. I am doing all of this due to a reversal of weather fortunes including accumulations of snow and no chance at foraging. There is a very real chance that this supplemental food is all the bees will have to live on until the goofy weather passes.

Packages vs. swarms

Packages elicit feelings *somewhat* like that of hiving a swarm. There is excitement. There are new bees flying and pooping. There is bee energy in the air. Yep, packages are exciting, but swarms are ***free***! When we buy packages, as best we can, we are buying a swarm. The procedures feel kinda the same, but at the same time, they feel kinda different. Either way, it's just another aspect of honey bee husbandry. Good luck this season. BC

[2]I am struggling with this point of queen release recommendations. We are leaving queens in longer and longer. Possibly, we should consider different queen introduction techniques that free her more quickly. But that discussion must come later.

Dr. James E. Tew, State Specialist, Beekeeping, Alabama Cooperative Extension System, **Tewbee2@gmail.com**

Joseph **Cazier**

Peering Into The Future

The Genius hive will be able to

Introduction

Many of the changes we are witnessing in the world today are driven by advances in technology. These technological changes are also coming to the beekeeping world. If you look at the changes that have already taken place and the seeds of what has started them, it is possible to make a good prediction of what is likely to happen in the future and how it will affect the beekeeping community and industry.

My colleagues James Wilkes, Ed Hassler and I made such a prediction this summer during a webinar on the Kim and Jim show jointly sponsored by *Project Apis m* and *Bee Culture Magazine* (Smarter Hives, Healther Bees, June 23, 2017 @ **http://www.beeculture.com/kimandjimshow/**). In that webinar, and at a few presentation since, we outlined the path we are on to what we are calling a Genius Hive. This article summarizes and extends some of the key points we made during those presentations and adds context for today's thoughtful beekeeper.

The Smart Hive

One of the most talked about new technologies in beekeeping is a smart hive. For us, *a smart hive is a hive that can tell you about itself.* That is, it can send information, often digitally, about what is going on in the hive. Typically, this type of information includes:

- Hive Weight
- Temperature
- Humidity
- Sounds
- Images

Companies like *Arnia*, *Solution Bee*, and *Broodminder*, as well as others, are making good progress at building a smart hive that can record and transmit this type of data. This is a significant and necessary step in the right direction and we cheer for their success. My friend, Frank Linton, tracks the progress on the development and use of these sensors on his informative website, **colonymonitoring.com**

While these actions are very important, this article is not about the smart hive; rather it is about how the smart hive is a progressive step towards building a genius hive. Since more people are familiar with the concept of the smart hive, the rest of this article will focus on how the smart hive can lead us to the genius hive.

The Genius Hive

A genius hive would be able to do everything that a smart hive does; however, it would go a step farther. Rather than just transmitting data about the current state of the hive, the *genius hive would be able to tell you what the hive needs to perform better than it does today.* It would take all of the data collected from a smart hive, combine it with knowledge of best management practices and data from thousands of other hives, and use machine learning and artificial intelligence techniques to optimize colony health, production, and pollination performance.

Here are a few things a genius hive would be able to do:

- Monitor the hive for signs of trouble and send alerts before trouble hits
- Monitor regional and national trends in real time and adjust for how those trends might affect your bees
- Suggest ways to improve your production, pollination, or bee health
- Prescribe the best management practices customized for a particular hive in a particular place at a particular time
- Preemptively suggest treatments before trouble manifests, or when you can forgo a specific action
- Identify the treatments most likely to succeed given your hive characteristics, current environmental conditions, and history

I think most of us would agree that having a genius hive could be beneficial to our beekeeping decision making process. The question is, how do we go from where we are today to where we could be in the future with a genius hive?

The Path to a Genius Hive

The first thing to understand about a genius hive is that it cannot be built in isolation. *No single hive or beekeeping operation will ever have enough data, on its own, to build a competent genius hive.* The genius hive can only be built as part of an *Intelligent Apiary Management System.* This is a collection of hardware, software, knowledge, and years of standardized data that has been mined for best management practices, which can then be applied to each unique type of condition a given hive may face.

In the next sections, I will outline, in four steps, how we can put all these pieces together to build a genius hive.

Step One – Develop and Adopt a Universal Data Standard

To have a genius hive, we need the assistance of machine learning and analytics. The application of these techniques are only viable when there is access to very large data sets of sufficient volume and quality; crunching the numbers of these large data sets enables us to then trust the results. To accomplish this, it will take **all** of the data from **all** of us.

However, most of us keep very poor records of our beekeeping operations. In fact, in a survey we conducted

A Path To The Genius Hive

tell you what it needs to do better.

with the help of *Bee Culture*, 74% of 693 respondents admitted to not using any type of inspection form to record their observations when they inspected their hives. Even for those who kept records, the data would still need to be transcribed digitally, shared, and converted to a standard format that could be combined with data from other beekeepers in other micro-climates with different genetic stock and conditions to take advantage of the true power of machine learning.

Yet progress is being made in the development of a data standard. For example, Dick Rogers, manger of bee health research at the *Bayer Bee Care Center,* has developed and released the *Healthy Colony Checklist* (**https://beehealth.bayer.us/who-can-help/beekeepers/healthy-colony-checklist**) as a comprehensive and standardized way to record data from hive inspections. In a future article, I plan to share more information about how we are testing, refining, and validating this framework as a candidate for a data standard for human observational (inspection) data. In the meantime, we have adapted a portion of our software at **hivetracks.com** to allow beekeepers to record data using this standard framework so we can further test and refine its usefulness and applicability as a part of a bigger data standard.

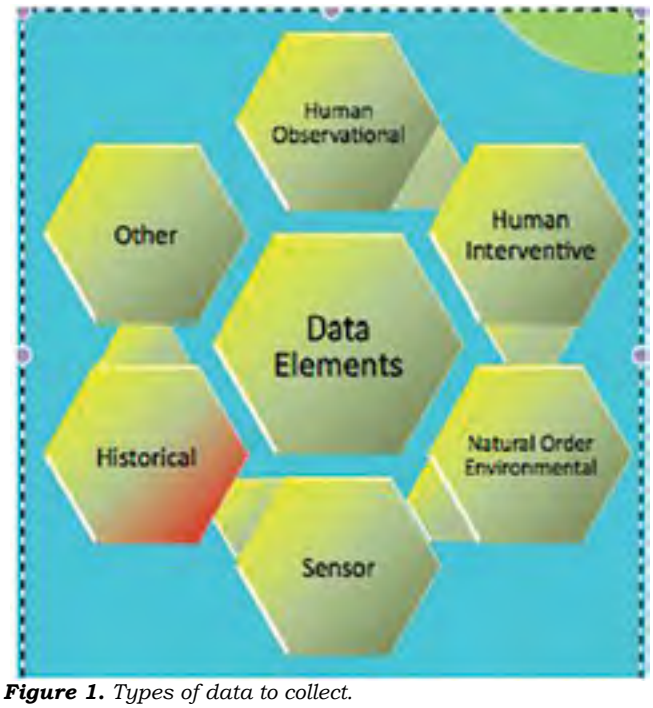


Figure 1. *Types of data to collect.*

Another visionary working in this area is Walter Haefeker, President of the *European Professional Beekeeping Association* and thought leader behind the concept of BeeXML, which is a way to share data between and among beekeepers worldwide. Walter was the key driver in the formation of an Apimondia working group called "Standardization of data on bees and beekeeping," of which I am honored to be a member. The goal of this working group is to engage beekeepers, vendors, and researchers to develop an international standard for the collection, transmission, and storage of data related to bees and beekeeping. This will enable us to collect the type of data at the scale necessary that we need to build a genius hive.

Step Two – Identify and Validate Best Management Practices

The next step is to identify and validate best management practices. There is a fair amount of work being done in this area with the data and tools we have now. Much more will be possible when we have access to large quantities of high quality data. In addition to some of the work you may have heard about from leaders in this area, such as the *Bee Informed Partnership* (BIP), *Project Apis m.*, the *Pollinator Stewardship Council*, I want to share a little about our efforts to date.

One of the projects I am most excited about is being conducted by my colleague Ed Hassler. Dr. Hassler is using his background in artificial intelligence programming techniques to build an intelligent agent that is reading *tens of thousands* of peer-reviewed journal articles and pulling out relevant nuggets of knowledge pertinent to beekeepers. Having this type of knowledge accessible to beekeepers around the world would be a great resource as we try to customize and optimize management for each individual hive. This research into *Evidence-Based Apiculture* would be a great leap forward in the development of a genius hive as it could encode a hundred years of high quality research into its decision and recommendation engines (see Fig. 2).

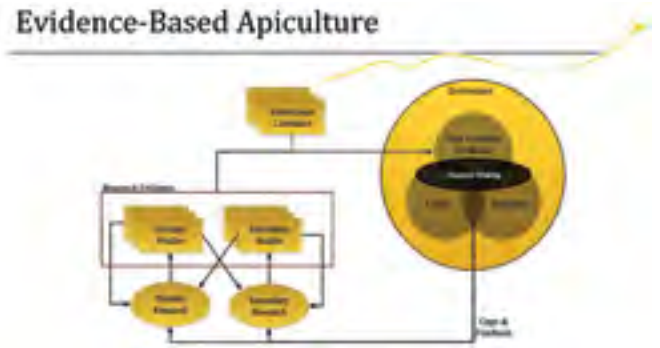


Figure 2. *Evidence Based Apiculture Concept Model*

Step Three – Integrate Data Collection, Machine Learning, and Best Management Practices into an Intelligent Apiary Management System

The third step is putting all of the pieces together. Many of the parts are currently emerging, if somewhat in their embryonic state. We are collecting a fair amount of data through our **hivetracks.com** platform (see Fig. 3), which can be anonymized and used to build a better system to move beyond recording what happened in the past: it could guide beekeepers on what they can do now and in the future to enhance hive management.

We are continually learning about best practices in management, and the nuances of when one approach is better for a particular hive over another. As more people begin to keep hive records electronically in a standardized format, and share some of their data with the bee community, we will be able to put all the pieces together to build and grow a genius hive.

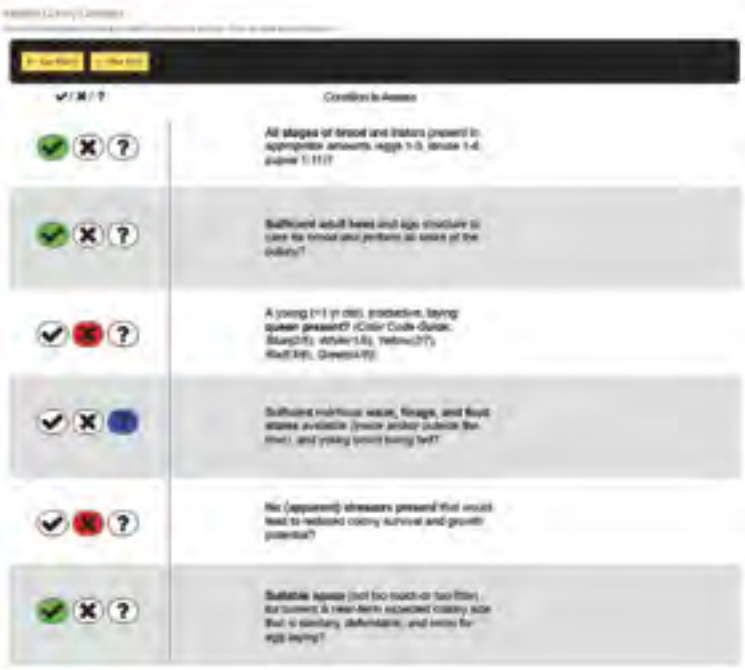


Figure 3. *The Healthy Colony Checklist at* ***hivetracks.com****.*

The author, left with James Wilkes from Hive Tracks.

Step Four - Continually use and improve the system with additional data, insights and technology

The growth and development of the genius hive will never stop, and its performance will continue to improve year after year as more data is collected. We aim to share the insights learned from our efforts with the broader beekeeping community. Even more, we are hoping to partner with others who care about bees and have a piece of the puzzle to work together to build this *Intelligent Apiary Management System.* Beekeepers (both hobbyist and commercial), researchers, and vendors all have a role to play.

Closing Thoughts

Benjamin Franklin said, "An investment in knowledge pays the best interest." If we accept this axiom, it follows that investing the time and resources to truly know your bees (HiveTracks Motto) will ultimately give us the knowledge we need to build a genius hive and improve the health and vitality of bees everywhere. Abraham Lincoln and Peter Drucker are both credited with saying, "The best way to predict the future is to create it." Our goal is to create a future where the genius hive helps beekeepers everywhere to not only know their bees, but to know what the bees need to be the best they can be.

I hope to be able to write regular updates to this article, sharing our progress and the progress of others in this area in multiple venues. We hope you will follow this effort and join us in making the best future we can for ourselves and beekeepers everywhere. We welcome all to participate by sharing data, contributing knowledge and insight, and/or working to understand and apply what we are learning from the data we collect.

Finally, special thanks to *Project Apis m.* for supporting a portion of this work with a Healthy Hive 2020 grant. These efforts would not have been possible without visionary groups like this one providing support and resources. BC

Special thanks to my friends and colleagues James Wilkes, Ed Hassler, Dick Rogers and Brandy Hadley for our insightful conversations on this topic.

Joseph Cazier is the Chief Analytics Officer for ***HiveTracks.com*** *and the Director of the Center for Analytics Research and Education at Appalachian State University. You can reach him at* ***joseph@hivetracks.com***

Harvesting Honey

An Overview

David **MacFawn**

Harvesting and extracting your honey crop in the Southeast region can occur as early as April or May. In South Carolina May could be the earliest extraction depending on the seasonal nectar flows. Prior to harvest and extracting, the beekeeper has nursed the bees from Autumn through the Winter into the spring with a large enough bee population to make a honey crop. Equipment has been assembled and prepared for the Spring nectar flow. Also, *Varroa* mite management performed last Autumn through late Winter and early Spring swarm management helped to achieve large populations of healthy bees.

How do you tell when the honey is ripe and ready to harvest? The traditional way is when about 7/8 of the frame cells are capped (about 90%). Using this guide, usually it is 18.6% or less moisture to prevent the honey from spoiling by fermentation. The 18.6% figure is the USDA guideline for which most honeys will not spoil. A more modern and accurate way is the use of a refractometer to test the honey's moisture content. The acceptable figure is again 18.6%.

The honey crop may be removed by brushing the frames, fume board, bee blower, and escape board. If you only have a super or two to remove, removing the individual frames from the super with bees attached, brushing the bees off the frame, and placing the frame without bees into a covered empty super with a lid such as an inner cover works well. The original super with bees can remain on the hive with the bees. Additional frames can be replaced into the super on the hive or the original super can be removed if the nectar flow is almost over.

Another method is the use of a fume board. A fume board is a cover with an absorbent material on the top's inside surface for the placement of a bee repellent such as Bee Go or Fisher's Bee Quick. The repellent's label should be followed for quantity and temperature requirements. The bees are smoked very little, just enough to get them starting down into the colony, then the fume board placed on top. If you smoke the full super too much, the honey will taste of smoke (antidotal experience). Often a super with empty frames is placed under the super you are removing, also known as bottom supering, to allow space for the bees being removed. The fume board should not be left on too long, just long enough to push down the majority of bees. You will then remove the full honey super, cover, and place it in your truck.

