Permaculture Design

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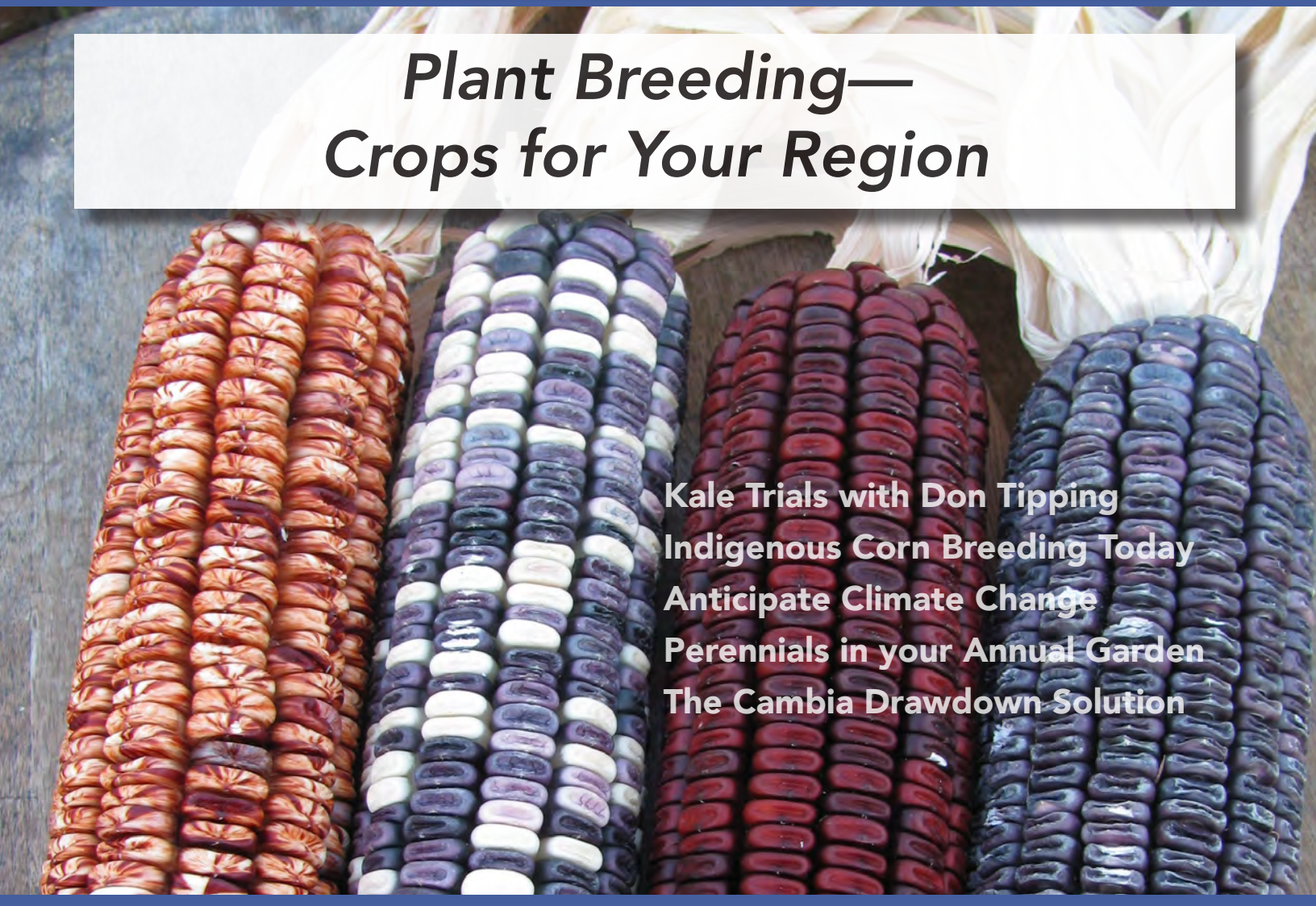

Plant Breeding— Crops for Your Region

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Upcoming Issues, Themes, & Deadlines

#106	**The Doorstep**	**September 1**
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#108	**TBD**	**March 1**

Working with Nature

Rhonda Baird

I THOUGHT THAT I UNDERSTOOD working with nature to co-create systems that would heal and regenerate the land and also people. I've been standing up in front of or in circle with hundreds of students now for over a decade. Because I'm serious about practicing nature connection, I felt confident that I knew how to proceed. I understood that we need to focus on food security and crops because, in terms of basic needs, there is actually lots of shelter—if not access to it—and plenty of clothing to keep everyone modestly covered for years to come; while food needs to be fresh, local, and nutrient dense to heal people and landscapes. Yet this issue on "Plant Breeding" brought me to another level of understanding about the relationships between people and plants. Truly, we are co-creating and co-evolving with the plants (and insects and animals), all while spinning on a planet undergoing marvelous changes. And we have been doing this our entire existence as a species. Mollison purportedly said, "Everything gardens." Everything selects what fruit to eat and which seeds to disperse. Reintegrating ourselves with nature means we are once again thoughtful about where and what we plant. Every seed planted and every plant nurtured is a choice about what will be available to our descendants.

This issue will help us to take some steps towards a better legacy. Don Tipping starts us off with his experiences with kale improvements. Zachary Paige shares about his work with the White Earth Land Recovery Project and their tending of corn. Susana Lein, Carol Deppe, and Eric Toensmeier share with us the importance and possibilities with breeding vegetables and perennials and much more. Liora Adler and Andrew Langford team up with an important article on using permaculture-based design in conjunction with dryland almond orcharding techniques that seem likely to greatly increase carbon sequestration, while increasing yields and reducing water requirements. Jennifer English Morgan writes of Emergent Design, while we can enjoy the second portion of Peter Light's article on designing from the doorstep. Chris Smith follows up his piece from #104 with a new one about including perennials in an annual-based garden. Jerome Osentowski and Tom Ward, aka Hazel, share their long-term permaculture projects and invite us to get involved. Adam Brock shares an important section on group dynamics from his new book. And, finally, the IPC team describes the International Permaculture Convergence and how it's shaping up: inviting us all to India.

With this issue, I'm also moving from a regular guest editor to senior editor with the magazine. My heart is filled with pride to step into this role. As the regular layout person, I've teared up as the issue goes for proofing and printing—filled with gratitude for what writers have offered of their experiences and insights into permaculture design. It has also been a full and welcome collaboration between John Wages, the publisher, and myself over the past year. We are pleased and excited by the steady pace of change occuring and by the positive response the magazine receives. Please do weigh in and share your observations and appreciations.

What gardens will our descendants tend? What foods might they eat?

I am writing this between packing for a much-needed week in the forest away from all communication. I hope that your summer includes some down-time; some fruits and vegetables from the garden, and some new adventures in breeding plants. Δ

Permaculture Design #106: The Doorstep

Share your insights and experiences in Zone 1 for our next issue. What have you learned about the importance of starting small and slow, working outward from a controlled front, and designing plantings with efficient zonation? Share it with our readers.
Articles needed by Sept. 1 (or thereabouts).

Breeding the Heirlooms of Tomorrow

Cultivating Resilience to Climate Change

Don Tipping

PLANT DOMESTICATION is an ongoing process—a relationship rather than an endpoint. When I first began seed-saving nearly 25 years ago, I perceived our relationship with the domesticated plants as more akin to one of enslavement and servitude. The more time I work closely with saving seeds and making selections across a wide diversity of plant families, the more I see how we are working towards one another's best interests. Through understanding what traits enable a plant to adapt more proficiently to its environment, we can tease out the best aspects of a given variety.

When I take a big step back and look at the long view of the history of agriculture, I believe that seed-saving is likely the defining element of agriculture, if not of civilization itself. Consider that before humanity was harvesting, saving, and replanting seeds, we were hunter-gatherers—or some mix of hunter-gatherer and horticulturalist. In this way, we may equate seed-saving with agriculture.

Ironically, agriculture has become so specialized that it is the rare farm that actually saves any seeds now. Most farms (including most organic farms) buy all of their seed every year. Seed-saving has become a task relegated to the experts. This is unfortunate, because along with the maintenance of soil fertility through on-farm nutrient cycling, saving your own seed is the most important feedback loop to fine-tune the whole farm organism to the climate, pests, diseases, stresses, and consumer preferences. If more farmers could witness what is possible through thoughtful on-farm selection, they might be inclined to abandon the expensive, fancy Dutch hybrids that fill the glossy pages of so many seed catalogs in favor of growing and selecting their own seeds.

First you must have a comprehensive knowledge of what is possible….

It is estimated that before the Green Revolution's far reach, India had over 30,000 varieties of rice. Afterwards, it had eight! Where did all of that agri-biodiversity go? And why were there so many to begin with? The likely explanation is that nearly all farmers saved their own seed in every microclimate, which allowed the plants to constantly adapt to subtle differences in soil, climate, and other factors. Put most simply: a plant that performs the best out of a population will make more seeds, thereby producing more seeds than a plant that does poorly. Over time, simply saving seeds inherently leads to adaptation to the environment.

Hand-pollinating squash and closing or bagging the flower ensures squash varieties do not cross.

Start with variety trials

When you save seeds from anything less than a whole population of plants, you are engaging in plant breeding. Obviously, applying some intention to the process can improve it greatly. The process of breeding first involves identifying the traits that you want. But first you must have a comprehensive knowledge of what is possible for a given species or type, beginning with variety trials—growing numerous individuals of a given species in order to thoroughly understand what is possible within the breadth of that species' diversity. This helps you to identify the endpoints of a spectrum for each trait and all points in between.

We have a lettuce variety trial planted at our home farm right now with 20 plants each of 75 varieties that we steward for our family farm organic seed company, Siskiyou Seeds. This will reveal a lot of information about the lettuces that we grow. We can observe how they stack up against each other in the field. We will evaluate and score them for appearance, vigor, pest and disease resistance, flavor, bolt resistance, and an overall grade. What may happen as a result is that we realize that some varieties are inferior to another in a given category, say red romaines, and we may wind up dropping a variety. We might notice that we don't have a good variety within a given category, such as French batavians—noted for their excellent growth performance in hot weather, and we may need to source new strains and trial them again to see about adding a new one. Our results may also highlight opportunities for us to breed for better bolt resistance by crossing similar strains, for instance one with good bolt resistance, and another with our preferred disease

resistance and leaf shape. The possibilities become staggering once you try and get a handle on all the plant biodiversity out there, but performing regular trials is a crucial component of any plant-breeding program.

A number of years ago, we planted a good sized kale trial with 100 plants each of 22 varieties that represented three basic types: Siberian/Russian *(Brassica napus),* Lacinato/Black Tuscan *(Brassica oleracea),* and Curly/Vates type Kale *(Brassica oleracea)*. We planted them in the late summer and observed their performance in the fall, winter, and spring. We had Red Russian Kale from five sources: (1) our strain that we had saved for over a decade here in Oregon, (2) one from southern California, (3) one from Colorado, (4) one from western Washington, and (5) another from a colleague 250 miles north of us. We noted that the kale from Washington truly disliked our hot early fall weather and suffered. The kale from southern California had never experienced cold like we had that winter (10°F or -12°C for a week in January) and died. The kale from Colorado did well with both the heat and the cold. And the kale from a bit north did great (as expected). This taught us an important lesson: bioregional adaptation is an important consideration, but more importantly is adaptation to climate patterns. So while we may actually be in the same general "bioregion" of the Pacific Northwest as western Washington, we have observed that the climate of the high desert of Colorado is functionally similar to that of the Klamath Siskiyou region that we inhabit. Once again, understanding these patterns is only truly possible through repeated variety observation trials.

We have strains of vegetables that have 40 years of adaptation to the growing conditions of our region.

Traditional plant breeding

Before the advent of modern hybrid plant breeding, we had many skilled traditional plant breeders across the world. In the US, many of these were affiliated with our Land Grant universities, helping to select and breed for varieties that helped those areas' farmers to thrive. This was a wonderful feedback loop that worked fairly well to serve the needs of small-scale family farmers. With the corporate takeover of plant breeding through proprietary hybrids and other strategies, much knowledge about traditional methods was lost and consolidated in the hands of companies whose goal was profit over people.

I am grateful to have had the opportunity to study with John Navazio, PhD, who was able to learn from some of the greats of a bygone era. He is currently employed at Johnny's Selected Seeds breeding open-pollinated vegetables. From his influence, there exists a new vanguard of amateur plant breeders. Many of them may have their own small seed companies to showcase their varieties and provide an economic vehicle for them to continue this slow and sometimes laborious work.

Before one embarks upon a plant-breeding project, a thorough understanding of the species that we aim to improve is vital. In the words of John Navazio, "we should strive to become a Samurai warrior for the species we want to work with." This entails an exhaustive study of its botanical relatives—currently available varieties—through variety trials and detailing of the important traits and agronomic considerations that we should focus our attention on. I believe that this is vital work, so in light of this we have been offering the five-day Seed Academy training at our farm, which is a deep dive in a whole systems approach to seed-saving, plant improvement, breeding, seed-cleaning, and seed stewardship, with guest appearances from luminaries in this movement for the past four years. The fall offering will happen in early November 2017. Please visit our website at www.sevenseedsfarm.com for details.

Why breed new varieties?

Paging through the *Seed Savers Exchange Yearbook* gives an astounding glimpse into the tremendous diversity of open-pollinated varieties that are currently commercially available. Nonetheless, this diversity represents a mere 7% (or so) of what was available 50 years prior. Why would we need so many different varieties? There are many unique microclimates in this country. Couple this geographical diversity with our culinary palates and regional preferences, and you can begin to understand that there are many ideas as to what constitutes "the perfect variety."

What do you do after performing thorough variety trials, and concluding that there is still something lacking? Consider further that what was once suitable within a region or amongst a community of growers may not be suited to today's conditions. Our ideals of perfection and suitability must align with the dual moving targets of climate change and shifting consumer preferences. Now it gets complicated!

The way I see it, seed-saving is the doorway into cultivating a deeper relationship of seed stewardship. We have been working with many of the varieties grown here at Seven Seeds Farm for two decades or longer. Add to this that we inherited a seed collection including many varieties that have been grown in the area since 1978. So we have strains of vegetables that have 40 years of adaptation to the growing conditions of our region—baby steps from an indigenous agriculture perspective, but also a good start.

Through evaluating the collection that we steward here on our farm and make available through our retail seed company, Siskiyou Seeds, we are firmly convinced that seeds "imprint" upon their locale. I believe that we have two paths that we can choose as permaculture horticulturists: one option is to adapt to climate change by adapting our seeds—from the inside out—taking a cue from how water flows around obstacles. The other option is the path that is being taken by most organic farmers and conventional agriculture—to adapt to change

by manipulating the environment outside in—row covers, herbicides, insecticides, high tunnels, and prima donna hybrid genetics that do great when everything is optimized perfectly. I've heard stories from John Navazio of Dr. Henry Munger at Cornell University who would grow thousands of cucumber starts and then taste the cotyledons of each, selecting for the non-bitter tasting ones that he had observed were less favored by cucumber beetles, thereby breeding for cucumber beetle resistance!

The more I ponder the question— "what is the way forward considering the enormity and potential severity of climate change upon the meta-stability of human civilization in light of anthropogenic induced climate change"?—I conclude that the thoughtful breeding of our annual food crops, domesticated animals, and perennial plants represent our best chance for thriving and maintaining resilient agrarian communities. I do not place my stock in techno-fixes. I believe in biology. Can I get an Amen?

Lettuce varieties trials for Siskiyou Seeds.

A variety improvement case study

From the kale trial that I described above, we determined that there was room in the available open-pollinated seed offerings for a workhorse curly green "Vates" type kale. This conclusion was underscored by the shortage of Winterbor F1 seed that was occurring at that time: a variety that most all organic growers were relying upon to fill boxes for kale-hungry customers. So, we let the seven varieties of that type in our trial of both open-pollinated and hybrid F1 types to intermate, or cross-pollinate. That was in 2010, and the total population was about 700 plants of seven varieties. That winter we experienced a week of sustained lows at about 10°F (-12°C). Nevertheless, about 25% of the plants survived and managed to make flowers and seeds—freely cross-pollinating amongst one another. What we had created was a diverse gene pool of potentiality, also known as a "Grex" which is Latin for "herd." Another term used for this is a synthetic cross, or "Syn" for short. It was anything but uniform, containing so many different traits. We harvested seed in summer of 2011 and replanted right away, overwintering and then flowering and inter-mating in spring 2012 again. Once again, we harvested seed and replanted in fall of 2012, allowing the cycle to complete one more time with no selection pressure other than the climate. In fall 2013, we planted a large population of about 2,000 plants and overwintered. In the early spring of 2014 we identified our favorite 100 plants based on the following traits: deep green color, vigor, deeply curly leaf shape, upright stature, and disease resistance. We tagged our favorites with surveyors tape and allowed them to flower and set seed. Once seedpods had dried down, we harvested the seed from our 100 favorite "mothers" into 100 separate bags. Mind you that the other 1,900 plants were allowed to flower and make seed so these 100 mothers had a potential of 2,000 different "fathers." Kale is a monoecious perfect flowering plant that has both male and female flowers on each plant. This project is known as a "Half Sibling Progeny Row Breeding program."