Ever consider A bee blower? A bee blower is essentially a leaf blower where you place the full honey super on a stand on the ground with frames vertical and blow forced air through the full super with the bees exiting the super's bottom. The full honey super should then be removed, covered, and placed in your truck. The bees removed via this method simply fly back to their hive.

Another way to remove bees from a full honey super is via an escape board. An escape board may be constructed by placing a porter bee escape in the inner cover's oval hole. The bees can go down through the bee escape but cannot return. Also offered for sale are triangular bee escape boards. The triangular bee escape board works well. The escape board is placed under the full honey super, and you wait a day for the bees to go down and they cannot get back up into the super. It should be noted if there is brood in the honey super, you will not normally be able to get the nurse bees out of the super. Escape boards work well but require two trips to the bee yard, first trip to place the escape board on the hive, and another trip to remove the full honey super.

The removed honey should be extracted within a day or two, with two days considered maximum, in the southeast to avoid Small Hive Beetle and wax moth issues. A low humidity (50%), temperature controlled, storage room for supers also helps with Small Hive Beetle control. To prevent honey standing too long awaiting extraction, only enough honey should be removed at a time that can be extracted in approximately a day.

Many tools are available to assist in uncapping honey. Essential tools are an uncapping knife, (either cold serrated or heated), an uncapping scratcher to uncap those cells that a knife cannot reach, and a hive tool to separate the supers and remove individual full honey frames. It should be noted having nine frames in a 10-frame super or seven frames in an eight-frame super will result in the bees pulling out the beeswax cells just past the top bar width allowing an uncapping knife to cleanly remove the cell caps. The cell caps are made of fresh beeswax and appear white in color unless tracked up with travel stains (foot traffic) by the bees. Uncapped frames can then be placed in an extractor or

You Can Remove Bees By Brushing, Fume Boards, Blowing or Escapes

Frame of honey at least 7/8 capped and ready for uncapping and extracting.

A fume board.

A triangular bee escape board, upside down.

uncapping tank. If a capping scratcher is used smaller beeswax particles will get into the honey that will need to be eventually removed to slow granulation and prevent cloudy honey. These smaller particles maybe removed by straining or allowing the honey to settle and skimming.

There are two common types of extractors. A tangential extractor extracts one side at a time and is placed tangential to the extractor's center. With a tangential extractor you need to be careful how quickly you spin the frame to prevent the frame's wax comb from blowing out. The frames have to be taken out and reversed to extract the other side. Honey bees consume about 8.4 lb. (3.8 kg) of honey to secrete 1 lb. (454 g) of wax,[1] so the comb should be reused whenever possible.

With a radial extractor, the full frames are placed radially in the extractor like spokes on a bicycle wheel. Both sides of the honey frame are extracted at the same time via centrifugal force. The cells slope slightly upwards, between nine and 14°, towards the open ends. A radial extractor is quicker and easier than a tangential extractor but usually more expensive.

When using an extractor, you can visually see the honey being slung as it collects on the extractor inner walls. When finished, the "wet" empty frames should be placed back on the original hives. This method prevents the spread of disease as well as allows the bees to clean up any residual honey. The wet empty supers should not be placed open in a beeyard when there is a dearth or when the nectar flow is over since the bees will typically tear the comb removing that last bit of honey, and ants, etc. can get into the supers. Wet supers should typically not be stored.

As the honey flows out of the extractor it pours through a sieve to remove beeswax and other unwanted particles on its way into a bucket. After the bucket is full, or extraction is complete, seal the bucket and allow the honey to sit several days to weeks. This will allow the air bubbles to rise to the top surface and debris settle to

Note the comb drawn past the top bar width with nine frames in a 10-frame super.

Inside a radial extractor with a brood frame inside for show.

A water jacket bottler. Note the elevated stand to allow easy bottling.

the bottom. The settled honey can then be poured into a bottling tank for dispensing into jars and other containers or if the bucket has a honey gate it can be bottled directly. (Tip: a piece of plastic wrap placed on top of the bubbles and foam will lift any foam and wax particles from the surface when removed.)

For the small hobbyist a 60-pound/five-gallon plastic bucket with a plastic honey gate is inexpensive and works well for bottling honey. A lid should be used to seal the honey and keep foreign particles and other objects from falling into the honey. A tight-fitting lid is also required to keep water and humidity from entering the honey. A pail perch eases the transfer of honey from a bucket without a honey gate to a bucket with a honey gate to allow all the honey to drain. For the larger operation, a stainless-steel bottling tank with a dripless honey gate works very well. Elevating the bottling tank above the jar height with the honey gate directly above the jar eases filling the jar.

Jars and other containers should be washed and sanitized prior to filling. Never reuse jars or containers. You have the choice between glass and plastic. Glass jars certainly show the honey better but plastic is optimum for squeeze bears. Also, glass is heaver to ship and handle than plastic but historically I have found the lids can pop off easier with plastic than glass.

When filling jars, the honey level should be filled just past the top ring of the jar. If filled too full, the honey will leak out the top when it gets warm. You want the correct amount of honey in the jar as defined on the label but not too much that will leak out when warm. The jars should be clean of honey on the outside prior to labeling.

Extracting and bottling your honey is exciting and fulfilling! Seeing that "liquid gold" flowing into your bottles is rewarding. Of upmost importance is cleanliness and sanitation in your extracting and bottling operation. The style, size, and other aspects of the containers you decide to use should be determined by your market and the customer base you will be serving. BC

[1]Graham, Joe. *The Hive and the Honey Bee*. Hamilton,IL, Dadant & Sons, 1992. ISBN.

Processing Honey

A Closer Look

Bob **Binnie**

The debate on what constitutes good food seems to be endless. Diets abound with notions that are as varied as the people expounding their virtues. This has put honey on some food hit lists being described as "just another sugar." Nothing could be further from the truth.

Along with its antibacterial and antifungal properties, honey has been shown in multiple scientific and medical studies to have numerous health benefits. Honey contains over 180 substances, some of which allow our bodies to use it very differently than other carbohydrates. It is not "just another sugar."

How good honey is for us, or whether it is any good at all, not only depends on how we use it, but also on how we process and store it.

This article will explore some of the chemistry of honey and how it can be affected by temperature, moisture, filtration and more. There are many pros and cons in honey processing, and knowledge of what we are dealing with can help us do a better job.

Temperature and Its Effect on Honey

For better or for worse, heat is often used in honey processing

Most operations handling more than a few buckets usually use heat in one form or another, even if it simply means warming honey to facilitate bottling. We should, however, be mindful that heat degrades honey and has an effect on many things including enzymes, color, flavor, and aroma.

Enzymes

Enzymes are important and all are affected by temperature. Merriam-Webster defines enzymes as complex proteins, produced by living cells, that catalyze or increase the rate of biochemical reactions. Simplistically put, enzymes can be thought of as energy. The presence of active enzymes is a part of what defines food that is alive and enzyme activity must be present in honey labeled "Raw."

Let's take a look at three notable enzymes in honey.

Invertase converts sucrose in nectar to glucose and fructose, which helps make nectar able to hold more solids thereby making it more stable.

Honey absorbs moisture in a high humidity environment.

Glucose Oxidase creates a chemical reaction which, among other things, lowers the pH of honey to an average of 3.9 and produces hydrogen peroxide. Both of these help stabilize nectar while ripening and contribute to the antibacterial properties of honey.

Diastase, as with all enzymes, is destroyed by heat, and because its activity is easily measured, it has been used by some importers and packers to tell how much heat honey has been exposed to.

The effects of heat on an enzyme are commonly measured by the time it takes to reduce half of the enzyme's activity or its "half-life" at a given temperature. For instance, the half-life of diastase in honey is 1,000 days at 68°F, 14 days at 122°F, and 30 seconds at 176°F. The other enzymes in honey are affected similarly. Enzyme activity stops when honey is held at freezing temperatures but returns when warmed back up. It does not return when destroyed by heat.

Two interesting side notes are that almost all the enzymes in honey are introduced by the bees, and all break down when liquefying crystallized honey in a microwave.

Flavor, Aroma and Color

Although the chemistry behind flavor and aroma is complex and not very well understood, they are a part of what defines high quality honey, and care should be taken not to cause unnecessary deterioration. One thing we know for sure is that they, along with color, are sensitive to high temperatures and deteriorate with time.

For instance, the color of honey is very slow to change when stored cold, but as it warms back up, the rate that honey darkens (and it will darken), will triple with every increase of 10°F. Flavor and aroma deteriorate in a similar fashion when temperatures rise. Something as simple as prolonged warming in a bottling tank, a hot warehouse, or even a hot spot in your kitchen will have a degrading effect on honey.

Flavor, aroma, and color are especially affected in honey that is heated while containing debris such as dead bees, old comb containing cocoons, hive trash, and much of the menagerie of things that can come out of an extractor.

Some go so far as to say that honey processed with any heat at all can no longer be called raw. We might be careful not to rush to judgement here, however. This could turn into a debate with Mother Nature considering the fact that the top tiers of a beehive, in full sun, on a hot summer day, can get quite warm. I submit that care and moderation are the key for those that want to produce a good, wholesome product.

National Geographic has recently reported that honey found in an ancient tomb in Egypt was still edible, but I'm not sure I would want to be the one to eat it. Just because it hasn't spoiled (fermented), and is still edible, doesn't mean it's still good food. Although not all honeys will deteriorate at the same rate, all eventually do. As with many foods, fresh is best and time is not your friend.

On another note, the internet has more than a few articles written by celebrated food experts stating that it is harmful to put honey in the refrigerator. This is not true. Cold honey degrades slower than warm honey and freezing temperatures are actually your best defense against deterioration.

Materials in Processing

Honey reacts with most metals

Because of its acidity, honey reacts with steel, iron, aluminum, galvanized metal, copper, tin, and more. Besides producing toxins, this can also affect taste and color. Although some are worse than others, steel and iron are considered especially bad for honey storage because they can rust and ruin honey. At least two exceptions to all this are silver and gold, but because we will probably not be manufacturing storage tanks out of silver or gold any time soon, I recommend food grade stainless steel as the next best, practical choice.

When using plastic in honey processing and storage, only food grade will do because other plastics can release excessive toxins. When bottling with plastic, polyethylene terephthalate (say that three times fast), better known as PETE plastic, is considered one of the best choices. PETE is clear and can be identified as having a number 1 in the triangle on the bottom of the container. High-density polyethylene, also known as HDPE plastic, is also commonly used and can be identified with a number two in the triangle.

In my opinion, glass is better than plastic for food, or anything else we ingest, but because plastic will almost always outsell glass when sitting side by side in a grocery store it's hard not to offer it. We offer both and let the customer decide.

Moisture

Too much moisture in honey lowers quality

Although moisture may not be a big issue in arid areas like the southwest, it can be in high humidity, higher rainfall areas such as the east and southeast. Having a high moisture content in honey lowers quality and leads to fermentation. It's actually easy to affect the moisture level in honey. It all revolves around a few basic facts.

Honey is hygroscopic, which means it will absorb moisture from a high humidity environment. It's also hydrophilic, which means it will release moisture when there is low humidity. There is always a point where the moisture level in honey will balance out with the humidity level it is exposed to and that honey will cease to gain or lose water. For example, given enough time, honey that is exposed to air with a 60% humidity level will balance out with it at about 18.3% moisture content. This is not a bad place to be. Most honey will not ferment at this level although there are some that will. When exposed to 50% humidity, the moisture content in honey will lower to about 15.9%. This is a better place to be because no honey will ferment at this level and because it will have a ⇨

U.S. Grade A Fancy

"Free of defects that affect appearance and may not contain particles that affect clarity."

thicker body, more character, and richer flavor, it would be considered a higher quality product. When continually exposed to 80% humidity, the moisture content in honey will eventually rise to 33.1%. No, that's not a typo. Unless pasteurized, honey with a moisture content that high will create enough pressure from fermentation to bend a metal jar lid into a dome if the seal holds or create a heck of a mess from leakage or both.

Honey bees try to keep their hive between 50% and 60% humidity for good reason.

Transporting, storing, uncapping, extracting, and the general handling of honey in a high humidity environment will absolutely add moisture to your honey. Doing the same in low humidity will have the opposite effect. A high quality hygrometer, which measures humidity, can be a good thing to have in a honey house. Cheap humidity gauges are usually inaccurate.

If you need to remove moisture from honey, it's helpful to understand that honey has a very poor diffusion rate. If, for example, you were to use a fan to blow warm air across the top of a drum of thin honey only the top layer would dry because the effect will not migrate very far.

For most of us, unless you have a commercial honey dryer, it's best to remove moisture before extracting. Honey supers can be placed in a warm, low humidity drying room which allows for a much greater surface area to be affected by warm, dry, moving air.

When removing moisture it is helpful to know that by simply raising the temperature in a given space, the relative humidity level will drop thereby increasing the drying effect.

If this is puzzling, remember that relative humidity is the amount of water vapor the air is holding compared to what it could hold if totally saturated at 100%. By increasing the temperature the amount of water vapor air can hold increases, so the relative humidity level, or current saturation level, goes down. This, along with the use of a dehumidifier and fans, can create a good, dry, low humidity environment for drying honey. Also, warm honey is easier to extract.

In our drying room at Blue Ridge Honey Co. we use two commercial dehumidifiers that run 24/7 during extracting season. Along with keeping the temperature 85 to 90°F, this keeps the humidity level well below 30% even when it is as high as 100% outside. We move this air through the stacks of supers with industrial fans mounted on the ceiling and by doing so see a notable decrease in moisture content in just a few days. Although, contrary to popular belief, moisture can and does migrate through wax cappings, we try to harvest our honey supers with a small amount of comb still uncapped to achieve a quicker and greater overall moisture reduction. If you don't have a refractometer for measuring moisture in honey you should get one. You may be surprised by what you find.

Yeast and Fermentation

Yeast can cause fermentation in high moisture honey

The yeasts found in honey are not the same as those used in bread and beer. They are tolerant of the high sugar concentration found in honey. The primary sources for these yeasts are flowers and soil and the bees bring it in freely.

Some bee books will tell you that fermentation will only occur in honey with a moisture content of 18.6% or higher. This is not always true. This number of 18.6% is dependent on the yeast spore count.

The yeast spore count in honey can range anywhere from one to tens of thousands per gram. Honey with a low spore count of one per gram will usually not ferment with a moisture content of up to 19%. Honey with a spore count of ten per gram needs to be 18.6% moisture or lower to be safe. A high spore count of 1,000 or more needs to have 17% moisture or lower, or fermentation can occur. For example, Mangrove honey with its low spore count is usually safe at 19% while Cabbage Palm honey with a higher than average count can sometimes ferment at 18%.

I can't say how many times I have been surprised to have a barrel of honey that I thought was safe begin to show signs of fermentation. In my view, any hint of fermentation lowers the quality of honey and a high level completely ruins it.

Yeast is affected by temperature

Heat kills yeast and cold stops its activity.

One of the reasons some packers like to use heat in processing is that it stops fermentation in thin honey by killing the yeast. The yeast in honey will be dead in 8 hours when held at 125°F, 30 minutes at 145°F, and 1 minute at 160°F. 100°F or greater will slow fermentation, but honey stored for any time at these temperatures will show a noticeable deterioration of quality in other areas.

Be warned: if you think that killing the yeast in thin honey with heat will solve all of your fermentation problems going forward, think again. Yeast is everywhere. It is in your apiary, it is in your equipment, and it is airborne in your honey house.

A filter with an 800 to 1000 micron mesh can remove large debris while allowing desirable substances through.

Only if you heat honey in a sealed container or pour it hot into a container that will be sealed before it cools, will it be completely safe from fermentation. As soon as the container is opened again, if it is too thin, it is at risk. Again, yeast is everywhere.

If you do have to store thin honey and don't want to use heat to kill the yeast, it can be stored cold. The activity of yeast in honey will stop when the temperature drops below 52°F, but it will return when the temperature rises again.

Also worth knowing is that crystallized honey has a greater chance of fermenting than liquid. Not all of the sugars in honey will crystallize and the one that does (dextrose) has a lower solubility than the others. As it crystallizes, it will leave water behind thereby increasing the moisture content in the rest of the honey.

Numerous times I have had honey with borderline moisture content remain unfermented for some time only to have it ferment after crystallizing.

Why Crystallization Occurs

Crystallization will occur in honey with a moderate to high percentage of dextrose

A 20% content of dextrose, also known as D-glucose, in honey is considered low and 40% is considered high. Honey with a 25% dextrose content or lower will generally not crystallize. Fresh honey containing 40% or more will begin the crystallization process faster than you can read this article.

I was once extracting a crop of Canola honey (which is high in dextrose) only to come back after a weekend off and find it setting up in the sump tank, pumps, and pipes. If you're not paying attention, honey like this can quickly crystallize in the comb and become almost impossible to extract. I learned this one the hard way.

Producing a good quality product can be a challenge.

Honeys high in dextrose will crystallize hard, and those with a moderate percentage will crystallize soft. A little lower percentage may give you a slurry or a thick, cloudy body.

Age can also have an effect on the consistency of crystallized honey. Over time, the percentage of dextrose in crystallized honey can decrease as it slowly converts to other sugars. This can give the appearance of honey that seems to have separated liquid from solid, with the solid on the bottom. Given enough time, some crystallized honey can actually go almost completely liquid again. Of course, this honey would be quite old and undesirable in my view because it will have deteriorated in other ways.

Examples of honeys low in dextrose are Black Sage, Tupelo, and Sourwood. Titi, Cotton, and Canola are honeys high in dextrose and because of this are sometimes considered bakers grade or industrial grade.

Crystallization is affected by temperature

The optimum temperature for crystallization is around 57°F. Those producing creamed honey can use this fact to their advantage. The farther the temperature moves either above or below this range, the less apt honey will be to crystallize. Honey will not crystallize at or below 32°F. Honey that has already crystallized will begin to soften at 85°F and begin to liquify between 100°F and 104°F.

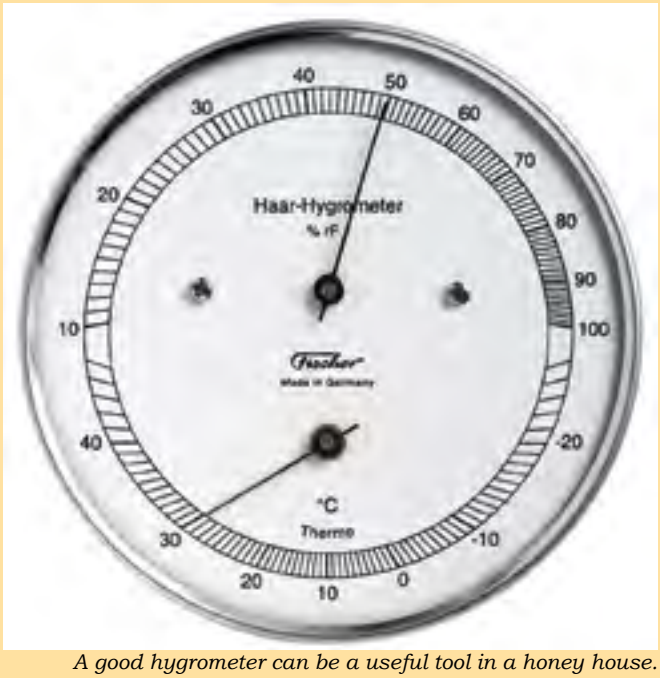
Heat is used to dissolve crystals in fresh honey that can initiate the crystallization process. Heat is also used to facilitate micro filtering which can remove particles that act as a platform from which the crystallization process can begin. Even a particle of dust can act as a starting point. Thirty minutes at 145°F will dissolve all crystals.

If you need a long shelf life without crystallization, heat will probably be needed.

Filtration

Filtration is considered a sin by some, and absolutely necessary by others

Honey labeled U.S. Grade A Fancy must be "free of defects that affect appearance and may not contain particles that affect clarity." Although this standard for honey is not very well policed and can be highly misleading (much foreign honey is labeled US Grade A Fancy), many packers believe it adds consumer trust. Other than complying with this standard, there are other reasons many may not want particles in their honey. Besides crystallization and perceived shelf life issues, honey without particles can simply appear cleaner, brighter, and more attractive to consumers.



A good hygrometer can be a useful tool in a honey house.

Of course, all of this requires fine filtering or "micro filtering" and there are those that feel this removes much of the "good stuff" in honey. That would include pollen, beeswax, and propolis particles, along with other substances considered desirable. Fine filtering also requires high heat to lower the viscosity (thickness) of

honey so it can pass through a fine filtering medium. Honey handled like this should not be called raw although it often is.

The extreme opposite is honey sold as ultra raw. This honey is bottled straight out of the extractor, without any straining or settling at all and of course would contain a lot of foreign debris. While some would argue that the debris in freshly extracted honey is perfectly fine, even desirable, it's important to keep in mind that not all debris is created equal. A bee wing or bee leg is one thing. A splinter or frame nail is quite another.

Just because I have product liability insurance doesn't mean I want to use it. Some straining or settling is recommended. If you want to remove large, potentially harmful debris but allow much of the "good stuff" to remain, straining your honey through something like a coarse, 800 or 1000 micron filter will work.

Settling can also be helpful. Because honey is so heavy, light debris such as dead bees, wood, and wax will float to the top while heavy items such as nails, dirt, and wire will sink to the bottom.

To put filter mesh size in perspective most pollen particles run between 10 and 50 microns with one occasionally up to 100. In case you're wondering, a micron, also known as a micrometer, is .001mm. or .000039 inch. The human eye generally cannot see a particle under 30 microns and a human hair is around 75.

Finally, on a personal note

I admit that when it comes to processing honey, producing a good quality product can sometimes be challenging. There will be mistakes made, and lessons learned the hard way. You may have to compete with people that have no problem with mislabeling and misleading customers. Let your quality and service speak for itself and remember it can take years to earn a good reputation, but it only takes a few seconds to lose it.

Bob Binnie is a commercial honey producer, honey packer and owns and operates Blue Ridge Honey Co. in Lakemont, Georgia along with his wife Suzette. BC

This drum of honey fermented after crystallizing and foamed over when warmed to liquefy.

SWARM INITIATION

A Nurse Bee Hypothesis

Edward **Balogh**

Dr. Tom Seeley (46) acknowledged and restated that "he would love to know how the bees decide when they are going to swarm"(3). The question has obviously been the subject of inquisitive beekeepers for many years, but as E.F. Phillips (17) notes in his 1915 Treatise on Beekeeping, "A discussion of the life of the honey bee and of the production of honey": *The simplest way to account for this phenomenon is to attribute it to "instinct" but... instincts are called into action only by definite conditions in the environment.* There have been many hypotheses presented regarding the pre-swarm conditions that usually are singularly or in combination linked to the swarming process that follows. They still don't identify the bee caste that by action starts the swarming process. Dr. Grozinger et al, (21) suggest that continued investigation at the genomic and physiological levels can help us to understand why only a small handful of individuals produce the key signals that coordinate the swarming process. Research supports an hypothesis that a quorum of nurse bees have a "distinct neurogenomic state" unique to them created by the multiple pre-swarm conditions in the hive similar to the genomic changes pointed out regarding scout versus nonscouts (28, 42) bees producing vibration signals versus those that do not (1), and bees departing with the swarm versus those staying in the hive (21). This quorum of nurse bees serves to establish a colony consensus that initiates the swarming process.

Narrative

In the Biology of the Honey Bee (66), swarming specifically describes a particular activity or event where a large number of bees leave a hive with the queen to establish a new colony. Fundamental to establishing a new colony is the rearing of a queen and consequently all swarming hypotheses describe conditions which result in queen rearing. The swarming phenomena has been an important topic of discussion for many years. The concept of splitting a colony was noted in a pamphlet "A description of the bar-and-frame hive" published in 1844 (34). Since the invention of the Langstroth hive design in 1851, and the associated wooden ware and frames, the ability to manipulate hives to avoid swarms became more feasible. Consequently, the management of swarms in turn led to more research to identify those conditions that precede swarming. This supports the goal of beekeepers to utilize this banked knowledge to take appropriate action to intercept and stop the swarming process. By doing so, the beekeeper's investment in his hives is preserved. While a variety of techniques to inhibit swarming have been employed, none have been found to be unambiguously reliable (18, 10, 56, 58). As is discussed in Swarm Essentials (41) there are some general conditions that effect swarming which include abundance of resources, genetic strain, environmental conditions and the age of the queen. Abundance of resources includes a high number of young bees, large amounts of nectar and pollen, the presence of sealed virgin queen cells or actual virgin queens. Genetic race or strain of the honey bee is a factor. Some races have differing tendencies to swarm. Environmental conditions are determinant depending on local seasonal weather conditions. The age of the queen is a determinant in how much queen substance she produces because research suggests that older queens are more likely to swarm than younger queens (41).

In addition to the general conditions that correlate to a hive swarming, there are more specific hypotheses that suggest that these conditions, singularly or in concert, increase a hive's propensity to swarm. In early research, as noted in "The Biology of the Honey bee"(59), was focused on explaining the initiation of queen rearing prior to a swarming. The nurse bee, or brood, food hypotheses (20, 32), states that a surplus of young nurse bees develops in pre-swarming colonies, resulting in an excess amount of brood food for which queen rearing is an outlet. Another, the colony congestion or crowding hypothesis (25,16) points out that crowding of adult workers and limited space for brood rearing results in the initiation of queen rearing. Neither of these hypotheses provided adequate proof to fully explain the initiation of queen rearing. Subsequent to these hypotheses, additional ones were developed. The following list, which while not inclusive, forms a representative sample: colony size, brood comb congestion, worker age distribution, reduced transmission of queen pheromones (18) and brood

pheromone (60). The following is a synopsis of each of these hypotheses:

Colony size: Three aspects of colony size are important for the initiation of queen rearing: comb area, colony volume, and worker population. The area/volume threshold is 40L and 23,000 cm^2 for European bees. Honey bees have an accelerated population growth following the Winter clustering period in the cold temperate climates. The critical threshold is at 12,000 bees, at which time queen rearing begins and the colonies swarm when the population reaches 20,000 workers. The most important aspect of the colony size is not the physical size of the nest, but the size of the active colony. European bees may construct enough to fill their cavities before swarming, although only 54-76% of that comb is used when the queen rearing begins (61). The first visible sign that a colony may be preparing to swarm is the production of queen cups – the first step in the queen rearing process. It is also possible for colonies to become congested, yet show no preparation to swarm, demonstrating that worker density and colony size are not sole deciding factors (53).

Brood comb congestion: There are two aspects of brood nest congestion which may be important stimuli to queen rearing: congestion of brood and crowding of adult workers. The effective brood nest is not the entire area of the drawn foundation in a hive, but only that area with the maximum number of cells occupied during a swarm cycle. Queen rearing is initiated coincidental with congestion in that area. At that time, 90-95% of all cells in the brood nest contain some stage of brood, and there are few empty cells in the brood nest for the queen to lay eggs (61). This necessitates an increase in nurse bees tending to the brood. In addition to the cells being occupied with brood, there may be a situation where foraging bees have started to store nectar and/or pollen in these same brood cells creating what is referred to as a "honey bound" hive. Interestingly and noteworthy, in colonies preparing to swarm, adult workers appear to crowd together in the brood area, even if additional space is available in the nest (53,65). This is because of the accelerated population growth and the effect of foragers pheromone that retards the normal temporal polytheism of nurse bees into foragers (22, 24) – thus creating a sub-caste imbalance adding to the brood area congestion.

Worker age distribution: A skewed worker age distribution is also associated with swarming: colonies preparing to swarm tend to have a large proportion of young bees (65). This phenomenon is likely caused by the emergence of large quantities of young workers from brood cells (19). In addition, the forager pheromone that retards the normal temporal polytheism of nurse bees into foragers increases the proportion of nurse bees (22, 24) compounding the problem. At the beginning of the growing season, the age distribution of a colony is greatly skewed towards older (≥24days old) workers. Gradually, as the older workers die and increasing numbers of eggs are laid develop into adults, and eclose to take their place, the proportion of younger (≤ seven days old) workers increases (18). However, adding a large amount of young workers to colonies does not reliably trigger swarming (52).

Reduced transmission of queen pheromones: The presence of a healthy queen is signaled throughout a colony by a combination of pheromones unique to the queen . . . the queen mandibular pheromone (QMP) and footprint pheromone. There is no difference in the production of one queen pheromone, (QMP) or 9-ODA, between queens in colonies preparing to swarm and those that are not (48) which suggest that it is the transmission of queen pheromones which is reduced rather than the queen's pheromones output prior to queen rearing (62). There is a difference in the amount of QMP produced by young queens and older queens and this may explain the tendency for older queens to swarm more readily than young queens. In addition, the congestion in the hive from an unusually large mix of nurse bees, particularly crowding the brood area, limits the queens mobility within the hive and thus is another factor interfering with the transmission of her QMP pheromone. In addition to the QMP pheromone influencing the swarming process, the queen has what has been labeled her "footprint" pheromone which is produced in the queen's tarsal glands and may be involved in the suppression of the first stage of queen rearing associated with swarming, cup construction (64) in a congested state, the queen's mobility is limited and in turn the footprint pheromones distribution. When a combination of mandibular and tarsal gland extracts were applied to the bottom edges of comb in overcrowded colonies, the construction of queen cups was inhibited (27). Neither of these secretions affected queen cup construction when applied separately. It should be noted that the presence of the queen and her QMP message slows the ontogeny from hive tasks to foraging (37). This could be traced by the QMP acting to inhibit the juvenile hormone production to regulate the rate at which workers progress from within-nest to outside tasks (43) thus increasing the disproportionate mix of nurse bees to worker bees.

Brood pheromone shift: A "two-way primer" model (7,35) hypothesizes that brood pheromone may both accelerate and decelerate the transition to foraging depending on the physiological state of the individual worker bee. Additional studies suggest that young and old brood release different chemicals which have opposing effects on the behavioral maturation (29). Furthermore, bees reared in the presence of low levels of BEP (Brood Ester Pheromone) behaved more like foragers in a sucrose response assay, while bees reared with higher levels behaved more like nurses (36). Consequently, the nurse bees inhibited behavioral maturation adds to the nurse bee imbalance and/or the earlier maturing of foragers are added without effectively being able to add a proportionate amount of nectar or pollen to the hive because of its honey bound state.