The laboratory can't do everything.

From these 100 different bags of seed, we planted 50 plants from each, giving us a total population of 5,000 plants that we transplanted in the early fall of 2014 in small blocks that were labeled with stakes numbered 1-100. This represented a sampling of the progeny of our 100 mothers, meaning that they all had the same mother, but that their fathers were unknown, hence the term, "half sibling." As the season progressed, we evaluated them for the same traits listed above, and then we "rogued" or eliminated about 30% of the mothers as unsuitable. Then, within the remaining 70%, we removed individuals that failed to meet our breeding criteria. This resulted in a total population of about 2,000 plants that went into the winter of 2014/2015. The following summer, we harvested the resulting seed from this vastly improved population. This became the new "Alive Vates Grex Kale," and we sold seed of it widely. In order to evaluate if we had actually made any genuine improvements, we planted another trial including a wide diversity of kale in the fall of 2015. This allowed us to compare our efforts against other commercially available strains.

Fortunately, we had made great strides in the direction that we were aiming. However, we realized that it may be worthwhile to breed more height into the Alive Kale population, so we selected the tallest and best specimens from the other Vates types in our trial and allowed them to overwinter with the 50 plants of the Alive Vates in our trial. In the spring of 2017, these 150 plants all flowered and intermated. They are in the field now, and seedpods are maturing. We will harvest this seed in July and then replant alongside our original Alive Vates to evaluate our progress.

I share this case study to highlight what a long process plant breeding becomes, especially with a biennial like kale. But please do not be dismayed, because, through employing traditional plant breeding techniques such as the half-sibling progeny rows and then the back-crossing to tall Vates Kale, we

can greatly accelerate the process over simple "mass selection," or simply saving seed of the best plants in a population. The parent lines of hybrids (including GMOs) are created using similar techniques. The laboratory can't do everything. Sexual reproduction in the field is absolutely necessary.

This deep interplay has birthed human civilization....

Where to start?

I encourage anyone reading this to not become overwhelmed by the seeming complexity of plant breeding. Start small with a crop for which you have an affinity, and begin the journey of a deeper relationship with plants. In a way, I see that selection, adaptation, and breeding allow us access to the fine-tuning control knobs of the genetic potential of a species. Holding the reins, we can begin to steer a variety towards the goals that we outline for our project, fostering greater adaptation to the stresses that that variety will encounter in our systems. We also become witness to how the great diversity of interactions that take place between soil, insects, environment, our diets, and our creativity converge in a given variety. This deep interplay has birthed human civilization, and I firmly believe with every ounce of my being that it is the portal of the way forward. See plants as your allies, and they will guide you to becoming more curious as to how we may be of service to them and all life in the process. Δ

* We have numerous opportunities to explore our work here: The Seed Academy training at Seven Seeds Farm in November 2017, the Life Stream Folk School 6-week immersion in permaculture living. Learn more at www.sevenseedsfarm.com. And then of course there is growing our seeds (and saving seeds!) at www.siskiyouseeds.com

Seven Seeds Farm is a small, organic family farm in the Siskiyou Mountains of SW Oregon. We are now in our 21st season. Lauded as one of the best examples of small productive biodynamic and permaculture farms in the Northwest by many, Seven Seeds mentors new farmers through internships and workshops. Seven Seeds has also been active in USDA Western SARE, Organic Seed Alliance, and other seed initiatives to advance the development of open-pollinated organic seeds. In 2009, we began Siskiyou Seeds, a bioregional organic seed company operated from the home farm. Don helped found the Siskiyou Sustainable Cooperative, which manages a 300-share CSA, commercial seed growing, and an equipment co-op and internship curriculum among 12 cooperating farms. He also co-founded the Family Farmers Seed Cooperative, a seed grower, marketing, and distribution cooperative comprised of ten western organic farms. More recently, we created the Southern Oregon Seed Growers Association (SOSGA) to advocate for and support a bioregional seed system. With this group, Our Family Farms Collective (OFFC), and Oregonians for Safe Food & Families (OSSF), we successfully banned the growing of GMO crops in Jackson and Josephine Counties.

Don helps people focus upon helping people build their skill sets in sustainable life skills such as permaculture, biodynamics, organic gardening, ecoforestry, seed-saving, and other traditional arts that help to build regenerative culture. He sits on the board of the Rocky Mountain Seed Alliance and is a regular contributor to the OSU Small Farms educational programs. The Seed Academy is a five-day intensive in organic seed production and plant breeding that occurs at Seven Seeds Farm with guest instructors including Rowen White, Bill McDorman, Belle Star, Andrew Still, Sarah Kleager, and Jonthan Spero. Don is also a charter member of the Open Source Seed Initiative (OSSI) as a plant breeder and a seed company advocate. He also sits in an advisory role with Top Leaf Urban Farms in Oakland, CA. Don is regularly sought out as a teacher, collaborator, and consultant in the Pacific Northwest.

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Breeding Plants for the Gardens to Come

In Search of our Ancestors' Gardens

Rhonda Baird

I REMEMBER EXPLORING my grandfather's gardens. Bryce Ping had five gardens located in different parts of Jackson County, Indiana: each one sporting some of the same—but often different—varieties of squash, corn, peppers, and tomatoes. The garden on his own property was one of the finest examples of integrated systems I've ever seen—replete with beds on contour, re-use of water, rabbits, geese, and chickens. Everything was mulched with newspaper and grass, sawdust, or spoilt hay from nearby. He lived from the salvage economy: heating with scraps from the sawmill and re-using every plastic container that entered his house.

He also introduced me to the varieties and unusual qualities of many fruits, flowers, and vegetables. His entryways were lined with canned goods (his own parents had tried to run a canning business when commercial grocery stores came into their region) and he continued to value preserved food—often experimenting with recipes. Jars also held seed saved from year to year. Paper plates lay about the kitchen in summer—drying various seeds from the day's harvest. He wasn't very meticulous about labeling them—but I imagine that he must have developed several of his own varieties. When he passed, my aunts distributed the goods—and I wonder what happened to those canned goods and seeds. It would have been a fortune in genetic diversity.

His story reminds me of one relayed to me one night over dinner in Naperville, Illinois. Peter Bane and I were teaching a permaculture design course at The Resiliency Institute, when Ron and Vicki Nowicki came to dinner. I still haven't made it to their garden—which by all accounts is a feat of implementation. Vicky shared the story of a tomato variety she grows out. The seed was brought into the country by immigrants, like many seeds in the US 100 years ago. The seeds were so important, the relationship over generations so strong, that many immigrants would sew the seeds into the linings of their clothing. The tomato she spoke of had been grown by a second generation Italian man for, if I remember correctly, 60 years, before passing it on to her. He inherited it from his grandfather and parents, but his own children did not care to garden. So she has taken up the relationship.

Perspective from the stars

If we consider that flowering plants evolved shortly after conifers roughly 200 million years ago, the development of hundreds of thousands of species today in the vast array of colors, shapes, scents, and behaviors is truly astounding. If we take it that the genus *Homo* has been around for perhaps 3-6 million years, plants embody a great deal more natural wisdom. Still, the 200,000 years of *Homo sapiens* might be defined by the relationship of people to plants—mutually cultivating each other (see

Flowers, such as this edible yellow daylily, have been the source of evolution and variation leading to incredible diversity on the planet.

Michael Pollan's *Botany of Desire* for more on that thought). Our leap into agriculture 10,000 years ago is only a fraction of that time and represents a rift in thinking: moving from relationships to plants in community (polycultures) towards primary relationships with a few key domesticated species (wheat, corn, barley, squashes, etc…). This earlier, multifaceted relationship of people to plants—especially cultivation of food plants—is one which we must re-enter—humbly and quickly. If you asked me the top five skills children should be learning, seed-saving and plant breeding would be high on the list. Food—and seeds—are also some of the very best tools to reconnect, not only with the land, but with our ancestors. (Okay, so I'm not SO keen on the leek favored by my Welsh ancestors.).

Everybody loves popcorn

While beginning to relearn the culture of my Cherokee forebears, I came across a story of "The Lucky Hunter" and his wife, Selu—a Corn Woman (1). In order to feed her children, Selu would give of herself. Corn is viewed as literally the mother of some of the earliest people in the land. The same reverence for plants that sustain and nourish us is found throughout the world. When I think of the awe that my grandfather instilled in me for flowers, fruits, and tastes that were varied and full of wonder; which resonated with the relationships of people to plants throughout history—I want THAT WORLD again for the next generation and all generations going forward. I firmly believe we will not survive as a species if we do not cultivate that respect and connection to plants and their children (seeds).

Dill is an easy species to start with. Besides the edible yield, their ecological functions in the garden make them a fun initial plant to save seed from if you are not used to it.

It must have taken some similar connection for people to facilitate the evolution of teosinte into maize. Teosinte, a multi-stem grass found throughout Central America with 5-12 small, hard seeds was domesticated into modern maize and corn varieties. The story might be that earlier people used teosinte as fuel in the fire and found that the kernels popped—everybody loves popcorn! Indeed, some of the oldest archeological records include popcorn (2). Research now recognizes that the development likely focused on only a few characteristics initially—severely limiting genetic diversity (3). Once favorable characteristics made the plant more desirable as a cultivated food source, other genetic variations —leading to more than 20,000 landraces (locally adapted varieties)—were bred into maize through local selection. This diversity probably reflected a combination of factors for selection including: migration, settlement, and local ecological diversity. Plant breeding has to consider the size of the population in any one area. Inbreeding among a variety can become a problem. Read Zachary Paige's article for more on how corn was kept from inbreeding too much.

In the 1920s, modern agronomists began breeding hybrids selecting for uniform yellow kernels, size, etc…. Today, the close kernel spacing and the tight hold of the cob to the kernel means that without intervention from farmers, most corn kernels would not be able to germinate and reproduce on their own. Truly, we are in a tight relationship of mutual dependence with this wonderfully diverse species. Our futures are linked.

Plant breeding today

Just this spring, the USDA granted $17.7 million to study plant breeding—all to universities and most to public land-grant universities (8). The grants were in the areas of foundational knowledge of production systems, plant breeding for agricultural production, and physiology of agricultural plants. Besides hybridization and cross-breeding, another technique: precision breeding—has become an option today. This technique works with genetic sequencing from embryos of the plant varieties without introducing foreign or new genetic material—and it gives results in one or two years instead of four or five (4). This technique is more appealing to European plant breeders who are cautious about genetically modified organisms with cross-species introductions of genetic material.

Who's who?

We know that land grant universities throughout the US conduct much of the nation's agronomy research. But there are other major players. The Gulf Coast Research and Education Center has brought us commercial tomato and strawberry varieties and is developing pomegranates that can tolerate the Florida summer and so replace or complement citrus (5). Seed companies themselves breed varieties of plants that are successful or in demand (think Johnny's Seed Company for varieties adapted to organic growing regimens). Then, of course there is Seed Savers Exchange—and now the many seed libraries found in communities everywhere. We are very familiar with plant breeding and patents on commercial seed. South Africa released its catalog of licenses recently, and most commercial crops were licensed to US-based Pioneer Hi-Bred and Monsanto (9). Other countries that do not have national laws recognizing plant patents are pressured to develop them as quickly as possible.

A new option has been developed in Germany: licensing seed research as open-source. "Anyone can use the varieties, so long as they do not prevent others from conducting research on derivatives; all of the plant's future descendants are also in a 'commons' " (10). The article continues to describe a similar project in the US—the Open Source Seed Initiative (OSSI) which concluded in 2014 that it was "too unwieldy to gain widespread acceptance among breeders and seed companies…." This is because intellectual property rights play a bigger role in plant breeding in the US—indeed plant patenting began in the US in 1930. "Commercial breeders, the main producers of economically important new crop varieties, can't use open-source seeds because they would not be able to claim royalties for any varieties they develop from them. If too many seeds were in the open source–only commons, they would be 'killing the business model,' [Neils] Louwaars [of Plantum in the Netherlands] says" The loss of royalties for plant traits or breeding tools would also adversely impact universities.

It might behoove us to more carefully observe what is evolving in our forest gardens and use that as a start.

Still, thinking back to Vicki Nowicki's story, many plants we have today were bred 100 or more years ago and continue to

produce (and sometimes cross). Luther Burbank, a contemporary and friend of Henry Ford and Thomas Edison, working in the late 19th and early 20th centuries, developed more than 800 new varieties of plants—"including over 200 varieties of fruits, many vegetables, nuts and grains, and hundreds of ornamental flowers" (6). His gardens and programs continue today in Santa Rosa, California. Indeed, Burbank's efforts inspired the annual Rose Parade.

Breeding for permanent agriculture

Breeding plants and patenting the seed's genetics are well known strategies for privatizing (and maintaining the option to get a yield, if you will pardon the pun) food crops. Open-source seeds, seed libraries, and commercial seed sources that maintain open-pollinated and heirloom seeds are some of our unsung heroes for food production. Editing this issue of *Permaculture Design* has highlighted for me the need for all of us to take up some small part of the work. There are so many benefits: saving money by saving seed; developing varieties that suit your particular system—whether that's being productive under extreme conditions, fitting a particular microclimate, or introducing new flavor or color into a variety. So, how do you do it?

Creating a permanent agriculture can start from various theoretical points—but they all go back to breeding and selecting plants. We cannot create a permaculture system without knowing how to select and breed plants in our own communities. Not every person has to be a seed-saver or nursery person, but we should all know at least one. J. Russell Smith, in his well-known treatise *Tree Crops: A Permanent Agriculture,* made the work of John Hershey, a Depression-era nurseryman in Downington, Pennsylvania, famous. Hershey grafted and developed various oaks: including his famous bur oaks (see *Permaculture Design* #99, Feb. 2016), for their vigor and early production of acorns. [Editor's note: since the publication of that article, a small group has begun taking scion wood and continuing to improve the oaks and fruit trees through breeding and selection. We hope to bring you updates on this effort, in future issues.] Similar trials for hazelnuts are now famous at Badgersett in Minnesota (see Eric Toensmeier's contribution, issue #102).

The Land Institute is also well known for its efforts begun by Wes Jackson in 1983 to create perennial wheat as a way to prevent soil disruption. The Institute has expanded its understanding and framing of its research and is seeking, through plant breeding, to develop several perennial grain crops. Kernza® is the closest to commercial implementation. This wheat variant is just now coming onto the market after more than a decade of development. While seeds are smaller (1/5 the size of most commercial wheat varieties), there are more seeds per stalk. The breeding program is selecting for "yield, shatter resistance, free threshing ability, seed size, and grain quality" (7). Programs to develop sunflowers and sorghum are also well underway. With sunflowers (starting from the perennial sunflower, *Helianthus silphioides,* the motivation goes beyond choosing a grain or oil crop that can become perennial in the landscape, to considerations for drought tolerance and climate change as well as ecological functions with pollinators. The group started with wild sunflowers that showed remarkable resilience during drought in the Plains states.

Whether we are looking to use improved selections for small-scale gardens or for broad-scale and regional production, we should consider our capacity for plant breeding. Even if you rent or coordinate a garden plot in an urban setting, you have the space and capacity to grow out seed. The new insights provided by Gregor Mendel and others into genetics stimulated the creativity of 19th century horticulturists like Luther Burbank. At a time of rapid change and variability in ecosystems, it might not be the minds and efforts of a few brilliant breeders, but the simple commitments and creativity of permaculturists everywhere working with nature that build the bridge between the gardens of our ancestors and those of our descendants.

Whats and hows

So, what are all of these plant breeders doing? They are, by nature, mostly savers of seed with an eye toward ensuring that particular plants reproduce seed in a relatively pure fashion. Seed-saving is one of the most direct ways to cross and breed plants. In classic plant breeding, individuals that are particularly early, robust, tasty, or beautiful—or fill in any other trait—are allowed to set seed and that seed is carefully harvested, stored, and germinated to grow out the next generation. Any propagation technique can be involved (cuttings, layering, etc…): the operative function is that humans are selecting favored characteristics and cultivating a space to include those varieties. Mutations can arise in individuals and perpetuate through vegetative propagation. It might behoove us to more carefully observe what is evolving in our forest gardens and use that as a start.

As with any breeding project, a variety can become inbred after a few generations—increasing the fullness of the desired traits, but also diminishing other qualities—including germination rates. Renew genetic stocks by bringing in—or intentionally crossing with—other samples of the variety or another variety which is compatible and might improve fruiting, flavor, size, disease and pest resistance, etc…. Two in-bred lines are crossed to produce an F1 hybrid. The yields from these plants typically

Marigolds are another easy seed-saving starter plant—and can be fun to select for color or petal variety.

A table full of heirloom and garden bred and grown foods. These foods really do taste better.

increase due to hybrid vigor, but crosses between F1 hybrids (the F2 generation) can be wildly inconsistent. It is a good idea to cross F1 and F2 back to the original stock or move back into very narrow selection in the breeding program.

When breeding your own vegetables and fruits (and sometimes shrub species, but not tree species very practically), you can control which plants pollinate a specimen by hand pollinating and bagging the flowers all the way through seed production, by isolating the variety from potential pollinators by distance, or by isolating the flowering in time from undesirable crosses. You can also weed out undesirable plants among a breeding population (called roguing).