All of the above hypotheses have established virtual thresholds which probabilistically correlates with the commencement of swarming. An alternative explanation for the inability to these hypothesis to support a single mechanism suggests that instead of being causal triggers, the hypothesized mechanisms are simultaneous artifacts (i.e. correlates) of the actual mechanistic cause of swarming. That is, there may be a single underlying mechanism coincident with the above mentioned factors (18). Lengefelder (26) summed up several of the already known theories of the origin of the swarming fever and concluded none of the theories was quite complete and formulated a new theory, i.e. the so-called theory of latent swarm workers that are formed in the colony a few weeks

FIGURE

Stephen **Bishop**

In twilight, my wife's poppaw Lowry was already sporting blue-plaid pajamas and was supposed to be retired for the day. Yet there he stood firmly in his slippers. He and an acquaintance with a swarm in the top of a backyard maple held an A-frame ladder steady. Tied to the A-frame ladder was the bottom of an extension ladder, its top fully extended twenty feet and wavering unsupported in the airspace below a small limb wrapped with writhing bees. At the top of that extension ladder clung a man in a white beekeeper's jacket. I was just about to cut the limb with a pair of hedge clippers when Lowry said, "Wait, let's figure about this."

"What?" I shouted back annoyed, having already dropped the hedge clippers once and having just figured out a way to brace one handle against the ladder and apply pressure to the other handle to perform the cut.

"If you're holding the ladder with one hand and cutting the branch with the other, how are you going to hold the branch to bring down the swarm?" Lowry asked.

"I'm not," I answered back, "I'm going to let it fall to the ground." In my mind that was a reasonable idea. I had caught many a swarm by shaking the bees to the ground and then putting the hive box beside them. The bees run into the dark confines of the hive.

"But we don't have bee suits," Lowry answered.

"Don't worry. Swarms don't sting." I replied.

"I'm not worried about me. I'm worried about you. If those bees hit the ground, we ain't gunna be holding the ladder no more."

The acquaintance concurred, "Boy, I don't know you good enough to get stung up. It ain't worth you dying."

I went down to do some more figuring.

The figuring degenerated quickly. When the best beekeeping solution a trio can propose involves a shotgun or chainsaw, then it's likely better to call it a night. We decided on the chainsaw. After tracing back the origin of the limb with a flashlight, we braced the ladder against the trunk and I proceeded to climb, running chainsaw in hand. The idea was to slowly saw into the shoulder of the limb and stop at the gravitational point where the limb begins to lever down in a controlled descent instead of suddenly dropping. All went well, surprisingly. I sawed into the shoulder of the limb without sawing my shoulders or limbs. The swarm safely touched down. We celebrated like Houston command and control after guiding astronauts in from orbit.

Beekeeping isn't rocket science. But it does involve figuring. Not to be confused with the real science that Randy Oliver does, figuring is what a beekeeper does when faced with flummoxing situations, when he rationalizes foolish solutions, when he decides to go ahead and work the meanest hive despite forgetting his gloves and lighter for the smoker, when he smells skunk and hears something rustling in the bushes behind the hives and decides to have a look, when he gets a bee in a veil and then decides to remove the veil in a bee yard in the throes of revolution.

Be careful out there this swarm season. Remember to figure. And figure on figuring being wrong half the time at least, especially if ladders, shotguns, or chainsaws are needed after dusk. If said materials are required, be sure to have a witness record the feat with a smartphone. If not mortally wounded, you can send the video into the funny video show for money (does that show still exist?) or upload it to Youtube for viral fame. Generally speaking, foolish attempts at catching bees are at least as funny as skateboarding accidents, groin hits, and laughing babies. These days, the world needs to laugh more. Remember to figure. BC

before swarming. What he considered important was the ratio of the brood, house bees and foraging bees. None of them, however, offer to identify the bee caste that would most likely take the lead in orchestrating the swarming process. This hypothesis suggests that it is a worker bee and that it is a quorum of nurse bees that act to initiate the swarm.

Consideration must be given to all three bee castes – the drone, queen and worker. Very few pheromones are known in the drone and most are linked to sexual features. This reflects the minor role of males in honey bee society, almost entirely limited to the mating function (33). Since the drone does not demonstrate any active role in sustaining the colony, the drones' involvement in swarming would be inconsequential.

The queen is most typically identified by beekeepers as being responsible for starting the swarming process. It is understandable because the queen is involved in several functional or pheromonal-influenced actions during the pre-swarm process. Consideration has to be given specifically to her involvement in the proposed pre-swarm hypotheses previously noted.

Colony size: The queen must be capable of producing brood at a rate that will sustain the hive. The success will result in producing enough worker bees to gather and store sufficient quantities of both nectar and pollen to sustain the hive's continued rejuvenation during the temperate climate as well as through the following cold weather when the hive will cluster. As noted above, the consequences of a large population correlates with a swarming event when populations reach prescribed historical thresholds. Exceeding the swarming population threshold of bees is an unintended consequence, and not necessarily an intent of the queen to promote a swarm. The size of the population also does affect the transmission of the QMP throughout the hive and this in turn, adds to the pre-swarm inclination of the bees – they are no longer inhibited by the QMP from queen rearing.

Brood comb congestion: The situation directly affects the egg laying rate of the queen. The diminished brood area that can effectively be employed by the queen to lay eggs has been reduced significantly by the ramping up of her egg laying during the Spring buildup and the fact that during the nectar flow, the foragers are starting to utilize the loosely defined brood area to store nectar in addition to the increased level of pollen necessary for the increasing number of brood. Again, the queen must throttle back her egg laying rate, and contend with the honey bound state that the hive is in. In addition, the increased number of worker bees, both foragers that have stopped foraging because of limited storage space and nurse bees that have disproportionately increased in numbers as a function of the increased egg laying rate of the queen and the maturation to foragers being delayed by both brood pheromone (36) and forager pheromone effect (43). The queen's mobility is affected by the crowding and her egg laying diminished considerably. Other queen related swarming consequences, describe the queen's subordinate role during the swarming process. It has been observed that the queen does not lead the swarm from its parental but is instead pushed out of it by workers(53). Furthermore, the queen is evaluated and if the consensus decides she cannot reproduce in a swarm hive, she will be superseded during swarm preparation(67). Frustrated swarms (those that cannot "coerce" their queen to swarm because she is clipped) often kill the queen in an attempt to rear one that can fly (14).

Worker age distribution: There is a disproportionate mix favoring young/nurse bees developing during the pre-swarm process. The nurse bees are the primary distributor of the QMP. It is done on a worker-worker contact. QMP influence is dependent on direct contact with the worker bees and is not transmitted by sight, scent or sound (25). Because the nurse bees are not as mobile because of congestion, the transmission of the QMP and the footprint pheromone of the queen is reduced and sporadic, which results in a significant pre-swarm condition conducive to queen rearing.

Reduced transmission of queen pheromone: As noted above, the dosage and transmission of the QMP and the footprint pheromone are a consequence of hive conditions, which the queen cannot control at this point in the pre-swarm state.

Brood pheromone shift: Brood comb congestion is a consequence. The decreasing percentage of eggs and in turn young brood, shifts the effect of the pheromone to produce workers with behavioral tendencies like nurse bees. This would increase the proportion of nurse bees in the hive to foster a swarming mix which is composed of a large contingent of nurse bees. The queen has no role in this shifting population mix until she can resume her full rate of egg laying.

Based on the above, the queen is not at any point starting the swarming process. The regulation of queen activity during colony reproduction may, therefore be controlled largely by workers that normally have little contact with queens, but help to formulate colony reproductive and movement decisions(44). The worker bee cast, and the nurse bee sub-cast specifically, is in a convergent position in all of the hypothesis to take action. Again, consider the pre-swarm condition hypotheses.

Colony size: The colony size must be populated with enough bees to support both the primary and swarm hives. Worker age is the major factor determining which workers will remain in the nest and which will issue with the prime swarm (8, 31, 57). Young workers have a higher probability issuing with swarms than older workers, and up to 70% of workers less than 10 days old leave with swarms of temperate-evolved bee races (63). This would correlate with the excess of nurse bees proportionately in the primary hive prior to the swarm lift off. Evidence supports the nurse bee cast as being in the

best position to access the proper colony size and caste mix for swarming.

Brood comb congestion: Obviously, the nurse bees are focused on the brood nest area and can best respond when unusual conditions are present. The fact that the queen's egg laying has slowed down, the proportion of capped brood to egg/larval state and the shifting of brood ester pheromone from the young brood dosage to the higher old brood dosage are cues that a shift from a preferred state had taken place (22). In addition, workers may be able to assess the queen's egg laying rate directly (30).

Worker age distribution: Nurse bees have established a large proportion of the colony population as compared to foragers. With this large nurse sub caste and the resultant diminished transmission of the QMP, the number of nurse bees uninhibited to queen rearing grows quickly, and the further increase in nurse bee population induces a rapid shift from high to low in the equilibrium proportion of the inhibited nurses (4). The mix of nurse bees and their distinctive physiological JH factor between nurse bees that swarm and those that stay supports a genetic shift theory of "swarm bees" (2). Nurse bees tend to crowd themselves on the combs (15). Taranov (55) concluded and Butler (8) and Simpson (52) agreed that as pre-swarm conditions advance, nurse bees become displaced from the brood nest in ever increasing numbers and become differentiated from the colony as "swarm bees" i.e the bees which form 70% the swarm when it departs (63).

Reduced transmission of queen pheromone: The diluted effect of the queen pheromone, both QMP and Footprint, liberates worker bees on the periphery of the hive to produce queen cups. The nurse bee proportion of the population is significant and being dispersed throughout the hive, can best assess the multiple pre-swarm conditions and take action to initiate the swarm.

Brood pheromone shift: As noted above, the mix of brood, when egg laying by the queen has been reduced because of brood comb congestion, results in the brood pheromone concentration promoting the worker bee behavior with nurse bee sub-caste tendencies increasing the nurse bee proportion of the worker bee population predicted in pre-swarming hive conditions.

Consistent with the above observations, Fefferman and Starks (18) considers, "It is likely that honey bees use pheromones to determine whether their colony is large, congested, or has a skewed worker age distribution." It is clear that worker behavioral development, which leads to the typical honey bee age polyethism, is a complex and flexible process, involving more than one stimulus. The combined effect of queen signals, worker pheromones (ethyl oleate), and brood pheromones results in a plastic modulation of worker activity that is able to adapt worker response to the needs of the colony, which vary depending on colony developmental stage and environmental factors(7,11).

There are several sub-castes which are formed during the swarming process. The swarm hive site search scouts – a sub-caste of forgers, the worker bees that put the queen on a diet and exercise her – a sub-caste of house bees, the bees that vibrate her prior to hive departure and of course the division of the population into those that swarm and those that stay – both sub-casts of house bees. This supports the formation of a sub-cast of nurse bees proposition. It is likely that the regulation of worker behavioral development is primarily modulated by the workers themselves, since the artificial alteration of worker demography is effective in changing age polyethism development even with constant presence of the queen (22, **23**). It is by now well known that such group-level decisions are the result of the individual insects acting mainly on local information obtained from the interactions with their peers and their immediate environment (5, 6, 9) – a decentralized decision model. In the context of collective decision-making, positive feedback allows the selection of a particular option to cascade through the group, as the growing number of adherents to an option increases its attractiveness to undecided members. Moreover, this initiative behavior often takes a step-like form, with an individual's probability of selecting an option changing sharply when the number of like-minded conspecifics crosses a threshold. Here we refer to this functional form as a quorum response, following well-studied cases in which threshold group sizes trigger key changes in behavior (39,49). Empirical evidence, at least in the case of honey bees Dr. Seeley (50,51) concludes that unanimity is not what triggers a consensus choice, instead, a final choice is made once the number of agents in favor of a particular option reaches a quorum (12,54). As the dilution of the QMP liberates worker bees from the inhibiting influence, the nurse bees also are liberated at a distance from the queen. A group or quorum of nurse bees could undergo a physiological shift in neurogenomic state which is the precursor to initiating the swarming process (21). The worker bees in various sub-cast tasks can assess the "abnormal" conditions present in the hive and colony ontology. Dr. Seeley (47) notes that when a worker bee processes the information in a signal, she often integrates the signal information with a large amount of contextual information. The conditions noted above are evaluated by the nurse bees and process the pre-swarm conditions. They integrate this information with a large amount of contextual information and a quorum starts to build throughout the hive. The formation of the swarm queen cups, which is the first sign of swarming and is a genetically programmed response to the diminished effect of the reduction in QMP throughout the hive (38), is the last pre-swarm cue that a quorum of the sub-cast of nurse bees assesses and conclude that the conditions are appropriate to swarm. The quorum threshold having been reached, a consensus choice follows, and the colony

911

Peter **Sieling**

Many years ago, an 11-year old neighbor girl followed me around the bee yard. For three or four years, Lindsay called herself my apprentice. Then her bees died, she grew up, went to college, and fell in love. We attended her wedding yesterday. I hugged the bride, and we reminisced for a few minutes between the father/daughter dance and the cake cutting.

Returning home after the reception, I checked the answering machine. It was blinking frantically. Here is a transcript with only the contact information changed. It's hard to express the emotion with mere words:

"My name is Thorgerta Helgersen. I live at 5555 Panic Rd., in Bellevue. Um, I have the BIGGEST swarm of BEES in my front yard!!! They're just hanging off a tree! They just keep COMING and COMING and COMING, I'm so afraid they're going to get my dog, I don't know what to do, you can't even go out front I mean I don't know where they came from they're just SWARMING! They're on my porch, but they're just hanging right off my second tree just like, I don't know, it's just like they're RAINING BEES! It's just HORRIBLE! I don't know what to do! PLEASE call me back! 555-1234. Thank you."

This is an example of a category five swarm call. I'm the emergency bee contact person for Steuben County 911. That means I get first dibs on any swarms that are called in. If it's too far away or too high, I call another beekeeper. If my apiary is full, well, I've never had too many bees, just not enough bee boxes.

Despite the late hour I immediately called her back, knowing I might have to figuratively talk her off the ledge. She picked up at the first ring.

As soon as I introduced myself, she launched back in, almost like she had just hung up to take a breath. I learned that the swarm had flown away once, and then came back. After a few minutes and after repeating my questions several times, I learned that the bees were indeed still hanging in a tree, not too high up and yes, even though it was an ornamental, I could cut as much out as necessary to remove them. I promised I'd arrive by seven the following morning and take care of them.

"How much will this cost?" she asked.

"Nothing. It's my service to humanity." I answered, then suddenly remembering how far I had to drive (27 miles) and how small some swarms can be, I added, "Maybe just something to cover the fuel."

She was thrilled.

I arrived at her mobile home at dawn. She came out and pointed at what I would call a typical easy swarm, five feet high and about three lbs., or roughly 10,000 bees. I stuck my hand into the swarm. This gives me the aura of a magician, plus it calms peoples' fears when they realize that the bees will not sting every person and dog in sight. I explained why bees swarmed and told her to watch for a secondary swarm in a week or ten days when the queen cells hatched. Then I shook them into a box with a screen window for ventilation, taped it shut, and stowed it in the van. She handed me a folded up bill. I thought I saw Jackson's portrait, more than I would have asked. I thanked her and drove home. Checking my pocket I found she had actually given me $50. The bees are currently residing in hive #11 in my apiary.

The first swarm of the year is always the most fun, especially if your client has never seen a swarm in her life. Fear turns to amazement which turns to fascination. It's a little like watching a two-year-old child discover a big dog or a duck. It's even more like showing an eleven year old neighbor girl a frame of little baby bees chewing their way out of their cells. I bet you don't remember when you thought baby bees were as cute as kittens.

It also rekindles that feeling you had with your first hive, if you can remember that far back. By the end of the swarm season I will be sick of swarms. I may have a couple swarms in cardboard boxes waiting for me to pound together more frames and foundation. But the anticipation of the first May swarm sharpens as the memory of the last September swarm fades. BC

now moves forward and initiates the swarm preparation. Exactly how bees sense a quorum remains an enigma. They may use visual, olfactory or even tactile information. This remains a subject for future study (45).

The direct preparations for swarming begins two to four weeks before the swarm issues (64). The preparations are described in detail in Honey Bee Democracy (51), Swarm Essentials (40) and The Hive and The Honey Bee (13). BC

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All The Buzzz in...

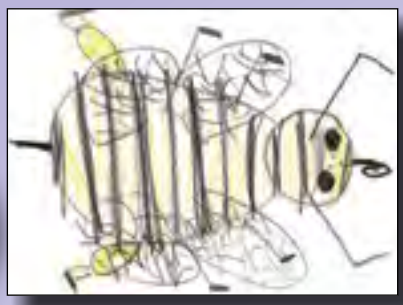
Hello Friends,

Spring is here! I hope you are enjoying warmer days.

Bee B.Queen

Bee B. Queen Challenge

What plants are blooming now? Are bees visiting the flowers?



Bridgett, 9, NJ

Bees by the Numbers

Honey bees are fascinating. The more you learn about bees, the more there is to know. Are you ready for a challenge? Put on your thinking cap. Using the facts below, solve as many math questions about bees as you can. The letter in parentheses corresponds to the information in the fact list that will help you calculate your numbers. The answers are on this page. Let's go!

Problems to Solve

1. If a worker egg was laid on April 4, when would the adult bee chew out of the cell? (A)
2. If a drone egg was laid on April 23, when would the adult chew out of the cell? (B)
3. How many more days does it take to for a drone to develop than a worker? (A, B)
4. How many weeks, on average, does a worker bee live in the summer? How about the winter? (C, D)
5. How long would it take for the queen to lay a maximum of 20,000 eggs? (E)
6. If a queen could lay eggs all year, what is the maximum number of eggs she would lay? (E)
7. How far could a bee fly in 20 minutes? (F)
8. If one bee could fly around the world, how long would it take? (The distance of around the world is about 25,000 miles) (F)
9. How many bee lifetimes would it take to make 1 tablespoon of honey? (3 teaspoons = 1 tablespoon.) (G)
10. How much honey would 12 bees make in their lifetime? (G)
11. How much pollen would a hive need for 3 years? (H)
12. How many years could a hive live with 385 pounds of pollen? (H)
13. How many foraging trips would bees need to take to make 32 pounds of honey? (I, J)
14. If bees could fly around the world, how many pounds of honey would fuel 16 bees? (J)
15. How many bees would be able to fly around the world (if they could) with 5 pounds of honey? (J)

Bees by the Numbers

A. The average number of days for an egg to develop into a worker: 20

B. The average number of days for an egg to develop into a drone: 24

C. Average life span of a worker bee in the spring and summer is 42 days.

D. Average life span of a worker bee in the winter is 135 days.

E. A queen bee can lay a maximum of 2,500 eggs a day.

F. A honeybee can fly up to 15 mph.

G. One honeybee will only produce 1/12 of a teaspoon (0.5 grams) of honey in its entire life.

H. On average, a colony needs about 55 (45 – 65) pounds of pollen a year.

I. To produce 1 ounce of honey, a bee would need to travel an average of 1600 round trips.

J. It would take only 1 ounce of honey to fuel one bee's flight around the world. (16 ounces = 1 pound)

Bee kid's corner

Produced by Kim Lehman -www.kim.lehman.com
www.beeculture.com
April 2018

Cocoa Peanut Butter Honey Truffles

Shared by Yoceph Cunningham

- 1 cup organic rolled oats blended into coarse oat flour)
- 1 cup all natural peanut butter
- 1/2 cup raw organic honey
- 1 tsp. vanilla extract
- 1/4 cup cocoa powder
- Optional: shredded coconut or powdered sugar

1. Mix oat flour, peanut butter, honey, vanilla, and cocoa powder in mixing bowl.
2. Mix and form a large ball in the bowl.
3. Cover with plastic wrap and chill for 15 minutes to firm.
4. After chilled, form into 1 inch balls.
5. Use clean surface to roll balls in coconut shavings or powdered sugar if desired.

Bee Bodies by the Number

Can you name bee body parts by the number? What body part does a bee have just one of?
Two? Three? Four? Five? Six?

Bee Buddy

My name is Yoceph Cunningham. I am 11 years old. I have been a Bee Buddy for a few years. My family and I have kept bees a number of times. We have always enjoyed the taste of fresh honey. One of our family favorites is to have hot tea with honey in the mornings, before we go about our day.

My Dad is a hobby bee keeper. I have helped him a lot with things like building and setting out the hives. We do not currently have bees but hope to get some in the spring. My Dad also knows how to rescue a swarm of bees. One time we rescued a swarm from an old shop.

I enjoy learning the ukulele. I also take karate and go to karate tournaments. We have a pony named Beauty that I ride for fun and in shows. I am currently taking ballet lessons.

Bee B. Queen says, "Thank you Yoceph for sharing a recipe and riddles with us!"

Riddles

by Yoceph Cunningham

Where do bees sit?
On their bee-hinds

Why did the bee go to the barber?
To get a buzz cut

What did the sushi say to the bee?
Wasa-bee

1. April 24, 2. May 17, 3. 4, 5. 8 days, 6. 192,500, 7. 5 miles, 8. 1667 hours or 69 days, 9. 36, 10. 1 tsp, 11. 165 pounds, 12. 7, 13. 819,200, 14. 1, 15. 80

Beecome a Bee Buddy

Send two self addressed stamped envelopes and the following information to: Bee Buddies, PO Box 2743, Austin, TX 78768.

Name
Address
Age
Birthday Month
E-mail (optional)

We will send you a membership card, a prize and a birthday surprise!

Send all questions, photos and artwork to: beebuddiesclub@gmail.com or mail to the above address.

BIGGER PICTURE

Jessica **Louque**

An Ode To Turkeys

I've been on a business kick for the past few months, but I thought I'd switch gears back to homesteading as an ode to turkeys. My Scooter died a couple weeks ago, and after reflecting on it, I'm going to attempt to make the case of eating turkeys that are heritage breeds.

Everybody knows I love the turkeys. The kids are jealous of them sometimes. They get all the leftover eggs, hardboiled and peeled (they like the yolk best but will suffer to eat the whites if the yolks are gone), fresh kale, first choice at food scraps, and lots of attention. I had no idea that they would be so friendly when I started with turkeys, but they now vie for attention and will pull each other out of my lap.

As you might remember from my initial foray into turkeys, I only had Marshall and Scooter survive. Both were broad breasted turkeys, meant to be meat production birds and growing at a rate too fast to encourage flight or mobility. Scooter was always a little more mobile than Marshall for some reason. When I ordered them, I had a mixed variety of turkey breeds, but I had accidentally ordered the totally random mix, rather than the heritage breeds only. My second go-round, I ordered Bourbon reds, Slate blues, and Royal Palms. These birds are much more mobile, able to fly (sometimes that's an unfortunate thing), and a little more aggressive on the male side. They always defer to Marshall and Scooter though, which I think is interesting.

My heritage boys are quite large, and fluff up dragging their wing feathers on the ground, and flap their snoods around all haughty-like, but they are still nowhere near the physical body mass of Scooter and Marshall. When Scooter died, I could barely lift him to get his body out of the pen. He was just a bit over 40 pounds. He (in reality, I think he was a she) never developed any sort of snood or beard, and did not strut at all. Marshall also shares this lack of physical maturity characteristics. Neither Marshall nor Scooter could perch after they were about five months old, and Marshall has never been able to hop up more than a few inches. I ended up adding some new accessories to the turkey pen after I realized that both of them were sleeping on the ground. In particular, about 10 bales of hay now coat the bottom of the pen. I suppose come Spring that will be some amazing compost, but for now, it gives some cushion to the ground and keeps them a little less muddy. We have a steel cow trough that is normally used as a chick brooder that I turned on its side and put in the pen. Even though there's a roof on the little shed part of the pen, it's mostly to keep the feeders dry. Most of the turkeys sleep on top of the roof or on other perches in the pen. Now, Marshall can sleep in the trough and be on the ground and dry, but it gives another place for the other turkeys to sit higher up.

When Scooter died, I decided to build another perch for the turkeys in memory of him(her). We've been trying to clean up some of our hoarding ways to be able to move easier, and took three trailer loads of bee trash to the landfill in the past couple weeks. I saved some of the boxes that were still in okay shape but that I wouldn't want to put bees in, and used them to make a double platform for slats. We had leftover chicken pen lids as well that fit perfectly into a sideways hive body and makes a walkway for the smaller turkeys to go through the boxes. It's

Chocolate Thunder.

Marshall in his new house with Princess on top.

Bee thieves.

The new perch.

Scooter, with Marshall's butt in the background.

next to the shed part of the pen, but it gives the turkeys a place to hop up and down without going through the shed sides (bee box openings). Lately, the weather has been pretty bizarre, going from -2° all the way to 74° in a span of maybe 10 days, so we've been worried about the bees surviving. Apparently, some of our hives did because the chicken and turkey feeders have been swarmed with bees taking over and making pollen baskets out of the high-protein food. It's not been warm enough consistently for us to put pollen patties in the hives, but I'd imagine they've started rearing brood and don't have anything natural to collect at this point. The turkeys are not fond of the bees, but they're not as scared as the chickens. Occasionally, one of the chickens will get stung in the face, so they know to avoid the feeders during bee time. The turkeys will sometimes eat around the bees, but if it's covered, they back off too and get really upset about it. You can hear them angry gobbling through the walls of the house.

Marshall and Scooter were not afraid of the bees, probably because the desire to eat overrode any sense of fright. Marshall in particular is a glutton. He will haul himself off the ground and stand long enough to eat at the feeder when it's refilled, as if the "new" food from the bin tastes better than the old food. It probably is less picked over, since I expect the bees are taking some of the molasses if they can. Eating is what motivates them the most. Since I've realized that they were the breed of turkey sold in grocery stores, I don't think I've been able to eat any. It's not that I'm against eating meat or turkeys, as I had originally intended to eat mine. It might have been different if Marshall and Scooter hadn't been in the batch, but realizing what sad lives they have made me feel a little bit sick about it. I don't think many turkeys have a life where they sit on the back steps and get cut and pitted cherries hand-fed to them, but nothing I did was going to really make their quality of life better due to their breeding program. I also can't eat my own birds now because they bond to people so easily. I guess if I eat turkey again, I will be finding a local turkey farmer who sells heritage breeds for meat.

Just as a size comparison, here's the average listed weight for each of my breeds based on McMurray's expectations:

Slate Blue- Young Tom: 23 pounds, Hen: 14 pounds

Bourbon Red- not listed but should be similar

Royal Palm – Mature Tom: 14-20 pounds, Hen: 10-12 pounds

Giant White – Tom: 45 pounds, Hen: 25 pounds

Broadbreasted Bronze – Tom: 38 pounds, Hen: 22 pounds

I am not positive of the breed for Scooter and Marshall, but I am pretty sure that Scooter was a Broadbreasted Bronze and Marshall is a Giant White, although he looks more like he should be a broad-breasted white. I just didn't see that as an option, but they may also not sell those anymore or have them in stock. My biggest and tallest turkey right now is a Bourbon Red named Chocolate Thunder. He's about three feet tall and king of the pecking order. The turkeys are now coming around to their six month old mark, and starting to grow beards. Some of the boys are having a rough time with their snoods and being able to eat without biting themselves. The girls will also peck at their snoods if the guys get too close to them. So far, the boys have been a bit aggressive to each other, but are not human aggressive in the least and enjoy coming up to beg for food. They will all follow you around like a pack of expectant puppies. Princess, my favorite girl, will hop in my lap as soon as I sit down in the pen.

Our biggest concern with the turkeys now is being able to move them safely. We are still looking for a farm to move to once Henry graduates in June, but the market is pretty slim right now. How we are going to move all these birds is going to be an interesting predicament. It's looking like maybe dog kennels right now. For the chickens, a cat carrier will work but it will take multiple trips. We do have a few chicken crates that will hold maybe six birds comfortably. The guineas will be the most difficult because they roost at night in the top of the pecan tree, so I don't know how we are going to catch them in the first place. Once we get the new place set up, I think the turkeys will have a larger pen so they are a little less territorial, among the boys at least. It will also give me room to make a turkey playground. I'd like to get more, but they are pretty expensive as far as pets go, and I haven't had them long enough to see if there's much of a market for turkey eggs. I've been selling the nicer feathers, and also making them into ornaments. I took some of Scooter's feathers to make a memorial ornament for him. I'm thinking about using them as marketing and having a "feed the turkey for $0.50" the next time we have a honey booth. I bet we'd make at least a couple dollars! BC

Jessica and her family are working hard, living the dream with kids, bees and poultry in North Carolina.

The Dystopian Bees Of Blade Runner 2049

Miles **Sarvis-Wilburn**

The word *dystopia* is the antonym of *utopia*, the latter commonly thought of as an ideal place or good imaginary world. Yet *utopia* has far more interesting linguistic roots, as it was coined by Thomas More in 1516 and reaches back from Modern Latin "nowhere" to the Greek *ou* "not" and *topos* "place." Linguistically speaking, the fundamental characteristic of a utopia is not its supreme goodness or idealism, rather, it is the fact that it does not and perhaps cannot exist. *Dystopia* takes a different turn; most notably used by John Stuart Mill in 1868, it means "imaginary bad place" and thus places a distinct normative judgement upon the item at hand.

It took 352 years for *utopia* to lead to *dystopia*, and another 181 years to reach the imaginative setting of *Blade Runner 2049*. Honey bees and their keepers were very busy over this period of time. Shortly after the publication of More's *Utopia*, the first European honey bees were imported by the Spanish to South America. At this time moveable frames had not yet been invented and we still believed bees gathered honey directly from flowers. But beekeepers are a creative bunch and were actively moving into new forms of beekeeping. These experimentations culminated with the publication of Lorenzo Langstroth's seminal work *The Hive and the Honey-bee* in 1853, a mere fifteen years before the term *dystopia* is widely introduced by Mill. Since then, the Langstroth hive has become the most commonly used hive in the world and countless dystopian works have been created. How many of these feature honey bees? That is a question beyond the scope of this piece which will look at one work in particular: the film *Blade Runner 2049*, released in October of 2017.