When it comes to keeping records, not only label seeds carefully during storage, but also keep track of what is planted, when, and where; and keep notes in a garden journal. If you keep a digital record, including photographs can be very helpful. Burbank was reportedly a poor record-keeper, preferring to see results in his gardens.

The seed hoarders' dilemma

I find myself with a problem that will be familiar to some of you. I don't have an unlimited budget for commercial seeds; nor do I have much land for test plots to grow out uncertain seeds. What I do instead is hoard seeds—including both commercial and home-grown seeds. I now see this as a fear-based way to retain natural capital. Remember our third ethic: I could give away seeds or put them in the seed library to be borrowed, renewed, and returned to me at some point when I can use them well. Perhaps I should continue to plant out the varieties in my seed storage and save the seeds from the plants I've grown: refreshing viable stocks and renewing genetics by offering seed and bringing in new seeds from seed exchanges and libraries.

All of this is to say that we can have a lot of fun practicing permaculture by breeding plants that marry our tastes and delights to the needs and functions of the gardens we inhabit. We can do that while feeding our families, sharing with our neighbors, and educating the uneducated. We can use our horticulture to build bridges with those who have a slightly different worldview (ever enter your prize pumpkin in the county fair?). Smart selections might also become valuable locally and spur greater innovations through seed exchanges. Rather than passively perusing the nursery's offerings, why not aim to create what you want—allowing the process to surprise, challenge, and delight you with discoveries?

This summer, my kitchen has begun to look like my grandfather's. He would be proud. ◬

Rhonda Baird is in search of the gardens of her ancestors and excited to contribute to those of her descendants. You can reach her at shelteringhills@gmail.com.

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Out in the Field

Indigenous Corn Breeding Today

Zachary Paige

CORN POLLINATION IS PURE MAGIC. As you may or may not know, many of our vegetable crops pollinate through sexual reproduction. Maize pollinates by the wind. Billions of microscopic pollen grains leave the corn tassels (male flowers) in mid-July (the broom at the top of the plant) and land on the silk of the ear (female flower), those annoying stringy things that get caught in your teeth when eating sweet corn. When each pollen grain lands on a silk, it grows a pollen tube and fertilizes just one ovule (one corn kernel). Amazing!

Corn pollen grains are so small and light that they can fly over two miles! This is why it is so hard to control the cross-pollination between organic and transgenic corn varieties. And before there were major seed companies looking to make major money, there were only open-pollinated populations. An open population is what it sounds like. It consists of many maize plants grown together, where seed selection came from the ears that were most desirable to the particular person or culture making the selection.

Native peoples stewarded corn, sunflowers, squash, strawberries, blueberries... and many other foods....

Desirable traits could include the most yield in weight, largest kernels, largest cob, color, plant height, strongest husks (to braid). The list could go on and on. Open-pollinated corn differs from conventional hybrids in that hybrid corn seed is produced by crossing two distinct inbred corn lines. Hybrid seed will have some added vigor that conventional farmers are trained to desire, but if the seed of the hybrid corn is planted, the hybrid seed will not be true-to-type. It would take about 7-8 years of seed selection of a hybrid corn to yield and look like something that is even close to where it started. The hybrid seed industry ensures that farmers purchase seed each year, rather than select and save seed.

Maize has been selected in open-pollinated systems for desirable traits for the last 8,000 years. In 2017, it is the largest grown crop in the world, ahead of rice for the first time. The story of maize began near Oaxaca, Mexico and has traveled with indigenous people throughout North and South America as a major food source.

The population genetics of corn in some ways is very much like people. If the population gets too small, health suffers and is what plant breeders call "inbred." Corn needs a population of at least 200 plants, and preferably 500 or more to sustain a healthy amount of genetic diversity to thrive over generations. When selecting seeds, one wants to save an equal amount of seed represented by at least 200 different ears. If we saved seed from only one ear of corn, the next year's population of plants would lack diversity, and its health would suffer over time.

Rowen White, a Mohawk corn grower we work with has told us a story of a "Mother corn." This is where separate families who all grow corn in a tribe would come together and grow all of their corn in one big plot. After this year of growing together, the corn would then be sent out to particular families to be grown in separate plots again. Many tribes of native peoples who lived in what is now called North America have been seed-keeping for thousands of years. They stewarded corn, sunflowers, squash, strawberries, blueberries, Jerusalem artichokes, and many other foods including wild food and game. Winona LaDuke, world-renowned Native American environmental activist founded the White Earth Land Recovery Project (WELRP) in 1989 to restore ancestral practices of land stewardship amongst other goals. Winona has been working on creating a regional seed network for the upper Midwest as well as easy access for White Earth gardeners to attain seeds. Most of the money spent on food in the White Earth reservation (and many rural reservations) goes off-reservation. Seed-saving is not just an economic activity; it also provides cultural, nutritional, and biological benefits. The White Earth Reservation is a sovereign nation, and there are tribal laws to

Bear Island Flint Corn.

protect the Anishinaabe culture and natural resources. There is an ancestral knowledge and history of growing food and saving seeds in White Earth and other native communities. By pooling resources and working together with other tribes in our region, this information becomes more accessible. WELRP hosts an Indigenous Farming Conference every year where native speakers from across the region and country bring people together and discuss issues of food and seed sovereignty.

Mainly because of Winona LaDuke's many contacts and the seed-keeping discussions held at the Indigenous Farming Conference for the last five years or more, the White Earth Land Recovery Project wrote and was awarded a grant from the Administration of Native Americans on October 1, 2014 titled the "Upper Midwest Indigenous Seed Keeping Network." A large part of the grant project is a traveling two-day "Train the Trainers" seed-keeping workshop led by native seed-keepers in more than 12 tribes, tribal colleges, and communities in the Upper Midwest. We are sharing resources on seed-keeping techniques, protecting seeds with indigenous origins through ancestral agricultural knowledge, and treating them with respect as living, breathing relatives.

We are concentrating our corn growing efforts in White Earth on a variety called Bear Island Flint that was grown historically in the Leech Lake, MN area by native tribes. This corn was grown on an island so that animals like deer couldn't eat it. Flint corn kernels have a particular glassy appearance. This multicolored flint corn grows well in our northern climate because it is hardy and has a short season. It takes about 75 days for this corn to mature. It is a very beautiful corn. At harvest time, it's fun to open each husk and see what colors will be revealed. Opening the husk on each ear is like opening a Christmas present.

Sunflowers and other foods tended on this continent for centuries need tending into the future. Photo CC0 via Pixabay.

We use this corn to make a hardy hominy, a traditional corn soup. 2016 was the third year that this corn has been grown for the White Earth Land Recovery Project (WELRP). We are selecting for earliness, large cob size, and anything at or under 12 rows of kernels on the ear as skinny ears dry faster. In 2013, we received our seed stock from Tessah Gowens and the Germplasm Resources Information Network (GRIN) National Genetic Resources Program. That year we grew over 2,000 plants in traditional mounds and selected about 200 ears for seed. In 2014, we grew out the same amount and selected approximately the same amount.

We identified another corn that grows well in our region called Saskatchewan White Flint (SWF). This corn has an even shorter growing season than Bear Island Flint and has been adapted to the cold climate of Saskatchewan. The growing season for SWF is about 60 days. The plants of BIF are about 4-5' (1.2-1.5 m) high and the SWF plant only grow to about 3' (1 m). The ears of the SWF are smaller, but the plants produced ears that had full kernels nearly 100% of the time. The ears were fully pollinated, whereas the BIF has struggled to pollinate fully. SWF kernels have a glassy white color.

The vast majority of breeding programs do not take nutrition into account.

In 2014, we de-tasseled about 200 Saskatchewan White Flint plants that grew in with the Bear Island Flint. De-tasseling removes the male flowers before pollination. The only male pollen left to fertilize these plants now are the plants that were not detasseled. The genetics of the kernels of the detasseled plants are 50% SWF and 50% BIF. We did this to add fresh genetics into the BIF population because from the start it was a very inbred population. It needed fresh genetics in order to thrive. The healthy F1 hybrid consists of 50% BIF and 50% SWF genetics.

Now, we have a breeding program for the Bear Island Flint and the SWF/BIF populations. We keep them separate from each other in order to keep the BIF seed we have pure. We do this by isolating those two types of corn when growing them out and making sure that they do not cross-pollinate. In 2015, we grew the SWF/BIF cross in a BIF patch and de-tasseled them again.

Now, the genetics of this new population cross for those seeds are 75% BIF and 25% SWF genetics. The reason that more BIF genetics are desirable is because we are selecting for a large ear size, and SWF ears are quite small. Yet, we want a corn that has a short season, a trait the SWF has. In 2015, we also selected BIF ears for the same traits. In 2016, we planted a small patch of the BIF, and a neighboring farm is growing another patch of the SWF/BIF cross.

In 2017, we planted an acre of each BIF and SWF/BIF cross isolated from each other. The ears that don't make the cut to be

selected for seed will be processed into food. We are excited to have a larger crop for food after stewarding this variety for a few years. Many of the tribes in our network are beginning to increase production and use more seed for food. Here in White Earth, we make hominy and corn meal. There are many health issues in native communities, particularly diabetes and nutrition-related illnesses. The traditional seeds typically have higher amounts of protein, oil, and beta-carotene than conventional organic corn.

I am a masters student of plant breeding at Iowa State University with a focus on high-nutrient corn. The testing that I have done proves that many of the colored corn varieties in open-population systems have more nutrients. The only problem is that these varieties tend to do worse for yield than organic and conventional hybrids. My theory is if the yield is 85% of a conventional hybrid, but is two times the amount of protein, then we are doing better than the conventional system. The vast majority of breeding programs do not take nutrition into account.

The Upper Midwest Indigenous Seed Keepers Network created a seed envelope that mimics the Organic Seed Stewardship Initiative's language. We say that our seeds can be saved and distributed to anyone as they are a gift of life. Seeds are alive and should have the same respect and care we provide to our other relatives.

You can help support our programs by enjoying the harvest with us. The proceeds go directly back into seed-saving and food sovereignty programs. We sell our hominy and corn meal online at www.nativeharvest.com and realwildrice.com. A few

You can help support our programs by enjoying the harvest with us.

other places to look include the Oneida Market if you live near Green Bay, WI, as well as Wozupi Tribal Gardens if you live close to Minneapolis. If you are a knowledgeable gardener, I encourage anyone interested to help with this work to look up what tribes are growing food in your area and ask if they need help growing out a particular variety. Sometimes we have too many corn varieties to grow out in a single year because we need to isolate them. We have our trusted allies and friends grow them out. Just last year, an Amish farmer grew out an acre of White Corn we used to make our hominy. Δ

Zachary Paige is interested in learning about the origins of cultivated crops, plant breeding, seed-saving and wild foods. Zachary served two years as an AmeriCorp VISTA volunteer at the White Earth Land Recovery Project (WELRP) on the White Earth Reservation in Northern Minnesota. He currently serves as the program coordinator of the 'Upper Midwest Indigenous Seed Keeper Network' grant project for WELRP. This project was funded by the Administration of Native Americans and serves 13 native communities across Minnesota, North Dakota, Wisconsin, and Iowa. Zachary graduated from the Sustainable Food Production program at MState in 2013, now known as the Deep Roots Program through the Sustainable Farming Association in Minnesota. He is currently working on an MA in the Plant Breeding Distance Program at Iowa State University and currently works on various breeding projects for organic growing systems. For the last five years, he has been the primary organizer for the Indigenous Farming Conference for WELRP. Zachary also contracts with the White Earth Band of Ojibwe as the Food Sovereignty Coordinator and is working with the community to expand agricultural production of indigenous foods such as corn, beans, and pumpkins.

Saskatchewan White Flint x Bear Island Flint F1 Hybrid Ears.

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Starting Landraces

Breeding Veggies Made Simple

Carol Deppe

TRADITIONALLY, A LANDRACE is a locally adapted variety of domesticated plant or animal that has usually been created largely by mass selection rather than by inbreeding in family lines. The individual plants within a given landrace are uniform for certain critical characteristics but variable for many others. In most cases, the obvious phenotypic variability comes along with additional invisible genetic variability, both of which contribute vigor and resilience to the landrace. In some cases, the variability is desirable. Variability in maturity times that spreads out the harvest can be desirable when the family is eating the food. If some plants are more drought-resistant, some are more heat-tolerant, and so on, the landrace may more reliably produce food in multiple seasons with variable weather than would a more genetically uniform variety. Above all, traditional landraces are selected to perform well and meet the needs of the people who developed them.

Sometimes we do not actually need pure varieties. I think our modern breeding has gone too far in the direction of worshipping uniformity for its own sake, that is, for over-inbreeding and creating uniformity for many characteristics beyond those that matter. Inbreeding eliminates genetic heterogeneity. And genetic heterogeneity is usually associated with more vigor and productivity.

In many cases, modern home gardeners want several distinct colors of leaf lettuce or beets, and actually plant multiple varieties or even buy a blend that is a mix of several pure varieties. The gardener is artificially creating some of the advantages of a landrace by using such mixtures. But she might be better served by growing a highly genetically heterogeneous landrace that gives multiple colors instead of the mix of pure varieties. The heterogeneous landrace would likely be much more vigorous than the pure varieties. And it is easier to save the seed of a single landrace than to save the seed of several pure varieties.

If you pretty much like all colors and shapes of summer squash, for example, instead of growing pure varieties you might let several varieties you like all cross with one another, and start saving squash from the mix each year. What you get when you plant a seed from this material will be pretty unpredictable. But as long as only summer squash went into the mix, it's likely to produce good summer squash. And if you simply start selecting for earliness, productivity, or whatever you care about, pretty soon you are likely to have your own landrace that performs better under your conditions than did any of the pure varieties.

Alan Kapuler frequently interplants two or more varieties and allows them to cross, then selects for vigor and production in subsequent generations under his conditions, but allows variability in plant form or colors. He calls such interbreeding mixes of offspring segregating out of crossed populations "grexes." They are one kind of landrace. For example, he produced 'Three Beet Grex' starting with three heirloom beet varieties: Yellow Intermediate Mangel, Crosby Egyptian Purple, and Lutz Overwintering. Three Beet Grex produces beets of gold, Day-Glo orange, orange-pink, or red. It's much more vigorous than any of the pure gold-beet varieties. And it is apparently widely adapted. It has gotten rave reviews for being the most vigorous beet in New England. And a friend of mine in Missouri says it does so well for him that it has become one of his major staple crops both for people and for animal feed. (Three Beet Grex is available from Peace Seeds, Peace Seedlings, or Fedco.)

When I got crosses between my dry bean Gaucho, a gold Argentine heirloom bean *(Phaseolus vulgaris)*, and Black Mitla, a supposed Mexican tepary bean *(P. acutifolius),* the crosses segregated out black, brown, tan, and gold beans and were extremely productive. And the mix of beans has a delicious, intensely beefy flavor. So I just continued growing and using the mixed-up material, which, after a few generations, I named Beefy Resilient Grex. I just select for a bit more earliness and for yield. (The selection for yield happens automatically if you keep nearly all the beans.) Beefy Resilient Grex is much more productive than either parent variety and has a huge amount of genetic heterogeneity, which helps the plants deal with disease or weather problems.

When Joseph Lofthouse interplanted every squash variety he could get his hands on, initially none matured completely on his Utah mountain farm.

When Joseph Lofthouse interplanted every *Cucurbita moschata* squash variety he could get his hands on, initially none matured completely on his Utah mountain farm. He simply interplanted all the varieties and let them cross. After a few generations of growing his squash, he ended up with Lofthouse Landrace Moschata, which gives squash of all sizes and shapes, but they are all early. I love the earliness, vigor, and size of the

Lofthouse Landrace Moschata, but I would prefer all or mostly all butternut shapes. That shape better fits my use patterns. So I am going to select for just butternuts. I could do this by self-pollinating a few plants for a few generations to produce pure varieties. But if I did that, I would be eliminating much of the genetic heterogeneity and, at the same time, probably much of the material's vigor and productivity. Instead, I plan to just gently mass-select for the butternut shape under open-pollinating conditions. That is, I will grow out dozens of plants and just save seed from the butternut-shaped ones without doing any controlled crossing, inbreeding, or hand pollination. In a few generations, I should have nearly all butternut shapes, but the material will still retain all the rest of the genetic heterogeneity and, hopefully, its vigor and productivity. That is, I want to reshape the Lofthouse Landrace Moschata to better fit my use patterns, but am happy to leave it as a landrace.

Landraces are not optimal for all purposes. I'm often too fussy about flavor or specific uses to find landraces appropriate. Many people are happy with landrace open-pollinated corn, for example, because they use their corn mostly to make cornbread, and you can make wet-batter cornbread with any field corn. And they mix their cornmeal with wheat flour, which dilutes its flavor, making the flavor of the corn less important. However, I need my flint corns to be very pure for flint type, because only very pure flint corn makes good quick-cooking delicious polenta from wholeground corn with no special screening to remove floury components. And I breed flint corns for their flavor as polenta as well as cornbread. Likewise, I want my flour corn varieties to be very pure flour types so that they can be used to make fine-grained cakes and cookies and gravies, not just cornbread. And I use all my varieties to make cornbread with 100% cornmeal and no wheat. So the flavor of the corn is critical. However, I'm willing to let my corn varieties contain multiple colors—but only those colors that vary by the whole ear rather than kernel by kernel so I can sort whole ears to get multiple flavors from one variety. And I only allow certain colors within my varieties, those I've figured out are associated with great flavor.