Amidst the ambient booms of the soundtrack and the vast landscapes panning across the screen, only a beekeeper would pay special attention to the bees in *Blade Runner 2049*. We meet them but briefly – two thirds of the way through the film – while "K" (Ryan Gosling) is searching for "Deckard" (Harrison Ford) in a desert of haze and crumbling monuments. The terrain is bleak and K wanders until surprised by a single honey bee that has landed on his hand. Himself a bioengineered human known as a 'replicant,' we can safely assume he has never seen a real bee before. He stares blankly for a moment until she leaves him, then follows her bee-line to a small apiary of just under 10 Langstroth hives, many of which bear multiple supers. The buzzing of the colonies is perhaps the first animal sound in the entire film. Entranced, K calmly slides his hand into the entryway of one of the hives and the bees beard onto his skin like a glove. He leaves the apiary then, this scene taking no more than a minute and a half, to return to his quest.

We must assume Deckard set up and operates the apiary. Deckard with his loving dog and collection of vintage items, living alone in the dystopian hell that surrounds him, it is he who has been humanized to the viewer of an un-human world. Is it a human thing to keep bees in the desert? There is no forage for them in the immediate area, nor perhaps anywhere on the planet as even the industrial crops have been secluded and automated. Instead, they feed from disc feeders suspended like rigid accordions playing no notes. The sugar substance within is likely genetically modified in a fashion we cannot understand – recall that in this world replicants are birthed by falling out of plastic embryonic sacks. Yet these consequences and conditions are irrelevant to the bees. They continue as they always have, with what they have, to survive. Like Deckard they are a world within a world, a small piece of what once was.

When we look at the situation of the bees more closely we realize that the mechanisms used to humanize Deckard only contribute further to his isolation. His collection of records, booze, and furniture show how he is like us, human, but these things are in and of themselves only links to the past. They are real within an irreality and fading fast. Even if Deckard should return with his daughter and live happily ever after, they will always be living like the bees: stripped of a nuanced existence. If a utopia is a not-world and dystopia a bad not-world, the latter could be described as world wherein there are only portions

of life, useful for this and used for that but always incomplete. In the world of *Blade Runner 2049* the bees are such; they are akin to a human being on life support. They receive only the bare minimum of nutrients and complexity, just enough to allow them to keep moving, building comb, and filling cells with what once was called honey.

The film inadvertently asks of us a simple question: what are bees without flowers? When we ask this question we begin to look at the practice of beekeeping differently. A world opens up from the bees themselves to the sources of nectar and pollen they need to survive, to the topsoil in which these flowers take root, and finally to the watershed that supports everything growing. We begin to think about how Deckard technically is beekeeping but his is a hollow form lacking vitality and beauty. It exists like a decomposing corpse wherein we can see and know what it was, but do not wish to look too long. Without flowers bees are lost – literally, they have nowhere to go. In this dystopia they have no reason to exist and we do not give them one. Instead, we functionalize their being and inadvertently turn them into living ghosts. We perceive their taking sugar water and making half-real honey as well-being, and congratulate ourselves on having fixed a problem we created. Only they are not there, not really.

Deckard's bees are replicants of a different form. They are a shell of their long history, a history much deeper than that of human beings, and one that will inevitably come to a silent end. When the colonies outside of Deckard's desert home die they will not be noticed as they were never truly alive. They will become like the other large-scale imagery in the film, testimony to a world long gone and untouchable. The true dystopia of *Blade Runner 2049* is not the inhumane world of replicants nor the destitute poverty of human beings, though these are terrible indeed. Rather, the bad not-world is quite literally a world that is incomplete. This is a world without flowering life and strewn with brief buzzing sepulchers filled like catacombs of pollinators drifting. BC

Hunting Stands For Bait Boxes

Will **Caverly**

Few hobbies have a steeper learning curve than beekeeping. But hunting arguably involves far more failure and frustration. Whether big game, small game, or in-between game, the hunter can spend days, months, or years without setting eyes on their quarry. Speaking personally, for all the time I spend outdoors, up in trees, pre-season scouting, and otherwise trying to make a successful harvest, I see few animals and get even fewer shots. Like my honey, the end product, sustainable, cage free wild meat, is pound for pound a magnitude more expensive than what I can buy in the store. That said, I love the chess game of hunting in the same way I love the monitoring and interpretation of honey bee behavior: interacting with natural systems on their own terms creates intensely rewarding experiences.

As in beekeeping, hunting equipment stacks up. My treestands lay unused from February to September. Many hunters leave their stands in the woods all year long. I take them down from my public land hunting spots to decrease weathering and the chance of someone stealing my equipment. They sit disassembled in my garage for months, taking up precious space, space I could be using for more beekeeping gear. But last spring, after placing some swarm traps, I had an epiphany. I decided to repurpose some of my hunting equipment this Spring for swarm catching.

As many beekeepers know, baiting swarms involves placing a bait box 15 feet off the ground[1]. Bees seek out high cavities to avoid predation. This selected adaptation does a few things: the new colony stays out of an animal's line of sight, the range of their nose, and many predator species don't scale trees. Bees can rid themselves of many problems through their vertical preference.

In a similar adaptation, treestand hunters climb trees in order to get out of the line of sight of their prey, prevent the animal's nose from picking up their scent, and get a better view of the woods underneath. Most treestands are designed for placement well above the 15 feet recommended by the swarm trapping literature. Hunters I know want to be at least twenty feet up. They carry the equipment to make it happen quietly, safely, and quickly.

When I first got interested in swarm trapping, I got online and watched people undertake some extraordinarily dangerous climbs. Using aluminum ladders better suited

[1]Seeley, et al. "Bait Hives for Honey Bees," **https://ecommons.cornell.edu/handle/1813/2653**;

A typical treestand on a shagbark hickory, complete with a baited cardbord nuc placed on it. Note the climbing sticks and platform are separate.

to house painting or cleaning out the gutters, they prop themselves against the tree, ratchet-strapping heavy boxes to trunks or fastening them in branch elbows. Others nail contraptions to the tree in order to support the weight of the bait boxes. Many swarm trappers couldn't renew their queen pheromone, lemongrass oil, or other attractant without a lot of trouble.

Let's not reinvent the wheel. Whatever you think about hunting, the sport of harvesting wild game has many participants taking safe climbs into trees, setting up mobile platforms that spare the tree from harm and ensure safety. Furthermore, meeting the bees where they want to hang out is the best way to find them.

I myself have used an old treestand to catch a swarm. The former owners of my property built a homemade stand that stood about 12 feet off the ground. Fred told me he'd hunted from the stand but never got anything. It stood in the same place for years, slowly wearing out. Now it has a nice patina of green mildew and creaks when you shake it. While I'd never get up in it for hunting purposes in its present condition, it held a quick swarm trap I made out of two old, cracked medium supers. I checked it out one day in May and was thrilled to see that a nice, healthy swarm had moved in only a week or two after putting up the bait box.[2] That swarm became one of my strongest hives, growing so much that I had to split it midsummer.

This brings up a related observation. Whitetail deer, the most hunted big game species in the United States, prefer edges and transition zones. I often place my stands just inside of the woods from meadows. The old handmade stand on my property borders an agricultural field but is set back in the woods a spell. Swarms tend to be sensitive to temperature, so don't want to be in full sun[3]. If you're already hunting and already setting treestands, or have a hunter friend or family member, you may not even need to take down a hung stand to have a good chance of catching a swarm in that location. Public lands and other kinds of liminal timberland could offer excellent opportunities for wild genetics.

But if you don't have a treestand, it isn't hard to find one. They range widely in price. Most I've encountered, even the basic models, are extremely durable and will last you the rest of your life if you take care of them. With some luck, you'll catch a cast swarm from a feral hive, introducing some hearty genetics to your apiary.

Here's a few pointers on what to look for in a hunting tree stand:

- **Time of year:** The best time to buy a treestand in most of the USA is after big game hunting season concludes, usually around January in whitetail country. If you thought people quit beekeeping in droves after their failed first attempts, get a load of craigslist after hunting season is over. Cruise your local or online resale outlets after your big game season ends to find a real bargain. Most sporting outfitters also offer sales you can take advantage of for new equipment.
- **Safety harness:** A system involving a harness on your person and a corresponding belt around the tree are relatively cheap for the potential price of a serious maiming or death. Some new treestands include a safety harness. The safest method is to climb the stand using a harness, then rig up a way to haul the bait box up from the ground. If you don't want to procure yourself a treestand, you'd do worse than to purchase a safety harness system for when you scale trees. The best safety harness is one that you'll use as part of your swarm trapping routine.
- **Type:** Treestands range from "ladder stands", involving a raised platform accessed by a ladder, to "tree sticks", a mobile set of ratchet-strapped pieces forming a ladder up the tree, with a separate platform piece. The best stand is the one that you're able to easily and safely access. But, as a rule of thumb, the "tree stick" stands are designed to scale the gnarliest wolf tree on your property. Since these stands are designed to keep an adult suspended in the air, even your heaviest bait box will be fine in a functioning treestand.
- **Placement:** If you're inclined to put a treestand on public land, you want to make sure you're in compliance with local laws, both in whether you can leave a stand out for long periods and whether it's legal to bait bees in that area. Otherwise, most stands are dynamic to place and can face south, the preference for most bait hives.

An old, homemade treestand that the author successfully used as a swarm trap.

The trapping method I discovered on my own turned out to pay dividends. It's a synthesis of two hobbies I enjoy in their moment and daydream about the rest of the year. This year, as the temperatures warm up and I'm enjoying venison burgers from my grill, I'll have my hunting equipment doing double duty and bringing in a different kind of harvest. BC

Will Caverly is a beekeeper in Pennsylvania and one of the stewards of Satoyama Homestead. The homestead website can be found at satoyamahs.org, where they maintain a blog and record The Original Transplants podcast.

[2]Bait hive swarm retrieval, Satoyama Homestead, 17 May 2017, **https://youtu.be/2pTfxXpmc8o.**

[3]I've learned a ton about swarm catching from reading Dr. Leo Sharashkin's enjoyable columns and on his website, **www.horizontalhive.com**.

OXALIC ACID & *VARROA*

Charlie **Vanden Heuvel**

From commercial to backyard beekeepers the number one threat to the honey bee is *Varroa* Destructor Mites. Since 1987 assets coupled with research have amassed their focus in hopes of thwarting this pest.

Harry Vanderpool, Oregon State Beekeepers Association President, made a remark in conversation which inspires this article. Interactions with other beekeepers finds a plethora of reliable mixed with unreliable information. Harry spoke of there being two chemical compositions associated with Oxalic Acid, only one appropriate for use in the treatment of mites.

Oxalic Acid is an odorless white solid, colorless liquid which mixes in water and sinks. Naturally found in various strengths in plants, animals, and humans it combines readily with calcium. In fact, it is important to our metabolic processes of glyoxylic acid (from glucose) or ascorbic acid (Vitamin C). OA stimulates peristaltic or smooth muscle (intestinal) motion in our contractual movement in the elimination of our bodily wastes.

Many of the foods we eat, such as rhubarb, star fruit, beets, chard, spinach, poppy seeds, black pepper, parsley, berries and beans have concentrations of OA. To place this in perspective, aspirin is considered a safe medication, yet it can result in death if improperly used, so it is with OA. Reading the accompanying information that comes with the product is vital.

"Oxalic acid HOC(O)C(O)OH can crystallize in different formulations. One form has only oxalic acid itself, with no waters of crystallization within the unit cell. That is what the term anhydrous means. Another form is the dihydrate, where for every oxalic acid molecule there is in the unit cell, there are also two water molecules in the spaces between the oxalic acid molecules. Its formulation is HOC(O)C(O)OH.2H2O. (Mark B. Fischer, Ph.D. Inorganic Chemistry)

Anhydrous oxalic acid will crystallize near 50°C (122° F) from its solution in acetic acid/water mixtures provided the water concentration of the solution does not exceed 5.2 percent. Crystallization of the anhydrous acid at higher temperatures may possibly be achieved over a still greater range of water concentration if necessary. The invariant point of the system at 50.21°C (122.378° F) was found at a solution composition of 20.94 percent (CO2H)2, 73.89 percent CH3C02H, and 5.17 percent water.

The below chart demonstrates the relationship at 40°C influence on crystallization of anhydrous oxalic acid in the presence of water. Decreasing crystallization temperatures affects the crystallization of OA.

Solubility of oxalic adid in acetic acid/water solutions		
$(CO_2H)_2$	CH_3CO_2H	H_2O
WT %	WT %	WT %
17.83	0.00	82.17
13.98	36.75	49.27
12.29	46.23	41.48
11.54	83.73	4.73
10.87	88.43	0.70

The mode of action, although not clearly understood, seems to be through its acidity (pH near 0.9). OA crosses the cuticle of the insects and mites through the topical application being observed a few hours after administration. Another view is OA vapors enter through the soft pads of the mite's feet and travels to the blood stream, killing the mite. It is also thought that it destroys parts of the mite's mouth. And yet another is the honey bees consumes the OA disbursing it through it hemolymph to be imbibed by the mite. It is important to appreciate the mechanism of action remains cloudy.

Two popular methods of application are **Solution** and **Sublimation**. Going back to our high school chemistry, if you can remember, there are three states (solid, liquid and gas). The act of sublimation transitions the solid crystals directly into the gas phase without passing through the liquid state. Most beekeepers refer to this as vaporization, but scientifically it is considered sublimation.

Although, as beekeepers, tendencies to create varying solutions in an effort to improve stewardship in the instance of OA can prove challenging. Consider altering the dosage or amount of OA concentration discovered by various researchers:

Charriere and Imdorf (2001) reported in trials conducted by dripping on colonies without brood in Switzerland showed an average 97% efficiency for the solution of 45 g of oxalic acid, against 96% efficiency for the treatment of 30 g of oxalic acid. In slovenia, the efficacy of oxalic acid treatments between 8 August and 16 September was 41% (Gregorc and Planinc 2012). A lower dose of 10–15 mL/hive (3.5%) showed a good acaricidal effect (98%) when smaller colonies were treated (Moosbeckhofer 2001).

Gregorc and Planinc (2001) treated colonies with brood three times in the Summer by applying 4.1–5.2% oxalic acid dehydrate in varying sugar solutions w/w corresponding to approximately 4.5–5.9% oxalic acid dehydrate w/v. An efficacy of 39–52% was achieved.

Investigations from Canada in a climatic region comparing with Central Europe confirmed the results of autumn treatments: 2.8 % oxalic acid dihydrate solution (40–50 mL/hive) killed about 55% of the mites, 3.5% about 90% in colonies with remaining brood (Nasr et al. 2001). Efficiency of up to 100% was reached only in broodless artificial swarms (Büchler 1998).

The method approved by the EPA and those States where is has also been approved call for the use of Oxalic Acid Dihydrate. Altering the concentration of OA directly effects the efficacy and bee mortality.

Sublimation – Place 1g Oxalic Acid Dihydrate powder onto the heat element of the vaporizer. Follow respective instructions of the vaporizer's manufacture. Typically ½ teaspoon (2 g) is placed on the element. MORE IS NOT BETTER. Once the vaporizer is placed in the hive, and the exits/entrances are sealed, the electrical connections are attached to a 12 volt (15 amp) battery. The electricity heats the element thus converting the crystals through sublimation into a gaseous state. The length of time to apply heat is dependent on the vapor device, so read the instructions, but leave the device in the hive where it will continue to heat any remaining crystals. Construction of the vaporizer and the various states of age of the battery affect the application. One should "test fire" their respective vaporizer prior to using live on a hive to ascertain the length of time required for use. The largest mite drop occurs the day AFTER treatment.