I also wouldn't be interested in growing a landrace summer squash, because I'm fussy about summer squash flavor, and most of the plants of a mixed pool of intercrossing squash would be unlikely to give me flavors as good as those of the pure varieties I like. In addition, I like to grow varieties that are tastier than most as fresh squash but that are also delicious when dried to be a winter staple. That way all the squash that escape prime summer squash size can be dried in summer to make soups and stews in winter. (For more on this, see *The Resilient Gardener.)* However, most varieties of summer squash are tasteless when dried. In an intercrossing population derived from many varieties, very few plants would produce fruit that tasted good dried, and there would be no way to tell which these were without laboriously drying and tasting fruit from every plant. So I will stick with pure summer squash varieties.

Squashes can be an easy and nutritious addition to a plant breeding program in your garden. Image CC0 via Pixabay.

When I bred the Hannan Popbean garbanzo, I started with USDA material that was a Middle Eastern landrace uniform for seed color, flavor, and the popping characteristic. But there was variability for everything else. Plant maturity ranged from early July to just starting to flower in October, after my rainy season has started, and freezes are threatening. This meant that the land was tied up from March until late fall and that many plants were too late to yield at all with the amount of summer heat I have. And only the earlier plants could finish without irrigation, so the entire plot had to be irrigated. The number of seeds per pod varied from one to four, so seed size varied from tiny to much bigger. This is okay if the beans are parched in hot sand, but I wanted to roast or microwave-pop them, which requires uniform seed size. Some plants were tiny. Some were big but crept along the ground and were no more than a few inches tall. Others were very erect and 3' (1 m) high. And there was everything in between. The landrace seemed to be uniform for resistance to soil-borne diseases but variable for resistance to aphid-transmitted legume diseases, for which the Willamette Valley is a hotbed. However, that huge genetic variability included resistance to all the aphid-borne diseases—at least in some plants. Many plants died of disease when small or became obviously diseased and had to be culled, however.

I needed bigger, more uniform seeds for the parching methods I was using.

I needed bigger, more uniform seeds for the parching methods I was using. In addition, I needed the plants to be resistant to my local diseases. And part of what I envisioned was a legume that could be grown without irrigation in my no-summer-rains region. I had too many requirements for a variable landrace, even a landrace adapted to my land. I needed a pure variety. So I mass-selected for plants that had one or two big seeds per pod, that were disease-free under my conditions, and that could be planted in early March and would finish drying down their seed

in late July. My Hannan Popbean grows well without irrigation and is uniformly resistant to pretty much everything. But at this point, it is a pure variety. There is little or no obvious physical variability from plant to plant within the variety. (However, since I mass-selected instead of using inbreeding, there might well still be plenty of invisible genetic variability.)

Here are four useful guidelines for creating your own landrace. First, when you start a landrace by crossing or by interplanting two or more varieties so they can cross, do not start selecting in the first generation. The characteristics of the first generation have mostly to do with which genes are dominant. You can't see the characteristics associated with recessive genes until the second or subsequent generations. So don't start selecting until the F2, the second generation after the cross.

Genetic bottlenecking is a result of saving seed from too few plants.

Second, in most cases it's best to select gently. You don't have to eliminate all of the plants with some undesired characteristic in any given generation. In fact, in most cases you probably shouldn't. If you don't like something, just save less seed from ones like that. In the early generations, you usually don't have all possible traits in all possible combinations. Not all possible traits even show up in the first few generations. So don't eliminate too much too fast. In fact, if you have the space, it's perfectly reasonable to do no selecting at all for the first few generations and just let all the genes and characteristics get more thoroughly mixed together.

Third, it's usually good enough to save seed based on just one parent. So when I select based on squash characteristics, I'm selecting based only on the female parent. But I need only gentle selection to create a landrace (or to maintain an established variety). Selection based on just one parent is usually good enough.

Finally, be open-minded and opportunistic. Taste and cook whatever shows up in various ways. Start separate lines where appropriate. You might pool all the seed from the plants that produce earlier but smaller fruits, and all the seed from the plants that produce bigger later fruits, for example. You might end up with two or more landraces that serve different needs from one project. Just eat the fruits from the plants where the two landraces are adjacent. And a little crossing between the landraces doesn't hurt. All you really need is semi-isolation, not true isolation.

Rejuvenating heirloom varieties

Sometimes we obtain a much-touted famous heirloom or other open-pollinated variety and plant it eagerly, only to find that the plants are so wimpy and lacking in vigor that it's hard to grow them at all. And they produce so poorly that they aren't worth the space or time. If it is a winter squash, for example, the plants may produce fewer and smaller fruits than they should. The flesh might be thin. And the fruits might mature late or not at all. And there can be weird characteristics, such as defects in flower form. In many cases, what has happened is that the variety has become genetically bottlenecked.

Genetic bottlenecking is a result of saving seed from too few plants. We might start with a variety that has enough invisible or visible genetic heterogeneity to be vigorous, but if we save seed from just one or a few plants, it's as if all the alleles (forms) of all the genes have to pass through a bottleneck to get to the next generation, and many of the alleles don't make it.

Genetic bottlenecking has two bad effects. The first involves deleterious mutations and alleles. New mutations are always occurring in the plants of any variety, and these are often somewhat deleterious. That is, they can make the plant less vigorous or lower yielding under some or all conditions. Or they can make the food lower in quality. If the mutation is dominant and the effects are large, visible, and obvious, we usually cull the plant carrying the deleterious gene or it culls itself by being unable to grow or thrive. But often the mutant gene is recessive. That is, it affects the plant only when it is present in two doses. In addition, many detrimental genes have only small effects or are detrimental only under certain specific conditions. If we grow just a small number of plants, we have a harder time identifying good plants. And if we save seed from just a single plant, we have a much higher likelihood of the planting being homozygous for one or more deleterious mutations so that our line of the variety will then be fixed for that mutation from then on. So, for example, where d is a recessive deleterious mutant allele and D is the normal version of the gene, we might have started with a line where most plants were genotype DD, but some were Dd, and there was an occasional dd. And when we saved seed from just one plant we might have, alas, chosen a plant that was dd. If so, from then on, all plants in the line will be dd, as all the D alleles have been bred out. The line has become fixed, that is, pure-breeding for the deleterious mutation.

Dry beans of multiple varieties ready to be eaten or sorted and used in the next season's garden. Image CC0 via Pixabay.

The other problem with genetic bottlenecking is that it removes invisible genetic heterogeneity, and heterogeneity itself

often confers vigor and resilience. So when a variety has been genetically bottlenecked, it can be wimpy and unproductive because it has either lost essential genetic heterogeneity or become fixed for deleterious genes or both.

With famous heirloom varieties, often there are many independently saved and transmitted lines of the variety available. And sometimes when we obtain a number of lines, one will turn out to still be vigorous and productive enough to be worth growing. But often all the lines have been bottlenecked to some extent. However, if the lines have been independently maintained, we can often recombine the lines and regenerate a vigorous, productive line that is everything the variety is supposed to be. And it takes relatively minimal effort.

Crossing bottlenecked varieties should result in a strain that is more productive than either parent.

Just obtain as many lines from as many independent sources as possible. (Ideally, you get lines from seed savers or small seed companies that have maintained their line themselves, or can tell you where they got their line from initially so you can avoid redundancies.) Then you interplant all the lines and proceed exactly as I described in the prior section for creating landraces. You just start by interplanting different lines of one variety instead of different varieties. You let all the lines open-pollinate and intercross in all possible combinations. You deliberately interplant in such a way as to get all possible combinations of crosses. Then you save all the seed without selecting that first generation and plant it out. You will usually have some much more vigorous plants the very next generation. However, in most cases, you should simply save seed from all the plants again. Then, the following year (the F2 and beyond), you just start mass-selecting for the characteristics the variety is supposed to have as well as for vigor and productivity. Often you can produce material that is mostly vigorous and productive and worth growing in just a few years. Most of the problems of the lines you started with vanish.

The reason why this works is that, while most of the lines might have lost much or most of their genetic heterogeneity, each line has lost different components. In addition, each line has picked up at least some new genetic heterogeneity through new mutations and accidental crosses. So by adding the genes of several lines back together we can often restore or re-create enough genetic heterogeneity to make a vigorous, productive variety again. Alternatively, where the problem is that lines have picked up deleterious mutations, different lines have often picked up different deleterious mutations. So when the lines are allowed to cross and recombine, there are actually good versions of all genes present in the mix that can sort out into a new line that is not fixed for any deleterious mutations.

When I started breeding Cascade Ruby-Gold Flint corn, I started by interplanting Abenaki (aka Roy's Calais) and Byron. Both are eight-row New England flint corns, but they have enough different characteristics that it was obvious they had been maintained separately for a good while. Each variety had some characteristics I wanted. Abenaki has big ears for an eight-row corn, and many are red, which makes cornbread with a unique and spectacularly delicious flavor. But I lost most ears of Abenaki because of poor husk coverage that promoted bird damage. (A bird-damaged ear in my regions gets colonized by aphids, so the whole ear turns into aphids and aphid muck and becomes inedible.) In addition, the yellow ears of Abenaki were pale, uninspiring yellow, and the interior color of the kernels was light yellow. So, I chose to interplant with and cross to Byron, which has good husk coverage, deeper interior gold color, and a maple pericarp color. Byron also had pencil cobs, however, which I did not want. (They break up or don't shell out as well in my hand-crank corn sheller.) Plus, Byron had smaller ears and kernels than Abenaki, and the yield wasn't very good. It also didn't have the red pericarp color, which gives the corn its unique flavor in cornbread. When you want something new with some of the characteristics of one variety and some of the characteristics of another, you start by just crossing the two varieties. Both varieties were very pure flint types.

But in addition, I figured that most Native American and pioneer corns have been genetically bottlenecked. If both varieties were bottlenecked, if I simply intercrossed them and kept the numbers I saved seed from high enough to preserve the genetic heterogeneity created by the cross, I should be able to get material that was much more productive than either parent. This turned out to be true. Cascade Ruby-Gold Flint, an early corn, is not only more productive than its parents but also as productive or more productive than the most productive full-season open-pollinated flint corn, Longfellow. (Longfellow is probably also bottlenecked, so is probably not living up to its full-season potential.) When I crossed the two varieties, I created a lot of genetic heterogeneity. Then, I saved seed from several hundred plants per generation thereafter so as to maintain as much of that heterogeneity as possible while I mass-selected for the characteristics I cared about.

Breeding crops for organic systems

When we organic gardeners and farmers create our own landraces, breed new varieties of our own, or adapt varieties as we save their seed, we are growing and selecting under organic growing conditions. Exactly what these conditions are varies wildly from garden to garden and farm to farm. In some cases, it might mean that the plants must be able to thrive on a regimen of modest soil fertility. But not necessarily. Many organic gardens and farms have very rich soil. Whatever else, however, crops that excel under organic growing conditions need to resist many insects and diseases without the aid of insecticides or fungicides. In addition, good organic varieties usually need to be able to compete effectively with weeds.

The first method for obtaining good organic varieties suitable to your specific conditions is to simply do all your plant breeding and selection and seed-saving under your growing condi-

tions. You will automatically be selecting for varieties that do well under organic conditions, and under exactly your version of organic growing conditions.

Sometimes a good organic variety thrives because it has specific genes that confer resistance to specific insects or diseases. But I think in many cases the good organic variety thrives not because it has a specific gene with which to meet every specific problem, but because it is just so vigorous that it outgrows most problems. The good organic variety may have resistance to a particular insect, for example. But in most cases it doesn't. It gets eaten by the insect just like everyone else. But the variety grows so fast that it shrugs off the insect attack as minor damage and produces excellent crops anyway. And nothing helps a variety compete with weeds better than just growing fast and being vigorous.

Keeping in mind the importance of vigor, a second method I use for developing good organic varieties and adapting varieties to organic systems is to simply focus on rapid growth and plant vigor. I select very strongly for fast germination, rapid growth, and vigor in the seedlings. This has the delightful advantage of being one of the easiest things to evaluate and select for. In addition, selecting for it can be done with virtually no extra land or labor. All that is required is careful attention to how much seed we plant and how we thin.

So whether I am developing a new variety or just saving seed with an established variety, to get powerful selection for growth rate and vigor, I start by planting at least three times as many seeds as plants I need. Then, I thin to the desired spacing, but only after the seedlings are big enough to have had time to express their own genes rather than just coasting on the food and biochemistry the mother plant puts into the seed. How long this takes I have come to understand through noticing and considering seedlings that carry spontaneous mutations that prevent the formation of chlorophyll in peas and in corn. Such mutations are lethal. The seedlings that carry them are completely yellow. However, a pea or corn seedling that can't make chlorophyll grows just as fast as the rest of the seedlings until it is about 2" (5 cm) high. It then comes to an abrupt halt and grows no further, then fades, shrivels, and dies. What this tells us is that up until the pea or corn seedling is about 2" (5 cm) high, its growth and vigor depend almost exclusively on the stored food and biochemistry synthesized by the mother plant. Only after the seedling is bigger than this is the contribution of the mother plant diluted enough so that the seedling's performance expresses its own genes rather than those of the mother. So, I let seedlings get as big as possible before I thin so that they have had as long as possible to display the virtues or liabilities of their own genes. With corn, for example, I let the seedlings get at least 4" (10 cm) high before I thin them. I leave them to grow even bigger if there is room. I want to avoid having the plants crowd one another too much and make thinning too difficult, however.

Another reason for not thinning earlier is that more shallowly planted seed often comes up first. If we thin too early, we can be thinning based on accidents of planting depth instead of genetic capabilities of the seedlings. By just waiting a bit, all the seed has a chance to emerge, and the minor differences in emergence rate associated with accidents in planting depth are overridden by the vigor and growth capability of the individual seedlings.

Tomatoes are a classic and easy place to begin a breeding program. Colors, flavors, varieties, and nutrition are all worth exploring. Image CC0 via Pixabay.

We get very powerful selection for germination rate, growth rate, and general plant vigor in every generation….

Most seeds are smaller than pea or corn seed and don't carry as large a store of food and biochemistry from the mother plant. So crops with smaller seeds may be expressing their own genes earlier than at 2" (5 cm) high. The same general principle applies, however. Sow excess seed and thin as late as practical in order to select for rapid germination and growth and plant vigor.

Selection requires eliminating plants, choosing which ones to keep and which ones to jettison. If we sow about as many seeds as the plants we need and keep all the plants, we aren't selecting. If instead we plant excess seed and thin optimally, we get very powerful selection for germination rate, growth rate, and general plant vigor in every generation, and our entire stand of plants is already selected heavily for vigor before we even get around to choosing which plants to save seed from based on other characteristics.

A corollary: it's often possible to tell which varieties will make vigorous organic varieties just by noticing how fast they germinate and how rapidly the young plants grow.

A third method I use in developing organic varieties is to focus on genetic heterogeneity. Some varieties are highly inbred and have little genetic heterogeneity but are nevertheless quite vigorous. This is most common in crops such as peas, beans, or tomatoes that are basically inbreeders and are not very sensitive

to inbreeding depression. These varieties have been selected for having genes that allow vigorous plants even when present in homozygous combinations. But many varieties and crops derive some of their vigor from genetic heterogeneity itself. When a plant or variety has a lot of genetic heterogeneity, it has many genes in configurations like Aa, Bb, or Cc rather than AA, aa, BB, bb, CC, or cc. That is, the plant is heterozygous rather than homozygous at many genetic loci (positions). (Why genetic heterogeneity tends to confer vigor is not yet understood.)

Once you have your new variety, save plenty of seed.

Some genetic heterogeneity is visible; it affects the way the plants look. But much or most genetic heterogeneity is invisible. So a vigorous heirloom variety might seem pretty uniform, but may actually have a lot of invisible genetic heterogeneity. Greater genetic heterogeneity is often associated not with just greater vigor but also earliness, yield, and general resilience of a variety.

We increase genetic heterogeneity when we cross varieties. We start with two varieties that are AABBCCDD and aabbccdd, respectively, and get an F1 hybrid that is AaBbCcDd, for example.

We decrease genetic heterogeneity drastically when we inbreed. For every generation of inbreeding, we lose half the genetic heterogeneity. You can see this by considering a single gene that is heterogeneous in a given plant, Aa. If the plant is self-pollinated, that is, inbred, the cross with respect to this gene is Aa x Aa. Our high school genetics tells us the offspring will be 25% AA + 50% Aa + 25% aa. Notice that one-fourth of the offspring are now homozygous for A, and one-fourth of the offspring are now homozygous for a. Both AA and aa have lost all their genetic heterogeneity at this locus. Only half the offspring are heterogeneous with respect to this gene. So we started with one plant that was genetically heterogeneous at the locus, that is, 100% of the plants were genetically heterogeneous. And we wound up with only half the offspring being genetically heterogeneous with respect to the gene. The same thing applies to all other genes that start off heterozygous. So we lose half the genetic variability with a single generation of inbreeding. This loss in genetic heterogeneity can mean lost vigor and resilience.