The **solution** method calls to dissolve 35g of OA in 1 liter of 1:1 sugar water (weight : volume). Key to this method is practicing on none active hive bodies with frames. Trickle or dribble 5 ml of the liquid between the frames which have bees present. No more than 50 ml should be applied to a double deep hive.

DO NOT let OA come in contact with your skin, eyes, be ingested or inhaled. Although OA is found naturally in our foods, the concentration is significantly greater in its powder form. Spend the money and time to protect yourself – rubber gloves, safety goggles, long sleeve shirt, and breathing apparatus (EPA recommends an acid gas respirator model 6211 or mask with N95 filter) is critical to your safety. Oxalic Acid dihydrate can be VERY DANGEROUS for humans. If it were possible to absorb it, a few grams could kill an adult. OA vapors re-crystallize to cover all the surfaces in the hive, which if inhaled will carry to the lungs.

OA is 95% effective in sublimation while the solution method has a greater efficacy. It is recommended to be applied during "non-brood" seasons (late fall, winter, swarms). OA will not cross the wax capping's of the brood cells where a significant portion of the mites are found. It

is very effective against phoretic mites. Honey bees have a low tolerance to OA. Overexposure can cause issues and death in the hive.

OA, in its dried, unmixed state should be kept in a cool dry place and will not expire or diminish in strength. Once mixed, the solution will last up to a week at room temperature and a few months in the fridge. Should the solution turn to a tan/brown or smell funny discard immediately. This discoloration means an alternate chemical [HYDROXYMETHYLFURFURAL] is forming and toxic to bees. BC

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Got A Question?

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A beekeeper in Pennsylvania writes:

I have a question on storing raw honey. What is the optimum temperature to help prevent crystallization? In the past we've kept some in the freezer with no crystallization after six months. Do you have any ideas on reheating crystalized honey that we would keep it classified as "raw honey".

Phil replies:

Honey tends to crystalize in a temperature range around 57°F. Five or 10 degrees more or less can reduce the probability and rate of crystallization, but still be in the danger zone. Of course, honey from some nectar sources tends to crystallize more readily and in a wider range of temperatures than others. Canola honey is notorious in that respect, though it has a light, delicate flavor. I am always cautious when storing honey between 45° and 70°F.

I think you have already found the best solution; freezing honey before it crystalizes is the best, and likely the simplest way of dealing with the problem, as long as you have enough freezer space. Freezing prevents crystallization from occurring. A few days before the honey is needed, it can be removed and allowed to sit at room temperature until it returns to a liquid state, just as it was before you put it into the freezer.

Your other question is more problematic, not because the process of de-crystallization is complicated, but because there is no accepted definition of "raw honey." It is a marketing term, not a legal one. "Pennsylvania honey", for instance, is specific. Logically, it means honey harvested in Pennsylvania, made from nectar sources within the state. Raw honey, on the other hand, can be interpreted variously. A customer might assume it to mean that the product is unfiltered, whereas the beekeeper intends to convey that it is lightly processed. The Phil Craft definition might be honey as it comes from the hive, without any processing at all – in other words, comb honey. After all, honey houses are considered food processing facilities and are regulated and inspected as such by the government in most states. By extension, if raw means unprocessed, it must also mean un-extracted.

Most definitions of raw honey include some restriction on the maximum temperature to which it can be heated during processing. Purists go so far as to argue that heat should never be applied. If you have honey to de-crystallize, that poses a problem. The **only** way to return it to a liquid state is to heat it enough to melt the sugar crystals – to 100°F at least. Though it's true that excessive temperature can alter the subtle flavor of honey (that's why most people prefer the taste of local honey to that of the commercially processed, flash heated, pressure filtered generic product available in stores), there's no agreement on what is excessive. This group says that honey is not raw if it is heated, that one that it loses quality over 115°F so anything less than that is OK. However, during Texas Summers, honey supers can get hot, really hot. Does that mean that honey from Texas doesn't qualify as raw even if it's not processed? It's a debate I don't want to get into. I won't even stand behind the Phil Craft definition which I offered tongue in cheek (though there is some logic to it.) I simply avoid using the adjective raw as applied to honey.

I can only tell you how I handle processing and labeling my own honey. I produce and sell about 800 pounds a year. After extraction, I store it in five gallon buckets, and when it's time to bottle I move it to a double-jacketed, water heated bottling tank. I always heat it to at least 100°F to expedite the bottling process. (Warm honey flows more readily, which saves me a lot of time and eases the strain on my surgically repaired back.) If it has started to crystalize in the buckets, I turn the heat up to about 110° to 120°F for a couple of days. This de-crystalizes it, without (in my opinion) harming the flavor. I label it as "Kentucky honey" or "local honey." When asked, I describe it as lightly processed. If a customer is looking for raw or unprocessed honey, I encourage them to buy it from someone else.

If you really want to sell your honey as raw and unheated, and to avoid the crystallization problem, one solution might be to freeze as much as you can and consider making creamed honey with the rest. Creamed honey is a product of controlled crystallization and is the form in which most honey is consumed in some parts of the world. If you don't already know how to make it, contact me again for suggestions. BC

Listening To The Bees

Gone, But Truly Not Forgotten – An Excerpt

Mark **Winston**

I've learned quite a bit from bees, lessons around the value of collaboration, clear communication, a strong work ethic and social responsibility. But I've learned as much from the people I met through the bees as I did from the bees themselves.

My first encounter when I moved to BC in 1980 was John Corner, the Provincial Apiarist from 1950 to 1983. John was born in Ladysmith, a small town in BC built around the logging industry. His family soon moved to the remote Kootenay Mountains where he grew up hiking and canoeing in the surrounding wilderness.

John began his lifelong interest in bees as a 12-year-old working for a local beekeeper. His passion for bees continued to develop during the Second World War while fighting in Belgium. He was a decorated hero, receiving the Order of the British Empire for gallantry, but rarely discussed his combat experiences. He did often mention that he studied beekeeping as a distraction from the war around him, developing a habit of reading voraciously that he continued throughout his life. John had no formal education beyond high school, yet was one of the most educated and scholarly individuals I've known. Self-taught, he became an expert in Aboriginal rock paintings, consulted by experts worldwide about the BC pictographs that he meticulously documented. His book *Pictographs (Indian Rock Paintings) in the Interior of British Columbia* remains a classic and much-cited work, detailing hundreds of pictographs that he recorded over decades of travel throughout the province.

His impact on beekeeping in British Columbia was immense, a major factor in expanding what had been a hobby and sideline endeavour into a commercial industry. Most notably, he conceived and led a project to breed queen bees for BC, collaborating with esteemed researchers globally to design and implement the project. Honey bees have an odd genetic system and breeding bees is one of the more difficult tasks in animal husbandry, yet John and his team studied the subject intensively and worked through the complex genetics to produce reliable lines of bees. Those queens were among the best I've seen and many of the individuals working on the project became commercial breeders still influential in the BC beekeeping scene.

John Corner kindly took me under his wing when I first arrived in British Columbia. I was equipped with a fair bit of academic knowledge but little experience relating to beekeepers. We travelled the province together for many years, visiting individual beekeepers and attending meetings, providing a unique opportunity for me to observe and learn from John about how to interact with often-quirky beekeepers. John was the quintessential gentleman, as gracious when chatting with servers in the many small-town restaurants at which we shared meals as he was talking with dignitaries. He was an appreciator, curious about the lives and stories of everyone he met. He had mastered the art of being quiet but attentive, sparse in responding but resonating with thoughtfulness and kindness when he did.

John's listening skills made him an insightful judge of people, but he wasn't judgmental, just perceptive. This skill yielded excellent choices in those he hired, sometimes after just chatting for a few minutes, and many of the individuals he mentored are still leading figures in beekeeping. I don't recall John ever directly instructing me, or anyone else, about how to be, but I know I absorbed important lessons through spending time in his orbit. I came to appreciate the power of listening, the importance of curiosity and the value in building relationships with those from different backgrounds and perspectives than my own. The beekeeping world served up a rich source of friends and colleagues, largely because I followed John Corner's example.

He also inspired me to apply the thoroughness of basic academic research to applied questions. John's approach to bee research combined extensive combing of literature, careful listening to the practical experiences of beekeepers, meticulous experimental design, a high regard for replication through large sample sizes and conducting experiments over multiple years and in diverse locales. Our research on package bees, pollination, swarm prevention, pest management and other practical research topics in my laboratory benefited greatly from John's example. Due

Mark Winston, SFU photo.

in a large part to his influence, my laboratory became known for our careful attention to practical problems.

Cam Jay, a professor at the University of Manitoba, also became a close friend and an important role model. He, too, was the most careful of researchers, equally esteemed by the research community and beekeepers, but what he taught me by example was that work was not the primary goal of existence.

Cam developed a pursuit that gave him precious time alone but also provided opportunities to visit with his many friends across the prairies. He was a pilot who loved to fly, rebuilding a 1949 airplane that he kept in a hangar on property he owned outside of Winnipeg with a grass runway. He had quite a reputation for swooping down and landing unannounced at beekeepers' homes, on whatever pasture could serve as a landing site. He'd drop in, visit for a bit, and then head off to another unexpected stop. He was particularly renowned for winter flying, when he would land on a frozen lake populated by ice fishing cabins, knock on a door with an empty pizza box he kept in his cockpit, and ask the fishermen whether someone there had ordered a pizza. He was invariably invited in for a chat, a drink and some fishing time before taking off to fly back home.

Cam was a kid at heart, hardworking but also fun-loving. His home was covered with photos of special family events, friends and travels, but it was only in his home office that his numerous awards, plaques and honours were displayed. He told me once that he kept them privately rather than at his university office because he didn't want people to think more highly of him just because he had received some awards.

One of my great regrets is that I never had the chance to fly with Cam, but we did have two other traditions. I mentioned to him once that I was a serious pie aficionado, and from that day on there was always a fresh pie waiting for my Winnipeg visits, baked by his wife Doreen. Cam was reserved about many things but his love for Doreen was highly public. He was known as the "Billboard Romeo" in Winnipeg because every 10 years, around their wedding anniversary, he purchased a large billboard advertisement to proclaim his lasting devotion.

I saw Cam often at conferences, where we exercised our second tradition. We'd sneak away from meetings to seek out the best local milkshake, as shakes were almost as compelling for Cam as flying. The pies at home and the milkshakes away were mostly a convenient excuse to talk, and here I benefited from Cam's considerable wisdom about how to live a life. There was much contentment in Cam's life, but also sorrow, as there is for all of us. His infectious laugh provided a wonderful lesson that, as difficult as life can be, it can also be replete with joy and love.

Like John Corner he was never too obvious with direct advice, but nevertheless would provide gentle caution when he saw that perhaps I was taking myself too seriously. Academia is a profession in which overwork is rampant, and ego abounds. I so valued Cam's example of a different work-life balance than I saw in many of my colleagues, and learned from our time together that there were things in life more important than the job. Work hard but always with a sense of fun, love your family and enjoy your friends – these were the core guiding lights for Cam, messages that I very much needed to hear as a young faculty member tempted to overwork.

Eva Crane was the opposite of both John and Cam, although close friends with them both. She was direct with advice where they were roundabout, pointed where they were subtle. Our first encounter was more of a wrestling match without a referee than a small talk getting-to-know-you session. Eva was quintessentially British, and in looks and demeanour could easily have doubled for the Queen. Born in 1912, she earned a Ph.D. in nuclear physics in 1941, an unusual achievement for a woman of her era. She married shortly after, and she and her husband were given a beehive as a wedding present to supplement their Second World War sugar ration.

Her passion for bees soon won out over nuclear physics, and in 1949 she abandoned that career and started an organization that eventually became the International Bee Research Association. In that capacity she edited their journals, wrote 180 articles and many voluminous, comprehensive and seminal books about honey, beekeeping and the archaeology of bees, mostly while in her seventies and eighties. One of her books, on the rock art of honey hunters, reflected a joint interest in pictographs she shared with John Corner.

Our first meeting was in my office at Simon Fraser University shortly after I'd arrived in 1980, and it turned into a tussle, albeit an enjoyable one. We'd barely said hello when she insisted that we find a larger room with a long table at which to work. She was carrying a manuscript I had submitted to the publication she edited, the *Journal of Apicultural Research*, and she didn't want to waste a moment before getting down to fixing my writing errors. We got to work and spent most of an afternoon reading through the manuscript word by word, arguing over what I thought were the most minor of changes. At first I was taken aback, then perhaps a bit defensive, but by the end of the day I had to admit how much I'd enjoyed myself.

Eva was my first serious editor, and through her I came to appreciate the importance of exact language and the power of focus in writing. Words mattered to Eva, not only in themselves but because bees matter, and anything that matters deserves the most rigorous attention to the highest standards of precision, clarity and nuance that language can provide.

John, Cam and Eva all passed away within three years of each other: Eva in 2007, Cam in 2008 and John in 2010. I felt the loss of each of them deeply, partly because they represented a rich era in bee science and beekeeping, but also because each had graced me with models for how I, too, might grow. From John Corner I learned to listen and to treasure the great diversity in personalities and attitudes revealed when we approach others with curiosity rather than judgment. Through Cam I grew to be a more balanced person, becoming more focused and effective at work as I learned to relax at home. Eva reminded me of the thrill in a well-turned phrase and the joy in finding just the right words (but not too many), igniting a passion for language that is still among my greatest delights.

As I age I am beginning to understand that a common phrase we use for those who have passed on is more than just a cliché. John, Cam and Eva: for me, you may be gone but you are truly not forgotten. BC

Beekeepers & Bombs

Ross **Conrad**

Varroa bombs. Let's think about that.

It is the nightmare scenario of every beekeeper. *Varroa* mite populations build up in colonies to such detrimental levels that it causes the health of the bees to decline dramatically. *Varroa* laden drones drift from the infected hive to other colonies nearby. Meanwhile there are not enough guard bees to defend the entrance of the *Varroa* weakened hive causing it to be robbed out by neighboring colonies. Mites then hitch a ride from the doomed hive to new colonies in the area further weakening bee's immune systems and vectoring diseases in the process. Perhaps due to the subliminal effect of America's never-ending war on terror, this situation has been called the varroa bomb.

A particular segment of the beekeeping community has consistently been singled out and accused of perpetuating the *Varroa* bomb phenomenon – those that don't treat for *Varroa*, known as treatment-free beekeepers. These people have been denounced, called bad beekeepers and much worse by angry beekeepers who blame the mite bomb for their colony losses. At first glance this line of thought makes sense, but upon closer inspection there are holes in this argument that suggest that, at least in some cases, the varroa bomb is a dud.

Faulty Assumptions

First of all the above scenario assumes that the treatment-free beekeeper is either ignoring the mite loads in their colonies, or is a hands-off beekeeper intent on the idea of letting evolution play out. The idea is that colonies that are susceptible will die off leaving the stronger ones that exhibit some level of resistance to carry on. Given the genetic diversity that nature helps to create every time a queen bee mates on the wing, the chances of keeping resistant bees resistant, let alone getting bees to develop resistance in the first place with open mating, is a long shot at best.

Despite the often misguided assumptions of many treatment-free beekeepers, finding them at fault for creating mite bombs is not necessarily valid. As I have written in the book, *Natural Beekeeping: Organic Approaches to Modern Apiculture, 2nd Edition*, just because a beekeeper does not introduce a substance of some kind into their hives to control mites does not necessarily mean that they are not taking steps to keep mites in check. Screened bottom boards, the culling of capped drone brood, regular comb rotations and brood breaks all can help a colony to overcome the impacts of varroa (especially when all four are combined) without the need for chemical treatments of either the hard or soft variety.