After we do a cross to start a breeding project, we often then have to do some inbreeding to create varieties that are uniform for the characteristics we care about. Most pure-breeding squash varieties are inbred four or more generations, for example. I think one way we can breed more vigorous organic varieties is to limit the inbreeding to what is absolutely essential by not requiring uniformity for characteristics that don't matter. These days, squash varieties are uniform not just for squash flavor, size, shape, and color, for example, but also for leaf color and shape and many other characteristics that don't matter. When we require a squash variety to be uniform for leaf size, color, and form, we do so only by discarding large amounts of genetic heterogeneity unnecessarily.

Another way we can maintain more genetic heterogeneity as we breed varieties is to mass select (as I described in the section on creating landraces) rather than inbreeding at all. When we mass-select instead of doing familial inbreeding, however, we often end up with a variety that isn't totally uniform for some of the characteristics that do matter. We should simply accept this. In fact, this pattern is characteristic of good heirlooms. They are vigorous and resilient but have a few percentage of off-types. This is probably because they were created by mass selection instead of familial inbreeding. They contain recessive genes that, when they appear in homozygous combinations, give rise to off-types. We simply rogue out the off-types each generation so that the frequency of the genes that cause them drops, or at least becomes no larger in the next generation.

When we mass-select for a characteristic associated with a recessive gene, it's pretty easy to fix that gene, that is, get it homozygous in all plants in the variety. But when we mass-select for a characteristic associated with a dominant gene, there are almost always a few recessive genes hanging around in the variety which occasionally give rise to off-types. The few off-types in each generation is a small price to pay for the greater vigor and resilience we can get in many varieties by avoiding too much inbreeding.

A final method I use is to go ahead and do familial inbreeding when I'm creating a variety, but then restore the lost genetic heterogeneity afterward. I inbreed and create not just one but several independent lines, then intercross them toward the end of the project as I did in breeding Candystick Dessert Delicata. Each inbred line will have lost much of its genetic heterogeneity during the familial inbreeding phase. But different lines will have randomly lost different components of the initial heterogeneity. By crossing the lines at the end of the project, I can restore most of the genetic heterogeneity but still have uniformity for all the characteristics I selected for when developing the lines.

Once you have your new variety, save plenty of seed. Rejoice in it. Cherish it. Share it. Pass it along. Congratulations. You have bred a variety that may become one of the heirloom tomatoes of tomorrow. Δ

Carol Deppe is the author of three books on gardening and breeding vegetables. This exerpt from The Tao of Gardening *was reprinted with permission from Chelsea Green.*

The Importance of Breeding Perennials

Eric Toensmeier

OUR PLANET IS HOME to approximately 250,000 species of plants. About 20,000 are edible for humans, and 6,000 are cultivated for food, fodder, materials, chemicals, and energy. Fully domesticated crops tend to show reduced toxicity, better flavor, greatly increased yields, and easier harvest. They also usually become more dependent on irrigation, pest control, and weeding. Of the 6,000 cultivated species, few are fully domesticated—perhaps 100 food plants and 30 industrial crops. That means we're relying heavily on only 0.5% of the plants we could potentially be using.

Plant domestication is a process of people—whether consciously or unconsciously—selecting for useful traits. In return, the plants become increasingly dependent on us for their survival and dispersal. For example, an individual tree might produce larger nuts with thinner shells, higher and more consistent yields, and more concurrent ripening relative to other individual trees. These traits might make it less suited to survival in the wild, but if it exhibits these traits on a farm, it may be protected from pests, may have competing plants weeded from its neighborhood, and may even be irrigated and fertilized. In this way, domestication is a two-way street, a mutually beneficial arrangement between humanity and our crops. When it goes far enough, both species become dependent on the other for survival.

Climate change mitigation has a tight time line. We have only a few decades to retreat from the tipping point to 350 ppm or below. The question of plant breeding and how long it takes to domesticate a new perennial crop is important in this context. During World War II, the US found itself cut off from imported rubber supplies. A search for a domestic rubber source identified a promising candidate (a goldenrod). Not surprisingly, it proved impossible to start with a wild, completely undomesticated plant and domesticate it to the point of serving as a commercial rubber source in just four years. Mass-planting a crop that is not yet ready for release, as happened with the industrial oil crop jatropha, which was planted for biodiesel production, can lead to disappointing yields and economic disaster.

It looks as if three waves of perennial crops may be coming to our climate rescue. First are those that are already in production, such as our global, minor global, and regional crops. Most could benefit from additional breeding work to improve yields and mechanical harvestability, but there are already good varieties in production. This wave of perennial crops is ready for widespread planting now. It is for this reason that this article places such a strong emphasis on regional and minor global crops.

The second wave may take 5 to 10 years. This includes crops such as perennial rice that researchers and plant breeders have been working on for decades, the results of which are nearly ready to release. It also includes some crops that require some more basic research or market development before they're ready for broadscale adoption by farmers, or they may perhaps require innovations in harvesting or processing equipment. Breeders estimate that developing and releasing a new variety of an established crop can take 8-20 years.

Hazelnut catkins. Image CC0 via Pixabay.

The third wave may take decades. Perennial maize could be ready in 10-40 years if funding were available. Although this might seem too far in the future to be of much use from a carbon farming perspective, all climate projections I've seen indicate that we'll need to continue sequestering surplus carbon through this century and beyond, especially since the current rate of fossil fuel emissions is likely to continue or increase. In other words, this third wave doesn't offer a short-term solution, but that doesn't mean we should abandon our efforts just because we won't see the fruits of those efforts for decades. We may still need them at that point.

International law does not currently have a mechanism to protect the intellectual rights of indigenous people and poor farmers who make contributions to plant breeding. Plant Breeders Rights (PBR) are rights granted to the breeder of a new variety that give the breeder control over the propagation and harvest material of a new variety for 20 years (and 25 years for trees and vines), but these rights are typically granted by national offices to large seed companies, creating a tension not only between the well-funded patent efforts by large corporations and the rights of individual smaller farmers, but internationally as well. In fact, corporations have patented numerous species and varieties that were developed by poor farmers. Perhaps the most famous such biopiracy effort was a Texas company's outrageous attempt in the 90s to patent basmati rice, a set of varieties developed by farmers in India over thousands of years. A fair trade group called PhytoTrade Africa is helping farmers develop markets for agroforestry products without losing intellectual property rights. For example, they helped a women's marula oil producers cooperative in Namibia develop a shared patent for their product that protects their rights and secures them a market.

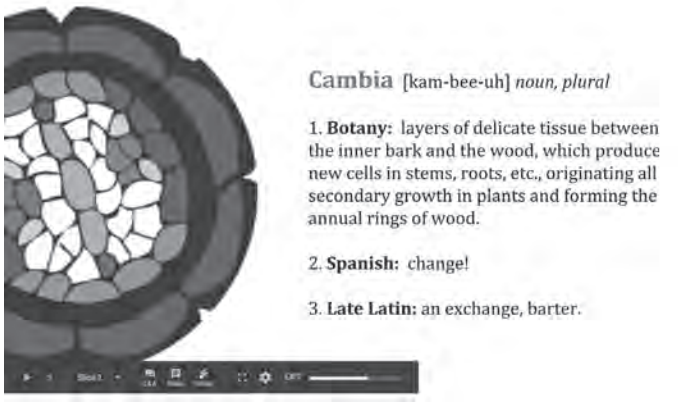
Ongoing efforts seek to develop an intellectual property model suited to small farmers, rather than a model that serves only the interests of large corporations, but to date no agreed-upon model has emerged. A modified form of PBRs would provide a 25-year patent to farmer groups. NGOs may be able to assist farmer-breeders by creating a registry of varieties that includes the GPS location of the original tree, the history of the variety, and a tree's "genetic fingerprint." Δ

Eric Toensmeier has written several books on perennial vegetables, forest garden design, and carbon farming. This excerpt is reprinted with permission from Chelsea Green from: The Carbon Farming Solution.

Innovations Make a Smart Match

The Cambia Drawdown Solution

(Alejandra) Liora Adler and Andrew Langford



THE CAMBIA DRAWDOWN SOLUTION is based on over two years of research under a $45,000 grant to Gaia University from Lush Cosmetics. It proposes a new agronomic operating system for growing almonds in California that deals with three (and more) major issues of this $11 billion industry that produces 84% of the world's almonds, while currently using over 11% of California's water resources—enough water to supply the city of Los Angeles for three years!

Lush has since moved their almond interest to Chile (another suitable mediterranean climate area) partly (we think) to avoid the premium costs due to the land speculation rife in California (recent legalization of recreational marijuana has added further fuel to this particular fire).

We continue to develop the project here as an enterprise so that it can earn its way into existence on the grounds that the emerging concentration of regenerative enterprises and their enabling institutions in California, many of which are food- and farming-related, has the potential to incubate a fresh and much needed world-scale 'New Economy.'

Our next step is to plant-out a 5-acre (2 ha) experimental orchard at Full Belly Farm starting late 2017 (here's a shout-out of gratitude to the Full Belly Farm partners from Guinda who are long-term strategic agents in the emergence of organic farming in Northern California. Their willingness to engage with the Cambia Solution after 30 years of pioneering work attests to their continuing commitment to flexible thinking about 'what comes next.').

Our pitch

Text and images repurposed from Liora's presentation to Food Funded 2017, the recent Slow Money event in San Francisco.

The Cambia Solution is a rare land-use gem that helps fix climate change by increasing carbon drawdown to soils by up to five-fold, reduces crop water use by up to 50%, and has the potential to double farm income per acre.

The results of our research are so powerful and far-reaching that, despite our commercial sponsorship coming to an end, we knew we needed to create a design for de-industrializing the California almond industry so that the Cambia Solution can go viral and expand to other crops and regions of the world.

We propose to create a Cambia standard for polycultural almond orchards—well beyond organic—through creating drought-hardy and diversified orchards in water-retention landscapes. Using water-wise rootstocks, a soil-food-web approach, and direct marketing, we will support farmers to plant orchards that draw down significant levels of carbon dioxide from greenhouse gases and reduce water use while increasing net income—an exciting prospect of making a healthy profit while effecting climate stabilization.

Breeding fungi for soil inoculation

Following on the extraordinary and heroic work of Elaine Ingham, for the last 10 years, Dr. David C. Johnson of New Mexico State University, has been researching the capacity for fungal-dominant soils to drawdown atmospheric carbon dioxide and convert it into long-term carbon. Fungal dominant means bacterial to fungal ratios of at least 1:1 and moving towards 1:5, 1:50, and more. The preliminary results are highly promising.

The grower makes aged, fungal-rich composts in static piles using an on-farm, simply made bioreactor (designed by Johnson's wife and project partner, Hui Chun Su). Recipes include ramial woodchip and associated, shredded leafy materials, and straw and grasses with or without animal manures. A water-based extract is made from the resulting compost.

When applied to soils or used as a seed coating, this extract provides a stimulating inoculant that kick-starts a soil biology that, over the following three years or so and with repeated applications (2.2 lbs. compost to the acre in solution = 1 kg per ha), is capable of sequestering 20-40 US tons of carbon per acre per year (45-90 metric tons per ha per year)

This fall, our first Cambia Grown Orchard will be planted on five acres at Full Belly Farm in the Capay Valley. Our 500 experimental trees feature water-wise rootstocks grafted with disease-resistant sweet varieties. They are currently under the watchful eye of the chief horticulturist at Sierra Gold nursery.

in farmland. Crop yields in the experimental plots also increase by 20-40%. You can find more on our YouTube video.

On the macroscale, Johnson's expert extrapolation is that if only 20% of the world's soils were inoculated with fungal dominant composts, we could, in 20 years or so, reduce carbon dioxide levels to 250 ppm. That's below the levels at the beginning of the Industrial Revolution.

Overall, these are extraordinary findings—they are off the charts (see Fig. 3.1 in Eric Toensmeier's permaculture-positive and important 2016 book, *The Carbon Farming Solution,* where 20 tons per ha per year is classified as 'extremely high'). Some caution is in order but, in our view, not so much caution to stop us 'getting on with it' and working with other citizens, practical activists, and progressive farmer/growers to see what we can do in real life. This has been the permaculture way from the outset, and we continue to celebrate working on this edge of theory and practice.

Our assumption is that this land needs to be in permanent tree crops or silvopastures of some sort to make this drawdown permanent enough to be considered stable, and further substantial improvements to drawdown can be made by adding biochar to the mix.

Breeding the necessary trees

Edible almonds are two-part trees consisting of a rootstock (that, if it were grown out would produce bitter and somewhat toxic almonds) grafted with edible, sweet varieties.

Starting with the roots

In California, most modern almonds are grown on peach roots. That may come as a surprise. Paraphrasing Tom Gradziel, UC Davis Professor with special interests in peaches and almonds, we arrive at the following explanation:

> *Peaches and almonds are almost genetically identical and originated from common parents (comparison between the fruit of peaches and almonds soon reveals the similarity).*
>
> *Then, in ancient times, tectonic plate movement caused the Himalaya to form and the parent plants were divided, some on the wet side of the Himalaya and some on the rain-shadow (dry) side. Over the eons, the wet-side plants became peaches (with shallow roots well adapted to functioning in lands with high water tables), whilst the dry-side plants became almonds (deeper roots to search for lower water tables and also adapted to coping with dryness through periods of summer dormancy).*
>
> *Originally (1860s till circa 1950s), almonds in California were grown on almond rootstocks derived from seed collected from inedible wild almonds to produce the hardy and so-called bitter roots), were planted on sloping land (to encourage frost drainage in order to protect the tender almond blossoms from damage during the blossom season (late February), on relatively poor soils and with no irrigation (dry farmed).*
>
> *By the 1970s, irrigation water was much more available due to completion of the Central Valley Project and the California Aqueduct and, meanwhile, cheap plastic irrigation tubing had been developed. Consequently, almonds could come off the slopes into richer soils on the Central Valley bottom, and the crop has since been intensely industrialized for higher yields with irrigation, artificial fertilizers, fungicides, pesticides, and herbicides.*
>
> *In irrigated and therefore wet conditions, almond roots attract rotting organisms causing fatal 'crown rot' in the trees and so peach rootstocks, better suited to wet feet, are used instead.*

For our purposes (drought resistance), we needed to recover original 'bitter' almond rootstocks or almond-dominant hybrid rootstocks. Tom Gradziel provided seed for Mission, a variety (pure almond) from the Wolfskill Experimental Orchard in Winters, California, and Chuck Fleck of Sierra Gold Nurseries provided Titan (almond hybridized with a little peach).

We decided to grow from seed in order to access the taproooting vigor of these varieties that goes missing when cloning

(tissue culture) is used. However, we have chosen to divert the tap root energy through a process of air-pruning of the roots (see the sidebar).

Adding fruits (nuts)

A primary requirement for the fruiting varieties is their natural resistance to brown rot. Brown rot is a disorder arising from airborne fungal spores attacking the blossoms of almond trees in that sensitive late February flowering time. It can cause significant die-back of limbs and crop losses.

Conventional growers spray against brown rot any time rain is expected during the blossom and post blossom period—conventional anti-fungal sprays are toxic (of course), and in wet years when soil conditions prevent access by tractors, are applied by aircraft, so undesirable spray drift is probable. Human health suffers as a result.

For our organic growers, therefore, we needed natural resistance (in three varieties that have overlapping blossoming periods to facilitate cross-pollination). With input from our expert helpers, we chose Non Pareil, Peerless, and Aldrich.

Other species, cover crops, grazing…

Further species can be used for animal fodder crops and for nitrogen fixation. *Leuceana spp* (frost-hardy species required), *Casuarina spp*, and *Geoffroea decorticans* all look especially enticing, as they meet both functions.

We intend to graze sheep and possibly poultry on the orchard floor which requires us to develop low-cost aerial harvesting methods (to avoid poop contamination of the nuts).

A further innovation will be in-field hulling (almond nuts come encased in a hard shell which is, in turn, encased in a softer, bulkier hull). Hulls make good animal feeds and are usually exported off the plantation for this purpose—our plan is to keep these on the land as a mulch element and to provide a nutritious post-harvest bite for the sheep who will be starting their lambs shortly. This method will also reduce crop drying needs.

A difficult context

These are big changes to the core agronomic methods of a large, well organized and wealthy industry with significant momentum. At the heart of the industry is the Almond Board of California (ABC), brought into being in the 50s as one of sev-

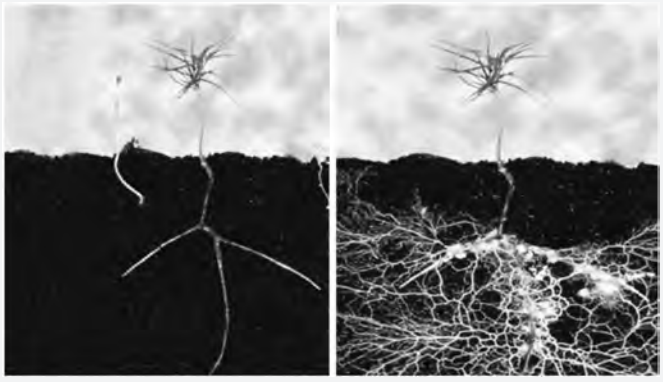
Tap Roots and Air Pruning

A taproot, it is thought, is critical to the establishment of a seedling germinating in the wild. It dives deep and fast, anchoring the young tree against wind throw and likely accessing soil moisture and nutrient reserves at depth.

However, in almonds, according to observations by Chuck Fleck, Head Horticulturalist at Sierra Gold Nursery, the taproot is thought to function this way for only two to three years before its job is done, and it then withers away. Evidence for Chuck's conjecture is that almond trees pushed over for removal do not show evidence of an intact taproot. Productive life span is 20-25 years for irrigated, high-input/high-yield trees, so we get to see pushed-over/uprooted trees quite frequently.

Note that relatively little is known about tree roots as they are hard to see, very difficult to excavate intact, and excavations destroy the subject plant. One of the best sources of information that draws from historical data and current thinking is Robert Kourik's valuable 2015 book *Understanding Roots*. Robert gave a technical workshop on the topic of roots at the 2016 North American Permaculture Convergence in Hopland, California, and our inquiries with him during and after this talk have been significant in shaping the rootstock experiments.

According to Dr. Carl E. Whitcomb of Rootmaker (www.rootmaker.com), it is possible to substitute for the taproot (and, indeed, do better) by a) finding other ways to anchor the tree in the ground and b) providing an alternative source of soil moisture during establishment. We can provide for both these functions, and so we have redirected the taproot vigor into significantly increasing the number of lateral roots.



More laterals enable trees to explore larger volumes of soil in the top 4-6' (1.2-2 m) of ground. This is ground we can access with amendments (such as the fungal extracts), affect with mulches and cover crops, and alter using Yeoman's plow techniques.

Also, the potential for tree roots to support mycelial symbiosis will be markedly increased due to more edge, as shown by a comparison of soil volume exploration between pine seedlings without (left) and with (right) fungal connection (images by kind permission of Sir David Read: Emeritus Professor of Plant Sciences in the University of Sheffield in the UK).

All in all, we expect this attention to the relatively accessible soil/root/mycelia zone to work better than a classic taproot approach.

The air-pruning method works by exposing the growing tips of roots to open air, causing the root to cauterize at the end. This stimulates several nodes behind the point of cauterization—the optimum point being at 4" (100 mm)—to put out fresh roots. This way, one root is branched into several. By repotting twice more once the roots have grown out four more inches, it is possible to develop trees with a massive number of lateral roots (on the order of 100s rather than just a few). Δ

eral crop-specific organizations mandated by a Federal Marketing Order.

The ABC leads using a polished, capital- and water-intensive, industrial agribusiness approach. It focuses on aggressively increasing the world market for almonds grown in the US, increasing acreage in production, increasing production per acre, developing more automation to reduce labor costs, seeking export routes that bypass unionized ports and outcompeting any other water users in California in regards to sharing scarce water resources.

The ABC does have a sustainability agenda with some fascinating projects on board (using existing almond plantations as floodplains during heavy winter rains is one such project that also serves to partly replenish groundwater aquifers), yet the overall thinking is unashamedly driven by the bigger, more, faster, productivity distress. In our view, this makes the industry inevitably increasingly extractive and is creating a bubble that is surely prone to collapse.

These almonds are part of the drawdown solution: providing improved yields on less water and sequestering carbon at the same time.

We do not expect to directly influence the ABC at this stage. This is the context where we are seeking to promote ecosocial system functions as a priority for almond orchards.

Cambia—the ecosocial functions

Ecosystem functions include drawing down $C0_2$ from the atmosphere to soil carbon, integrating animals into orchards for cleaning and weeding to eliminate the need for pesticides, adding year-round wild pollinator habitat wherever possible, using keyline design and water retention landscapes to reduce flood risk and reduce drought effects, setting the stage for rewilding, and more.

Social system functions include eliminating toxic runoff to drinking-water aquifers, reducing overall competition for water, and eliminating toxic dust pollution and spray drift, whilst reconfiguring orchards for coolth and conviviality making them desirable places to be.

We are not expecting this to be a quick or easy sell, especially as we have yet to prove that a Cambia concept orchard is viable—there are many variables at play, some of which are novel. We need to sustain the project for at least four years before we will have undeniable results. Once we get there, then we'll be able to work with the early adopter growers of organic almonds. More of these show up each year—over 9,000 acres (3,600 ha) of new organic almond orchards were planted last year, and replanting, which happens every 25 years, also provides a window of transition for yet more growers, and the consumer market is underserved.

Right now, we consider ourselves deeply fortunate to have Full Belly Farm on board as our pre-early adopter experimental partner, with whom we are working during the proving phase. Their land, deep experience, and existing customer base are three of the major resources required for success.

New Economy methods

Cambia needs financing, of course, and we are assembling a suite of economic methods—some new, some old—to help with this. A Direct Public Offering is in the making, we are seeking means to access the progressive edge of the informal carbon credits markets, and we have costed up crop share values to ensure that Cambia and its investors share risk with the farmer-growers.

We are adding our permaculture design perspective to the long term design-and-do process, alive and well here in California, that aims to emerge a whole ecosytem of capital raising, enterprise, and technical support webs capable of spreading the Cambia Solution across broad landscapes and diverse perennial crops.

The California Healthy Soils Initiative, new this year, also provides an opportunity to seek state funding—for this we are delighted to be able to leverage the now useful reputational capital of Gaia U—this enables us to carry some modest door opening and authority forward, especially in the informal world and increasingly in the formal. This is a valuable enabling function.

For example Gaia U, at the end of last year initiated a free online training, 'Creating Regenerative Livelihoods,' that speaks directly to energizing the emergent new (permaculture) economy. The course has attracted people of extraordinary creative talent—Cambia, as an offshoot of Gaia U, has been able to access these wonderful people and offer them worthwhile contracts, paid and work-traded, to support the developing design of Cambia itself. We expect this synergy to expand over time.

To find out more, go to: cambia.works; gaiauniversity.org. Δ

Andrew Langford pioneered permaculture in England in the 80s becoming the first UK Permaculture Teacher and co-creator of the UK Diploma of Applied Permaculture Design, now in its 22nd year. This led to the creation of Gaia University now in its 11th year with Liora Adler.

(Alejandra) Liora Adler is a visionary social activist and has shared her experience and knowledge in 30 countries, as a member of the Board of Directors of the Global Ecovillage Network, its representative to the UN, and co-founder of two ecovillage projects in Latin America. Liora currently serves on the Board of the Global Village Institute and the Permaculture Institute of North America.

Andrew and Liora live in the Capay Valley in California, where, based on Andrew's research, they have co-founded Cambia: Drawdown by Design—a climate change solution.

New life from venerable heirlooms

Create Seed for your Bioregion!

Susana Lein

This article is adapted from the 2017 book, Kentucky Heirloom Seeds: Growing, Eating, Saving, *edited by Dobree Adams & Bill Best, University Press of KY. From the introduction by Dobree Adams (Editor): Susana Lein created Salamander Springs Farm near Berea, Kentucky, from degraded logging land without topsoil in the Appalachian mountains…. This self-sustaining market farm is entirely off-grid, and Susana lives in a passive solar tiny house she built herself. Without tillage and very few outside inputs, the farm produces grains, dry beans, veggies, fruits, nuts, forest foods & medicines, flowers, and herbs for Community Supported Agriculture shares, local markets, an online store, restaurants, and retail outlets. Susana teaches permaculture and natural building workshops on the farm and for organizations in many states…. The farm's no-till systems of producing staple grains and dry beans were inspired by rice farmer Masanobu Fukuoka's work; the no-till cornmeal & popcorn are produced in Mayan-style Three Sisters cornfields… [Susana provides] a perfect example of the ongoing development of heirloom seeds, selected and bred for size, vigor, color, flavor, drought tolerance, and pest resistance for continued viability on our changing planet.*

SELECTING SEED TO ADAPT food crops to our bioregion, and more specifically our microclimate, has been important in sustaining Salamander Springs Farm over the years. At the market, both old-timers and younger folks appreciate the rich flavor and nutrient density of our heirloom varieties. Often, the same named varieties from heirloom seed catalogs lack the vigor, productivity, and flavor of our own locally selected and developed seed. Salamander Springs produces staple grains, beans, and veggies without tillage, fertilizers, and with very few outside inputs. Our bioregion experiences the extremes of too much rain and drought in a season. Heat, humidity, sudden cold spells, forest-held frost pockets, pest pressures, and clay soils all create growing conditions distinct from those where the catalog seed was grown. Our task is to continue the legacy of the heirloom seeds by selecting, adapting, and developing the seed for changing planet conditions and our local needs. If stagnated in time, heirloom varieties will no longer do well in their native regions, as many have experienced with heirloom tomato varieties from this region.

These crops meant survival for many a family.

Two examples of local adaptation and development of seed varieties are dent corn and pole (string) beans, which have long been staples of the Appalachian region. Heirloom dent corn provided the staple grain for cornbread, grits, and hominy, as well as delicious "roasting ears" at the tender (sweet corn) stage. Pole beans harvested at the full bean stage provided sustenance (and protein) through the winter. These crops meant survival for many an Appalachian (and Native American) family.

Farm apprentice Dori Stone picks heirloom cornfield beans at Salamander Springs (July 2009).

Kentucky Rainbow dent corn

In 1999, the late Daymon Morgan gave me seed of a dent corn grown for generations by his family in Leslie County, Kentucky. Although he still called it Bloody Butcher, an all-red heirloom dent corn, it had crossed over the years to have a diverse parentage and few red ears. Most ears were predominantly white with some blue kernels mixed in. During my first several years of selecting and saving seed, the gene pool occasionally expressed Bloody Butcher in entirely red-kerneled ears, but predominately represented genes of the white-kerneled Tennessee Red Cob or the thinner Hickory King (with a white cob and fewer rows). Blue Clarage was likely the parent for the blue-kerneled corn. Occasionally represented were a thin-kerneled gourdseed-type corn, and ears with painted orange kernels, a favorite and now more prevalent in my gene pool.

After 17 years of my selection and breeding, there has been a considerable change in color, size, productivity, and plant vigor. About one-third of the corn gene pool now has red cobs, along with the array of kernel colors for which I have selected and bred over the years. Ear size has increased dramatically, reaching 12" (30 cm) long and yielding a pound (0.5 kg) of corn on one ear. Primary ears with over 14 rows of kernels have increased from about 30% to more than 80%. Plant vigor of this corn is astounding to those who see it in the field. Most plants

"How many feet in a meter?" In disbelief, Salamander Springs Farm apprentice from Austria, Franzi Habith, measures the corn stalks! (August 2014)

now have two ears and measure 16' (almost 5 m) tall. Some tassels have reached as tall as 18½' (5.6 m)! Selecting and breeding for plant traits that help provide protection from rain and pests have increased my marketable harvest, such as a tighter husk closure and ears which turn down on the cornstalk as they dry, keeping rain from entering the ear.

In 2008, the Virginia-based Southern Exposure Seed Exchange (SESE) approached me after my workshop at the Carolina Farm Stewardship Association conference in South Carolina. I began selling seed for their catalog, at which time I named it "Daymon Morgan's Kentucky Butcher," attempting to include some of its history. We have since changed the name to "Kentucky Rainbow" dent corn to reflect its diverse parentage and my selective breeding changes. Because of its overwhelming popularity in the catalog, SESE now contracts several other seed growers in the Southeast, who use foundation seed stock from Salamander Springs Farm. When the seed of so many heirloom corn varieties are showing GMO contamination from wind-born pollen, my location has been a blessing—on an Appalachian ridgetop surrounded by forest, and a great distance from any conventional cornfield. I am blessed to not have to bag my corn at silk stage to avoid cross-pollination of the seed. I plant my shorter season popcorn (a 90-day flint corn) early and wait a month to plant the Kentucky Rainbow (average 110-day dent corn). During two seasons when spring conditions closed in on that 5-6 week window, I de-tassled the popcorn after ear formation to avoid cross-pollination of the later dent corn.

Kentucky Rainbow has become an immensely productive, drought-tolerant corn in my no-till Three Sisters system with squash and beans. Customers across the country rave about its incredibly flavorful cornmeal. While Kentucky's corn production was reduced more than 50% by the intense drought of 2012, tour groups at Salamander Springs Farm were amazed to find a healthy and productive cornfield (on a ridgetop!) without irrigation.

The sweet roasting ears remind me of my years in Central and South America. The core of my knowledge of corn seed selection and development came from the seven years I worked with Mayan Pokomchi farmers in Alta Verapaz, Guatemala, especially the late Don Gavino Ca'al, with whom I worked and learned so much. In the years since, my research of how genes represent themselves in corn reproducti on have substantiated the wisdom of the Mayan "people of the corn."

Each hamlet of the Pokomchi people where I lived during the 90s was identified by the color of their corn—blue, white, red, and all shades in between. Seed was selected for size, vigor, and tolerance of difficult conditions without irrigation or added amendments. Because of the centuries of work of these Native American farmers, 12" ears of corn were developed from teosinte, its parent, the size of a grain of wheat.

Cornfield beans

In 2011, Garland Elkins, a neighbor in Rockcastle County, gifted me seed of several heirloom varieties of pole/cornfield beans when delivering some geese. Some were Appalachian heirloom varieties I already grew: White and Cut-Short Greasy Beans, Half Runners, Rattlesnake Pole, Turkey Craw, and Goose Beans. But a 200 year-old heirloom bean he called the Elkins Bean had a special family history. Garland's great-grandmother, Robinette, was eight years old when the family journeyed over the mountains from NC to KY sometime before the American Civil War. She was charged with keeping the seeds of this special bean safe and dry in her apron pocket. During the post-Civil War years in KY, she often told the story of how the family rested on their journey at a beautiful place with fresh spring water, where WV, VA, and KY meet. When Garland was a teenager in the 50s, his family journeyed to see this place that she had so often told him about—which is the present-day Breaks National Park, near Elkhorn, KY.

The Elkins bean is now a treasured part of the cornfield at Salamander Springs Farm. The seed has been well selected over the centuries for productivity and vigor through drought, heavy rains, and pestilence. It looks somewhat like the popular Half Runner bean, but with an unsurpassed hearty flavor. Many staunch Half Runner customers at the market have been won over! It is delicious as a fresh string bean in the summer and as a protein staple in the fall and winter. The Elkins family shucked the later yellowing beans for "the best soup bean there is." Garland still enjoys many staples of our ancestors' diet, who by necessity lived entirely from the land—soup beans, squash, cornbread, grits, and crackling bread made with the fat of a butchered hog. Now almost 80, Garland Elkins wants his treasured bean seeds to live on. That requires us to select and save seed for plant vigor, resistance, and productivity, continually adapting it to the changing conditions of our bioregion. May we keep these heirlooms growing, adapting, and feeding the people of our communities! Δ

Susana Lein of Salamander Springs Farm, Berea, KY, has been featured in the 2015 permaculture film, INHABIT, thepermaculturepodcast.com, articles in Mother Earth News, Orion, and Permaculture Design*, as well as online features by organizations for which Lein has taught, including the Stone Barns Center (NY), Cornell University Reduced Tillage Panel, Southern Sustainable Agriculture (SSAWG), and North American Biodynamic Association conferences. Lein received her PDC at Crystal Waters Permaculture Village in Australia. She teaches permaculture and natural building workshops on the farm and for organizations across the US.*

Finding the White Tiger

Emergent Design

Jennifer English Morgan

"Design creates culture. Culture shapes values. Values determine the future." ~ Robert L. Peters

THE FUTURE IS BALANCING on precarious tipping points. An acceleration of planetary chaos has many of us waking up to our own sense of accountability and desire to live more intentionally and purposefully. I wish to harness this momentum and support the refinement of pathways for people to engage in life with increased authenticity and agency.

The process of Emergent Design achieves this by emphasizing conscious engagement, and the exploration and refinement of self. Consciousness activates an alert observer of our experience, and engagement illuminates the focus of our participation. Design choices are explicit interactions with the world around us. At the core of design is an intervention within a specific system, with the intent of manifesting or tracking a particular outcome, by using and tracking an appropriate process unique to the situation.

We are designers of life.

The word "emergent" means that we are tapping into the present moment and witnessing the unexpected arise into view. The words "emergent" and "emergency" have the act of attention in common, as they both require authentic presence and responsiveness in the moment. Emergency has to do with a sense of reacting in a crisis. Emergent has to do with responding to what is arising before you. However, because we are often in a state of societal strain, with fear, anger, and attachment as common frequencies; we have an increased tendency to behave in a reactionary state activating our adrenal response, even in non-emergency situations. The attention and ability to respond with agility and dynamic adaptability is necessary to access and/or alleviate what is emerging. This is important in the context of our current work as designers, because we can use design to create order in the midst of chaos, and ultimately reshape the direction of our evolution. Join me as I explore how we can become self-empowered conscious co-evolutionaries through Emergent Design.