What Does Science Say?

Then there is the science that suggests that there are serious flaws to the *Varroa* bomb argument. This comes in the form of solid research conducted by Tom Seeley biology professor at Cornell and arguably the world's leading expert on honey bee behavior. Dr. Seeley studied feral European honey bee colonies living in the Arnot Forest, Cornell University's 4200-acre research forest located 15 miles from Ithaca, New York. He found that these wild hive locations were not simply being reoccupied by swarms from managed colonies each year, but were able to survive *Varroa* mite infestation without any treatments being applied by beekeepers. (Seeley 2015a) Seeley also co-authored research that indicates small nesting cavities and a high frequency of swarming contribute to a feral colony's ability to persist in spite of the mite's presence. (Loftus 2016) Since a significant number of treatment-free beekeepers are relatively inexperienced at preventing swarming and/or are using top bar hives that naturally limit the size of the brood nest cavity, it is likely that these treatment-free bees are able to benefit from some of the same hive conditions as the feral colonies in the Arnot Forest.

Additional research indicates that honey bee colonies that are widely spaced across the landscape (such as those found in the Arnot Forest or the single colony kept by a backyard beekeeper) are less likely to experience drifting or robbing to and from neighboring bees, compared to colonies kept in crowded apiaries. (Nolan 2016, Seeley 2015b)

Either the solitary hive in the backyard is able to naturally suppress its mite levels and resist drifting of bees that may carry mites and pathogens due to its relative isolation, restricted cavity (in the case of the top bar hive), and propensity to swarm, or they are varroa magnets that end up collapsing and spreading mites and diseases to all the other hives in the area – we can't have it both ways.

Some Personal Experience

Admittedly, not all treatment-free beekeepers have a single hive or keep all their hives isolated and separate from others. I have been conducting a study comparing varroa treated colonies to colonies that have no mite control whatsoever.

I started the study with 30 colonies that have received *Varroa* control and 15 colonies located about ¾ of a mile away in which *Varroa* are not controlled at all. This situation should create the perfect *Varroa* bomb scenario. Although colony survival after two Summers and one Winter are statistically similar in both groups, what is different is the cause

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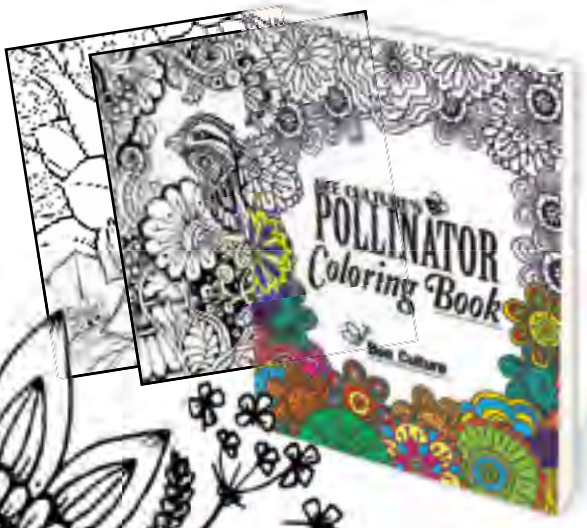

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of colony death in each beeyard. While some of the bees in the non-treated group failed during the warm active season, most died during the cold season after going into Winter with very high mite loads. The group in which mites were controlled and *Varroa* populations were low going into Winter almost all survived Winter and died primarily during the Spring, Summer and Fall from queen issues. This is not the kind of result we would expect to see if the *Varroa* bomb theory holds. My experience suggests that if northern climate beekeepers that are on top of *Varroa* and treat for mites in early September so mite levels are low going into Winter, so-called *Varroa* bombs are a non-issue.

Another hole in the *Varroa* bomb theory is that in northern climates when colonies die out during Winter from mites, the intense cold and lack of flying weather ensures that the mites in the infested hive will be dead by the time other colonies come around and start robbing. Therefore, the *Varroa* bomb issue does not apply during a significant portion of the year in colder regions and suggests that whatever harm the *Varroa* bomb phenomena actually creates is more of a concern in warmer climates such as those that exist in the southern United States.

Colony Losses Climb

Over the past seven years throughout the U.S., those who are "good neighbors" and judiciously use treatments to keep *Varroa* populations under control experienced average yearly losses of 33 percent. While this is a 10 percent improvement over those "irresponsible" treatment-free beekeepers that lost hives at an average rate of 43 percent (Bee Informed Partnership), it is significantly higher than what had been considered to be the normal yearly loss of between 10-20 percent in the early 2000s and the less than five percent yearly losses experienced in the 1970s before mites were found in the U.S.

Misreading the signs

The Deformed Wing Virus (DWV) is closely associated with stress from *Varroa* mites. As a result a common method of determining mite related losses is the presence of bees with shriveled wings caused by DWV. However, research indicating that neonicotinoid pesticides can increase DWV replication 1000 times the normal rate all of a sudden makes this way of gauging a colony's *Varroa* stress level and cause of death unreliable. (Di Prisco 2013)

Scientific evidence indicates that when colonies are crowded together in a single apiary they are much more likely to share mites and diseases than when colonies are isolated and spread out over the landscape.

How many times has a beekeeper blamed a neighbor's *Varroa* bomb for their colony losses when the signs of DWV were a result of neonicotinoid contamination? Or perhaps it was a failed treatment that led to high mite levels in treated hives. Depending on the treatment used, many things can go wrong including mite resistance, inappropriate temperatures during treatment, incorrect timing of treatments, old and outdated treatment materials that are no longer effective and incorrect treatment applications.

Despite all the things that mimic the *Varroa* bomb scenario, but not cause it, accusations are still quick to fly. I get it. It has never been as hard to keep bees alive as it is today. Average annual hive losses have reached 30-40% in most areas of the U.S. Bees treated for mites are too often dying anyway.

A House Divided Cannot Stand

For those who work diligently to keep *Varroa* under control, the primary culprits of honey bee decline are pesticides, a destabilized climate, and loss of forage habitat due to land development and industrial agricultural practices. As a result, in many cases, the cry of the *Varroa* bomb comes across as horizontal or lateral violence. Lateral violence is defined as displaced violence

directed at one's peers rather than one's adversaries. Thus, frustration and anger not able to be vented on the powerful corporations and ineffective government regulators behind most of our colony losses are instead taken out on those within the beekeeping community – the treatment-free beekeepers.

To quote from Abraham Lincoln's famous 1858 speech, "A house divided against itself cannot stand." We live in a time where it is more urgent than ever for beekeepers to come together and speak with one voice. While it is easier to lash out at members of the beekeeping community than deal with the corporate giants and government bureaucracy that perpetuate some of the most deadly threats to the honey bee, we would be wise to pause and think twice before doing so.

Ross will be teaching a two-day intensive, Getting Started in Organic Beekeeping class May 19 - 20, 2018 at the Metta Earth Institute in Lincoln, Vermont. For more information visit ***http://www.dancingbeegardens.com/events.html*** *or call 802-349-4279.*

Hive designs that do not allow the beekeeper to easily add more room when needed such as the top bar hive, limit the size of the brood nest which can lead to increased swarming. The break in the brood cycle caused by swarming has a detrimental impact

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For details and registration visit **www.Coloradobeekeepers.org**.

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CT Beekeepers Association will hold Bee Talks April 12 at Rockfall Foundation, 27 Washington Street, Middletown, 6:30-8:00 p.m. **Spring Inspection Workshop** April 14 at Massaro Farm, Woodbridge, 9:00-10:30 a.m. or 11:30 a.m. - 1:00 p.m.

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♦GEORGIA♦

UGA / Young Harris Beekeeping Institute, May 9-11 at Young Harris College, Young Harris Georgia

The most comprehensive (and fun) beekeeping event in the Southeast. Includes lectures, workshops and demonstrations from local, national, and international speakers. Plus hands on beekeeping training, the Georgia Master Beekeeping Certification Program, Welsh Honey Judging Classes and International Honey Show.

For more information please visit **www.ent.uga.edu/bees**.

Queen Rearing Classes will be held at Honey Pond Farm, Jennifer Berry, April 13-14 and May 25-26. **Beginning Beekeeping Class**, April 22.

For information contact **www.honeypondfarm.com** or **Jennifer@honeypondfarm.com**.

♦KANSAS♦

Northeastern Kansas Beekeepers 2018 Funday June 2 at the Douglas County Fairgrounds in Lawrence. This is a special day to honor Dr. Orley Taylor.

Chip Taylor's grad students will be speakers – Marla Spivak, Mark Winston, Gard Otis, Jose Villa and David Roubik and others.

For information visit **www.NEKBA.org** or contact Joli Winer, 913.593.3562 or **joli@heartlandhoney.com**.

♦OHIO♦

Lorain County Beekeepers Association will have a Spring Management meeting April 13 at Life Church, 1033 Elm Street, Grafton.

For more information visit **www.loraincountybeekeepers.org.**

♦PENNSYLVANIA♦

The Capital Area Beekeepers' Association will hold is 31st Annual Short Course, May 5 and 12. Part 1 at the Dauphin County Agriculture & Natural Resources Center in Dauphin starting at 8:00 a.m. and Part 2 starting at non at Strites Orchard, 1000 Strites Road, Harrisburg.

The cost is $50 which includes membership and the book, *Fundamentals of Beekeeping.*

For additional information visit **cabapa.org** or contact John Novinger, 717.365.3215 or **jdnovinger@epix.net**.

Queen Rearing Classes May 12-13, 9:00 a.m. - 4:00 p.m. and May 22, 6-8:00 p.m. at Delaware Valley University, Doylestown, Feldman Bldg. Room 122.

The cost is $219/person and Vincent Aloyo is the instructor.

For information and to register visit **www.delval.edu/continuing-and-professional-studies/non-credit-certificates-and-courses**.

♦VIRGINIA♦

Top Bar Beekeeping April 7. Classes take place at Spikenard Honeybee Sanctuary in Floyd, VA.

For more information visit **www.spikenardfarm.org or contact: info@spikenardfarm.org** or 540-745-2153.

♦WEST VIRGINIA♦

WV Beekeepers' Association will hold their Spring Conference March 23-24 at Tamarack Conference Center in Beckley.

Speakers include Debbie Delaney, Parry Kietzman and others.

For information and to register visit **www.raleighcountybeekeepers.com** or contact Mark Lilly at 304.860.9638.

♦WYOMING♦

WY Bee University and Bee College, Cheyenne, March 16-18.

The Bee University has a choice of four all day workshops on Friday, March 16. The Bee College runs, March 17-18 and offers five tracks on day one and four on day two.

For more information and a schedule visit **www.wyomingbeecollege.org**.

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Yesterday was a grand slam. First I got a massage from a chiropractor of rare talent. She trades her services for our honey, beef and lamb.

Then, a couple of hours skiing on Aspen Mountain. The Aspen Skiing Company kindly awarded my gal Marilyn and me lifetime passes, in recognition of my 44 years on the ski patrol. As a patrol retiree, I no longer have to tackle the gnarliest runs or carry bundles of bamboo on my shoulder while skiing. I don't have to listen to my patrol radio or touch a toboggan. Skiing's fun again!

Next, my annual Medicare physical, from a physician who sees things my way. Look, I'm 70 years old. Nobody lives forever; I'll take my chances. Let's not go chasing test results that might sit me bolt upright in the middle of the night. And please, no risky biopsies in certain sensitive bodily nether regions. I've been in the hospital. I'd rather spend my time in the beeyard. The good doctor took all this in and nodded sagely.

I told him that cannabidiol, or CBD, cured the arthritis in my hands. Used to be I couldn't button my shirt without help. CBD might not be legal where you live, but here in wild west Colorado all the pot shops stock it. CBD is derived from marijuana but does not make you high.

Then, after my physical, I walked across town to the annual mid-season Aspen Mountain Employee Appreciation party, of which I was a sponsor. Lesson learned: Next year we should order less beer and more pizza!

I was going to ski another day this week, too, but I got caught up in the endless complications of submitting to Colorado's state pesticide czar recommendations for amending the state's Managed Pollinator Protection Plan (MP3). The state's current plan basically states that pesticide applicators ought to follow label directions, if it's convenient. The Colorado State Beekeepers Association (CSBA) argues that the plan would be more effective if it had some teeth.

The Pollinator Stewardship Council did the heavy lifting to get the CSBA's MP3 recommendations to CSBA members so they could sign them online, using mysterious "Salsa lab" computer technology that I do not pretend to comprehend. There were details, questions and last minute changes. I needed to stick around, so my ski plans got canceled. I'd wanted to ski in the morning and look at bees in the afternoon on the way home.

OK, I didn't get to go skiing. I still checked the aforementioned bees at 1:30 sharp, because I'd made a reservation the week before to do so. They belong to a billionaire who likes honey bees and pays me to look after his. You could Google this gentleman's name. He's controversial.

On most properties where I keep bees, I come and go as I please. At this particular apiary, however, my instructions are to call before I visit the bees, so that there's someone to "buzz me in" through a series of locked gates, and so they know I'm coming.

Last June I sold this guy four hives, for a song. *Mea culpa,* but he pays me handsomely to take care of his bees, so everything's all right. It's just that beekeeping is a little more complicated when it's on a billionaire's estate. Take hive access: I can only visit his little darlings Monday through Friday, nine to five, provided I've called ahead. I can't just drop by if I happen to be in the neighborhood.

I don't deal with the billionaire directly but rather through his personal assistant. The assistant is a good kid. He relays information about the bees to the owner, who is rarely mentioned by name. He's simply "the owner." The owner knows a little about bees and has concerns about their care and feeding. I'm working to win his confidence.

Then there's the owner's chef. He got all indignant when the honey I dropped off last September crystallized. I tried to explain, but there are people you just can't get through to.

The hives themselves are bomber. When I sold them last June, they were just four strong colonies looking for a square meal. In September I pulled over 200 pounds of honey, which around here is a decent harvest. Afterwards the bees got on a short but wicked honey flow, so the hives went into the winter plugged. When I visited them last week, on February 7, all four had at least ten frames of bees. They were still dead heavy. I wish my own overwintering colonies looked this good!

You don't want to gush or brag, because honey bees can surprise and disappoint you. So when the owner's assistant asked me what update he could provide the owner, I simply said, "They look fine."

Marilyn met me at the employee appreciation party in Aspen. She doesn't imbibe, but she can hold up her end of a conversation. She's very popular. We chatted with a woman who took beekeeping lessons from a "bee whisperer." The woman's an old friend, and I didn't lecture her about going off the deep end of bee husbandry. Maybe I can bring her to her senses yet. I'll make sure she gets an invitation to come to the June 9 CSBA meeting. Our keynote speaker is Sam Ramsey, who can tell you things you never dreamed of about Varroa mites.

At the witching hour of 7:30, Marilyn and I walked arm in arm to the bus stop. On the ride home, she put her head on my shoulder. We were back at the farm by nine. The blue heeler Pepper greeted us at the door. It had been a big day, but it wasn't over yet. Looking back, I'd call it a grand slam.

Ed **Colby**

Grand Slam

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