Stepping into engaged action

During the 2016 election cycle in the US, I experienced an upheaval of my emotional stability, as an onslaught of anger, elation, and fear arose near the November election. Shifting to see what was behind the emotions, I recognized the presence of collective consciousness. The emotions were not mine to hold. Detaching left me with an invigorated sense of purpose to become more politically engaged and integrated into a unified front with my community. However, I soon after started questioning my ability and right to take action. Who was I to judge what was good or bad, when I know the concept has a link to ego? In a society that is so focused on power over resources, people, and the pursuit of control, I started questioning my own motivation for stepping into my power as a designer. It felt as if I were tripping over my own choices around taking strategic political action. I set out on a journey to find my will and purpose for action, and here is my story.

We are designers of life. It's in our nature as humans. In one of my earliest designs, I built a forest fort as a young child in the woods of Pennsylvania. I began working as a professional designer about 15 years ago, and am now one of the design instructors at Gaia University. With a lifetime of experience in the field, I took this inquiry as a design challenge. I began tracking this weariness and confusion around my ability to step into direct action. I used Emergent Design as a lens and container to track these observations and succeeded at applying the process and principles to find my peaceful center and clear focus on taking political action.

The rest of this article is on my discoveries of stepping into my power as an Emergent Designer. I really believe that we can as individuals and as a collective force alter this evolutionary

The Dragon and the Phoenix energies in design. © Guangliang Huo accessed via Dreamstime.

momentum. Specifically, in the case of this inquiry into action, we do so by reshaping the direction of our evolution both as resistance to and as solution for the chaos arising from the global turbulence of neoliberal capitalism, neo-fascism, and climate change.

Understanding motivation

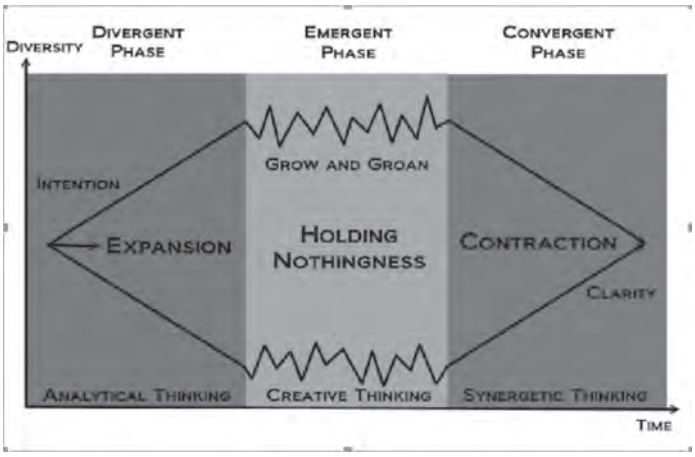
I've been paying a lot of attention to my thoughts and actions. I notice times when I feel peaceful and other instances when tension arises. The key to Emergent Design is conscious engagement. Unconscious decision-making doesn't equal active design.

We are often unaware of the complex mental functions happening, and I'm not just talking about our biological processes. I'm referring to those times when we make decisions that are out of alignment with our authentic self. It's important to look at how and why we make decisions and the driving force of motivation shaping our behavior.

There are internal and external motivating factors. Internal factors can be influenced by our genes, health, sensory preferences, history of experiences, our knowledge, and our sense of purpose in the world. External motivation includes inspiration, fear, and incentive-driven factors, which can be generated or manipulated by our families, communities, and culture. Combined, these shape our beliefs.

These attitudes are a collection of feelings and values based on our lifetime of experiences and education, which includes enculturated worldviews passed implicitly and explicitly as societal values. A good deal of our conditioned responses do not serve our authentic self-interests, the interests of our communities or, indeed, the planet. Many of our habitual behaviors and attitudes happen out of illusion, repetition, addiction, restimulation, and expectations.

The more we derive our decision-making from conscious personal motivation, the more we can develop an awareness of and a drive for self-actualization. Through this self-fulfillment, we can maximize our potential as human beings. To do this, though, we must unlearn counterproductive attitudes that developed through negative conditioning. Engaging consciously through goal-setting, and applied transformational thinking and action, creates a deeper awareness and confidence in one's own abilities, while dissolving barriers and unhealthy patterns.



Skillful Navigation of the Center. *The above chart was generated by Laura Kaestele adapted from Sam Kaner's book* The Facilitator's Guide to Participatory Decision Making.

Natural patterns

A healthy replacement pattern of engagement that exists at the foundation of life is the breath pattern, a process with three phases—divergent, emergent, and convergent in four actions (in - transition - out - transition). They are different and complementary ways of thinking and working, and can be linked to the three stages of breathing: in (lungs expanding), transition or holding (emergence), out (lungs contracting). The breath is at the heart of Emergent Design. The following chart shows this breath pattern. Applied to design and consciousness, expansion/divergence is when we open up to surveying ideas and creating possibilities. Contraction/convergence is when we make decisions through analysis and sharpen our focus. Emergence is the balancing place in between. Inside emergence, you will discover a choice to transition or hold incoming energy. Ultimately, everything is received and released. Our ability to skillfully navigate the center is the apex of Emergent Design (See chart, "Skillful Navigation of the Center.").

Building on this concept, there are two common patterns in how people engage in the world and specifically at the apex of decision-making. One emphasizes too much, and the other too little. I'm a student of Ayurveda, which is the life and medical science in India. In Ayurveda, this concept has to do with the flow and utilization of energy. Ayurveda recognizes rajasic energy (excessive) and tamasic energy (deficient). Neutralized harmonious energy is called sattva. In 25 years of working in the community, business, non-profit, and higher education sectors, I have observed two common design approaches that mirror this pattern. Andrew Langford, co-founder of Gaia University has identified them as "predict and control," and "using no system at all."

TWO COMMON DESIGN PATTERNS

PREDICT AND CONTROL	USING NO SYSTEM AT ALL
Too much analysis	Too little analysis
Attachment to form and structure	Attachment to intuition
Fear of leaving the plan/losing control	Fear of losing the magic
Analysis paralysis	Conditioned decision making
Lack of engagement/focus	Lack of approach or thinking
Dismissal of intuition	Stuck in dreams, not taking action
Over investment of energy and low yields	Chaos, disorder and low yields
Non-responsiveness to opportunities	Lack of attention/motivation
Silo mentality (compartmentalization)	Procrastination

Both of these patterns contribute to a disconnect from our authentic center.

Emergent Design can be found in the middle of these two design patterns. In Ayurveda, I'd refer to Emergent Design as having sattvic attributes that bring about a state of peaceful harmony and refine the art of balancing form and flow. This reminds me of the attributes of the Dragon and Phoenix.

I started thinking about the symbolism as I considered how our society seems to be shifting towards chaos whilst stuck in an egotistical state of controlling and grasping for power.

The Dragon and the Phoenix are considered yin and yang in

Chinese feng shui. In my exploration, I've come to understand that the Dragon represents focus and form, and Phoenix represents emergent flow. This is synonymous for contraction and expansion in our more common design language. All of these descriptive attributes have the flow of life energy in common. The pairing of Dragon and Phoenix is regarded as a powerful sign of energetic good fortune in life. This is reflected in the ancient Chinese expression, "When the dragon soars and the phoenix dances, the people will enjoy happiness for years, bringing peace and tranquility to all." *(author unknown)* This inspired me to share a metaphorical reflection.

Be the phoenix awakening in the fire of change. Don't trip over the ashes of transition, and the center will emerge. Be the dragon in the infinite sky. Focus and refine your power in the present to illuminate the path of creative change.

The Dragon and Phoenix represent the clearing of the mind and focusing of the mind at the same moment. The Phoenix is clearing. It empties and frees the mind of attachments. In comes energy, and life emerges. The Dragon is focus: setting the intention and direction of awareness, tracking the course, and illuminating attention. Ultimately, this metaphor represents energy being received and released. What we do with that energy determines our experience and evolution. In enters our will—the White Tiger.

The symbolism of the White Tiger represents our pursuit of personal truth and the power of conviction. Inner strength allows the Tiger to stand by values, even if they are not popular opinion, to advocate or champion political or philosophical freedoms from a place of non-judgment. Contrary judgment does not align. To step into the energy and attributes of the White Tiger one needs to acknowledge and accept the shadows and the light.

With Power and Strength, you glide through the night,
silent as the mist that evaporates with
the first rays of morning light
Eyes, glowing with a blue fire that reflect both water and sky,
you stare deeply into the Soul, leaving nothing unknown,
for all is revealed before your penetrating gaze
Keenest of all is the gaze you turn Inward,
searching the depths of your restless spirit
in a quest to know your Self
The Hunt for Personal Truth is called
... and swiftly answered
When the Truth is revealed, torn free from the grasp of the past,
any fear felt is faced with stealthy observation
and unrelenting determination,
for fear now is the prey.

~ Crystal Wind

Finding the White Tiger and balancing the energies of the Dragon and the Phoenix requires an exploration of the edges and transitions between their dance and flight. The White Tiger arises after much inward reflection. The following illustration represents my experimentation with this edge pushing.

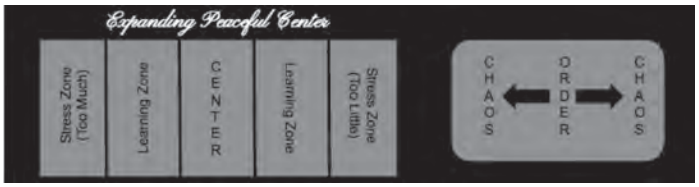
I've expanded on the idea of Michelle and Joel Levey's

The White Tiger can balance the energies of the Phoenix and the Dragon. Image © Oksanita accessed via Dreamstime.

learning zone model (www.wisdomatwork.com) to incorporate the energies of too much and too little (See chart, "The Expanding Peaceful Center.). In the center is a space of sanctuary, peace, and comfort. The terrain is well known, and the skills needed to thrive are honed.

Out from the center exists a space of learning, where expansion and contraction occur. This is when we step outside of our comfort to gain a new skill, solve a problem, face a challenge, and critique or expand our thinking. As we engage in life, we often move from this central place of order out into challenges, complications, and in some instances pure chaos. Challenges can simply be areas of skill that are unfamiliar to us, or they can be complexities in society. Someone who doesn't know how to cook, who is preparing dinner for 20 people, will be moving out of their comfort zone. How they handle the situation will determine if the experience becomes learning or stress. The more time they spend in the learning zone, refining the process of learning, the more likely the person will incorporate the lesson. Returning to the center of comfort is restorative and necessary. The center is a place to integrate and embody learnings into wisdom and intuition.

Through learning, we extend our skills and ability to be comfortable amidst challenges. By living on the edge of our comfort, our learning zone can expand within complexity, and enable us to better respond to emergent behavior. If we stay only inside our comfort zone, we can get stuck in unresponsiveness; if we stay too long in chaos without learning comfort, we can burn



The Expanding Peaceful Center

out from over-responsiveness. The goal is to stay on the edge of aliveness and in the present moment, by anchoring into the center, into the now.

Practice and experimenting with edge exploration refine our ability to perform successfully. The more we skill up as designers, the more we can reprogram our response patterns and be effective in co-creating the world we live within. We can reshape and redefine our patterns and even reprogram our brain's neurocircuitry through practice and repetition, helping us choose the best and quickest responses. Rapid cognition streamlines brain function, and this can happen through practice.

Intuition derives from experiences. Our gut reaction, or that part of our brain that makes automatic decisions, is part of intuition. This thought led me to consider *The Art of War* by Sun Tzu. Naturalistic decision-making or recognition-based decision-making helps us understand how people make choices in demanding real-world situations. In war, we have no time for logic—we need a situational response. Our brain functions in if/then statements. Compacted information is a pattern in life, such as DNA, which is a template of codes. This is important when considering reprogramming our brain's ability to function in chaos.

We need analysis to understand and respond to systemic problems, and to deconstruct our internalized oppression by reprogramming our situational response patterns. We also need intuitive presence, because ultimately that is where our brain is thriving in the moment, and responding to emergence. Understanding this increases our capacity to refine the art of balancing form and flow.

We need this dynamic to receive or release what is emerging. This is similar to aikido. The word "aikido" means "the way of unifying (with) life energy" or as "the way of harmonious spirit." We move with the emergent energy towards an optimal evolution. An emergent designer witnesses and interacts with the unexpected, while creatively moving towards and along a pathway of self-actualization and the manifestation of intentions.

The principles are patterns of engagement with holistic properties in consideration of process.

Emergent Design principles

Gaia U. Masters Associate Laura Kaestel and I have been experimenting with applying Emergent Design since 2015. Through our collaboration, we have observed a growing list of twelve principles that guide the process of balancing form and flow, and can be used by a designer. The undercurrent of these principles is related to cultivating a harmonious mind space for making decisions and design interventions. Points of intervention are specific places in a system or mindscape where a targeted action can effectively interrupt the functioning and open the way to change. The principles are patterns of engagement with holistic properties in consideration of process. It is essential to accept the concept of emergence during the use of these principles, finding value and opportunity in what arises, and feeding that back into the process, rather than attaching to the path or an outcome.

Observing frequency and patterns

Life is like a song—it has crescendos, flows, and stops. Our bodies and minds are like a fine instrument. There are different frequencies for different types of experiences, and we can train ourselves to recognize the transitions between frequencies. There's a moment when everything is ripe. Sometimes we pick things too soon or too late. Recognize patterns in what is driving our motivation. An example is to notice the voices of "I'm great" and "I'm not good enough." Practice focusing the mind, surrendering the mind, and facing some of the shadows of our own motivation. Fine-tune yourself with patience.

Cultivating pathways and embodying knowledge

The true voices of reason are intuition and wisdom. Pay attention and set anchor to the quality of these voices and how they arise. Utilize the anchor and signs to help find your way through life. Set observing and interacting from a heartfelt center as the default brain state setting. If you lose your aim or the path, this is a useful place to rest your mind. Cultivate a healthy confidence. Practice and learn. Become the embodiment of your skill. Follow your intuition and trust the unfolding of the journey, your aim, and focus. Continue to hone your skill as it is ever changing.

Receive and release

Hold knowledge not power. Power is a current, and we are a conductor and transmitter. We can't give or take control. Celebrate, like a dolphin riding a wave. The ego tries to harness power. The issues in society are a reflection of ego trying to capture and control power. As with power, observe, receive, and release ego. Similarly, when taking action, suggest and observe, rather than manipulate and control. Also, skill up in methods to release stuck energy. This can reset our ability to be authentically present. To hone the ability of witnessing the current, practice welcoming and thanking each thought and experience as it is received and released. Also, study the dynamic of power and energy across fields such as physics, chemistry, biology, ecology, and Eastern and Western life sciences.

Utilizing creative tension & edges

Contradict contrary thoughts from a place of calm center. Don't get stuck in analysis or doubt while applying critical evaluation. There is no right or wrong. Creative tension allows us to focus on what we want to create, rather than reacting to stressful tension or avoiding responsibility and taking action. This is the difference between emergence (attraction - pull) and emergency (pain - push) or applying generative energy versus reactive energy. Edges create diversity. An increase in diversity equals an increase in learning opportunities and possibilities for adaptation and integration. Learning includes facing and incorporating the shadows of self and society.

Generating conscious intentions

Understanding the purpose and motivating force behind the change you want to see in the world, generates a powerful sense of purpose. Those thoughts and intentions can become charged with the law of manifestation. Through visioning and attracting like energy, a project has more potential to manifest. The more you put your energy in a certain direction, the more the universe responds to that energy and opens up opportunities for the energy to arise. Being clear and conscious with your purpose also helps you be more ready and agile to catch opportunities that may otherwise go unrecognized. Having a willingness to experiment is essential in releasing attachments to outcomes and overcoming fears of success or failure. Cultivate a sense of simplicity in creating experiments that are not overly complex. When it comes to the focus of the mind, stack functions rather than multi-task. By stacking, you can get a lot accomplished with a singular effort. Multi-tasking divides and fragments our attention.

Emergent design allows us to take the steps toward greater liberation and alignment with our own design journey. Photo CC0 via Pixabay.

Relearning

Free the stories and worldviews that prevent the realization or acceptance of a process, pathway, or destination. Reprogram the voice of ego that hides peace behind illusions. Refine your mindflex with a flexible, dynamic collection of assumptions, viewpoints, and mental attitudes. Refining our mindflex is inherent to our learning capacity and a process of actively engaging with and changing thinking, rather than being trapped by dysfunctional worldviews and thought patterns. Skilling up on dynamic adaptability, agility, and other emergent design practices creates awareness, sustains liberating structures, encourages transitions, and embraces life's uncertainties. It's essential that we exercise the mind and hone our ability to learn. However, we all need rest and restoration for the full integration and embodiment of knowledge to anchor. Practice techniques for being still: recuperation, deep restfulness, and tools that reset your focus on center.

Interacting with & accepting feedback

By observing patterns, we can use them in our design work, to engage with the natural flow of life energy, not against it. Observation enables us to understand complex systems to make a small informed intervention. Carefully observe and incorporate feedback by tweaking interactions. Together, careful observation and thoughtful interaction inspire design. Rapid prototyping is a simple process to incorporate feedback from our environment, actions, and people as exact instructions for what to change to get the intended results. Rapid prototyping with built-in feedback loops is critical to effective learning. Small iterative and integrative processes allow for agility and responsiveness through constantly developing and refining a design based on feedback and evaluation.

Supportive frameworks and models create order and a liberating structure when applied within an emergent context.

Connecting with presence

Staying present and having a realistic appraisal of the current moment creates authentic connectivity. The groundedness in and acceptance of what is, exactly and intrinsically, is the foundation for any change to happen. In that sense, the first position and ongoing practice of a designer is to be present, centered and connected before, during, and after taking action. Routine reflection also keeps us linked to remaining in the present moment and keeping an eye on real emerging opportunities and constraints. By all means, appreciate the aliveness of presence whether in awe or celebration. Smile.

Balancing insight & ideation

Insight is the capacity to gain an intuitive understanding of something. Ideation is the ability to form ideas and thought. As emergent designers, we make the best use of both our intuitive and intellectual mental capacities, depending on what is appropriate in the particular context. Actively engaging and connecting life gives us access to our full creative potential beyond the limits of what we know.

Creating liberating structure

Supportive frameworks and models create order and a liberating structure when applied within an emergent context. This allows evolution, which is more elegantly ordered complexity, to happen. Liberation in this regard means that the conscious use of certain tools can help create enough innovation and order, to free up energy. The aim would be to create a greater sense of power for the individual while removing traditional control or social conditioning.

Dynamic adaptability

This dynamic creates agility and enables forward intentional momentum without a fixation or attachment to an outcome. The unexpected is met with grace and a proactive positivity. In this space of open, curious flow, expectations are released, problems become solutions, and new opportunities are harvested and woven into an integrated whole. Attachment to outcomes is limiting and even painful, as things take their course and can neither be predicted nor controlled. Releasing expectations and attachment to results opens us in an humble way to the awe-inspiring magic of—and being in flow with—life. Dynamic adaptability describes our capacity to thrive, while responding to and navigating changing situations without attachment.

Regenerative & holistic thinking

The term "regenerative" describes processes that restore, renew, or revitalize their sources of energy and materials, creating sustainable systems that integrate the needs of society with the integrity of nature. As designers, we filter our choices by ensuring our direction is towards creating and serving life. Holistic thinking is characterized by understanding the parts of something as intimately interconnected and explicable only by reference to the whole. Whole systems thinking focuses on linkages and interactions between these parts.

Emergent Design refines and actively engages our authentic self, and gives us agency and direction to take action.

Emergent Design as a tool for world change

"Evolution in complexity theory is more elegantly ordered complexity. Bringing things together doesn't create emergence. Bringing them together in a way that is particularly elegant is the key." ~ Daniel Schmachtenberger in his video, "Emergence"

I appreciate Schmachtenberger's concept of elegant evolution. We have the opportunity to reshape the direction of our evolution in response to the chaos arising in the world. Chaos may be seen as a metaphor for change. Because chaos relates to changes over which we have limited or no control, applying Emergent Design confronts that chaos with wisdom and intuition. It refines and actively engages our authentic self, and gives us agency and direction to take action.

Regarding my own authenticity and agency, I set out to find my White Tiger and discovered the balancing art of the Dragon and the Phoenix. After much reflection, I've decided that I am clear about my philosophical and political values. I also know they are not definitive. I will meet each moment with this intention and travel with purpose, conviction, and non-judgment as tools in my satchel.

The process of Emergent Design creates awareness and agility, enabling people to gain more skill in embracing life's uncertainties. We can release expectations and truly be proactive in harnessing the opportunities of the present moment. If we accept change, upgrade our outdated modes of operating, and move towards an approach that values and serves life, then we are tapping into powerful possibilities. I highly recommend watching Schmachtenberger's video after reading this article (www.youtube.com/watch?v=eh7qvXfGQho). His work aligns with my thinking on Emergent Design and emphasizes how humans have the capability of impacting the planet in a meaningful way.

Life—we can consciously choose how to participate. We can forecast, create, and steer the direction of our collective experience by applying appropriate interventions within a system, guided by our center. We have the opportunity to engage with a participatory and regenerative worldview that serves life. It is our responsibility to consciously choose to participate on this path as active change agents. Δ

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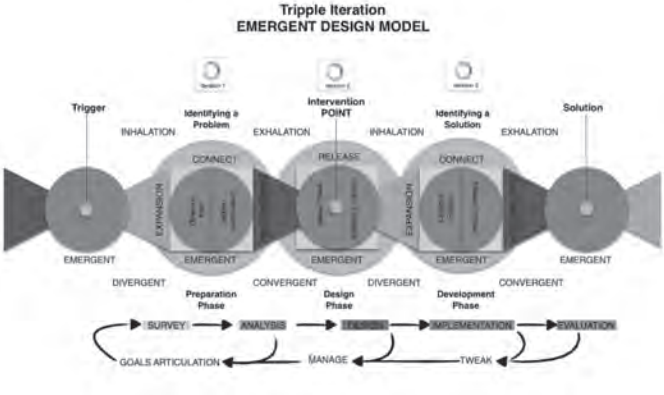
Much of the content of this page was generated in collaboration with Gaia University Associate Laura Kaestele as part of a research project on Emergent Design.



Designing from the Front Door, *cont'd.*

Peter Light

[Editor's Note; This is a continuation of Peter Light's article from #104: Permaculture Design Process, which describes Peter Light's approach and experience in implementing a site.]

THE PRINCIPAL DETERMINING FACTOR influencing the location of one's doorstep is sunlight. It takes supreme precedence over all else. Not being oriented to the south, or having buildings or large trees casting serious shadow onto zones I and II, is a type-one design error that must be avoided; otherwise, a satisfactory permaculture design will be prevented or seriously diminished from the very beginning.

Water and soil right at one's feet are the next factors to consider. How wet or dry is the location? How fertile is the soil? Deficiencies or excesses of these are easier to correct, however.

The destinations

I already knew where my van would be parked, in a pre-existing space half-way up the driveway with room for two vehicles 100' (30 m) from my doorstep. I didn't want it closer, because I didn't like the idea of regularly driving it through and into intensive food production areas—due to exhaust pollution, the space it would take up, and the shade it would cast. I do, however, want to be able to occasionally off-load supplies of bulk materials closer to where they are going—preferably directly into the wheelbarrow and to where they are to be used. Firewood, manure, grass clippings (delivered), and mulch material immediately come to mind, although increasingly my system is supplying those resources.

Other relatively distant destinations are the home sites of other tenants, the bottom of the driveway at the highway, and other further-away areas of zones III, IV, and V: the orchard, the lower field with trees and bamboo, and routes into the woods.

I pay particular attention to the number of steps I have to take….

It is best to have multipurpose destinations so that there will be many reasons to use the full length of the paths to observe and tend what is growing along them. Not having these multiple reasons is almost guaranteed to sabotage what we are trying to establish and maintain in less used parts of our system design.

Sometimes there is more than one way to get somewhere. If one route gets obstructed for any reason, even a small area may not get visited for months and months, so that no monitoring of what is happening is taking place: rot, tree-fall, plant decline, or blackberry growth.

Paths and simple structures to enjoy away from the rain and surrounded by garden.

Sometimes, one route is shorter and simpler, so that the path looping through the orchard is seldom taken. A solution is to make that one's beginning more beguiling. Emphasize the entrance and make the path easier to traverse.

Much of what applies to the distant destinations is also applicable to those that are closer to one's abode, distributed within and throughout the first two zones, from chicken house to outhouse, from manure barrel to raspberry patch.

The paths

I noticed a long time ago that much of my hippy, homesteading lifestyle consisted of walking around moving material objects from one place to another. Consequently, I pay particular attention to the number of steps I have to take to get from my doorstep to various components; and to the precise layout of the paths.

I spend a lot of time meticulously laying out the exact routes and gentle curves of the paths, using tape measure, rope, stakes, and flagging tape. I place and shape for their function, and I shape for the aesthetics. The curves often develop naturally or are obviously indicated. Often, there are objects or land-forms to pass around. Not only are the curves pleasing to the eye, and to the body in motion, but crenulations form a greater length of path—and therefore user interface with the landscape. This strategy increases edge and bed for more diversity and productivity.

The principal path, down through the center of the 4.6-acre (almost 2 ha) property from one corner diagonally to the other, is 5' (1.5 m) wide, broad enough for two people to walk comfortably side by side. Next, the main paths branching off from it, to, through, or around large distinct areas—the orchard, my zone I and II, etc...—are 4' (1.2 m) wide; the principal paths *within* each zone, 3' (1 m). Finally, the network of access to and through each individual *part* of each zone—garden beds, individual trees, out-buildings within feet of the house—are 2'

(0.6 m) wide.

The ground immediately in front of my bottom step, which is two steps from my door, is an intersection of three paths; within another 25' (7.6 m), there are a further 35 branchings, some proceeding onward and outward, some doubling back.

Path-side picking beds

It makes so much sense to be growing food—especially food that is eaten often, and plants that need much attention—alongside all the paths. I am beginning to work with the idea that along well-traveled main paths extending through multiple zones, path-side picking beds in zone II can be thought of as extensions of zone I, and those in zone III, extensions of zone II.

Path-side picking beds in zone I might be 2-3' (0.6-1 m) wide, with mostly annual vegetables and some perennials; the others, in the more spacious zones, can be 3-5' (1-1.5 m) wide, with taller plants such as raspberries, espaliered dwarf fruit trees, small vines, Jerusalem artichokes, asparagus, etc. in the back, with a mix of annuals and perennials at their feet.

I try to establish low-growing Dutch white clover, *Trifolium repens*, on all my paths, even very wet sections that have had to be surfaced with drainage rock. Clover is more desirable than most plants that will otherwise colonize bare ground. It is the only plant I know that is listed as trample-*proof*. It helps immensely on paths that would otherwise get moderately wet, muddy, and slippery during the rainy season. It is a bee plant. The leaves and flowers can be eaten. It fixes nitrogen for the plants whose roots are growing under the path; and it can be mowed or scythed for mulch and chicken food.

Perhaps here is where that fabled, fertile ground of mistakes might lie.

Activity zones

Activity zones or work areas need to be considered at the same time path-side picking beds are being determined and laid out.

These areas are places for wheelbarrows; garden tools; liquid manure and rain barrels; garden hose outlets; compost piles; and off-loaded supplies, recyclables, soil, clippings, prunings, leaves, manure, flats, and plants that are coming and going. The closer these areas are to the doorstep, the smaller they are. Further away, they can be larger. Because these spaces are at the expense of ground to grow food in and push everything on one side of them further away from the epicenter of the system if they are expanded; I've tended to turn a blind eye to their need, or the size they should be. But they are necessary, and cannot be overlooked if we wish to have a well functioning design that is not crowded and littered with obstructions.

Filling in

This is the meat and potatoes of a permaculture design. This is when the real work begins. This is where things get complicated. This is when I try to bring maxims to mind, teachings to bear, and personal life learnings to the fore. This is when I feel I need to remember—all at the same time—everything I know about permaculture and all the parameters of the plants I am trying to site!

It seems that this siting of plants is mainly what we do once the large spaces are defined by the skeleton of the system we are creating. Likewise, we start with the largest species first. That is what I am in the middle of doing, trying to find the correct location for the trees and shrubs I acquired last year and potted up for the winter.

I am finding this to be the most difficult part of designing so far. Despite knowing each species' ultimate height and width, their sun/shade, wet/dry preferences, their permaculture zone range, and all the other factors that are necessary to account for, I find myself walking around for hours agonizing over their placement.

The problem is compounded by a number of factors. One is other components already sited; another, wanting to put certain fruits in chicken runs; another, Martin Crawford's "plus 30%" spacing rule. Suddenly, areas I thought I would be planting in Sea Buckthorn, *(Hippophae rhamnoides),* more Saskatoons and elderberries *(Amelanchier* and *Sambucus),* a mulberry *(Morus),* and a clump of sweet-shoot bamboo *(Phyllostachys dulcis)* seem to be ruled out.

What I am having the hardest time with is the placement of these trees and shrubs on about an acre of land that is already at least a third planted with trees. Another third lies in raspberries, currants, and blueberries; and a third more open ground is planted with comfrey and old garden beds. The principal limiting factor is sunlight.

There is so much to consider: yes, height and width for a start, but more particularly, the height and width that the particular tree in hand will likely attain in this particular system in any given location. How closely can they be spaced if I put them in a single hedgerow? Yes, deciduous or evergreen, but if deciduous, what percentage shade is tolerated in summer and winter? If it is a single tree standing alone in relationship to an area of sun-loving annuals and perennials, how much loss of production will that understory suffer?

Perhaps here is where that fabled, fertile ground of mistakes might lie. With the limited experience I have had with this crucial stage of permaculture—siting large and medium sized plant elements in a landscape already haphazardly occupied—it might be a time to finally just act: try out some possibilities, remember "design over time;" over-plant with the aim of thinning out after a few years of early production; allow some areas to form a crowded thicket; or be prepared to remove some to transplant elsewhere if it becomes obvious that they are in the wrong place.

Maybe my mistake was going a little wild when I suddenly discovered two local sources for many of the "rare and exotic" fruits for edible landscapes, and bought more than I could use! I'll find out soon enough.

Target species and guilds

One thing that can help is the idea of target species, and guilds. There are tens of thousands of living, breathing components to choose from and apply to a permaculture canvas. Mollison famously wrote in his field notes in the 50s, and I quote from a limited memory from his autobiography *Travels in Dreams*: "The forest seems a simple thing. I think I could build one." But if we are modeling nature, then we are modeling complexity. This can be overwhelming to a designer. It is sometimes useful to chunk complexity down into smaller, individual parts. One of the ways I am finding helpful to do that is to think of each tree and shrub that I locate being a "target species" that becomes the start of a guild of plants radiating out from it. It has been further useful to consider these developing guilds as islands that merge.

Design from nature

I am excited to look at how vegetation has re-colonized the sides of the local two-lane highway that cuts up the coast past my property. I see such good examples of the abundance and diversity of the edge, of multilevel stacking, from grasses in the hard-packed gravel within inches of the pavement, to the firs, hemlocks, and cedars that mark the edge of the forest after clear-cut road construction. In between, there is a mix of indigenous and native plants. It is of particular interest to study what grows along the north-facing side of the highway, and to note what produces a credible yield in areas receiving less sun.

I also note the mix of opportunistic species—indigenous and otherwise—and their changing relationships with each other and other plants. The only species that can seem to dominate at times is blackberry, which is not, however, one that is being targeted as part of the current misplaced hysteria about so-called invasive plants.

Make sure there are lots of places to sit and enjoy life.

Design over time

This, of course, is just one more thing that adds further complexity to our considerations, but it is one that I am recently finding useful. If a plant will start producing in a short few years, but will take decades to reach full size, one can plant that species—say a walnut—at half the recommended distance, and then cut out every other one as they begin to crowd, utilizing the wood for lumber or firewood, and using the space opened up for other, shorter-lived species. Conversely, one could plant the large trees at a normal spacing (plus 30%), and interplant with short-life shrubs that will be ready to be removed as they get crowded out. The above is but one example of using this design principle. It is a sub-set of "design from nature," where we can look to find other examples.

How far away will the resource be used? How much processing will be involved?

Making the best use of

I often bring this maxim to mind as I go about my permaculture design and maintenance, the daily chores, and the tasks at hand. Because most of these involve walking around and moving objects—often resources—from one location to another, I've noticed that the "best" of this rough translation of "aprovecho" often means consideration of the urgency and appropriateness of a need, and the time and effort that will be expended fulfilling it—how far away will the resource be used? How much processing will be involved?

Today, two examples arose. In pruning raspberries, I lay the cut stems on either side of the rows and woven through the middle, as mulch, as I do every year. It is an easy decision: returning biomass back to the soil right on the spot where it was created.

The other example: last year, I harvested my four-year-old coppiced willow for firewood and was left with many, many branches. Half of these I laid across my driveway pull-out and two-car parking area, there to be broken up and pulverized by the movement and weight of my van and the vehicles of occasional guests and customers. Today, one year later (remember, design over time), getting ready for a load of road base to be put down on the parts of the area that are wet and muddy, I raked off all the broken up and rotting organic matter on its way to becoming topsoil.

The closest place to use this material was along the driveway, mulching a short stretch of one edge of the willow coppice, not something that really needed doing, but close at hand. I started doing this with the coarsest material, but it didn't seem appropriate for the mixture that remained. I could use it whole to create mounds in wet areas where I intent to transplant some bamboo—*Fargesia murielae*—but the area isn't ready yet, and I'd rather not dump it somewhere else until it is.

I could also sift it through, first, a quarter-inch screen for

some fine rich soil for part of a planting mix, and then through a half-inch screen for part of a coarser potting mix, finally using the coarsest remaining material as at least a base for some mounds. This was a lot more work, but was off-set by the value that accrued. I opted for this use.

Protracted & thoughtful observation

It is not advised to jump to the first thought that occurs to us—to rush to a decision. It is seldom necessary to do something right away. It is usually possible and always desirable, if we have any doubts, to "sleep on it"—for a night, a week, a month—letting both the conscious and unconscious mind work on a good solution to some problem we might be having trouble solving.

This maxim ties into "making the best use of" and helps avoid extra work and difficult corrections. I applied it to a pile of slabs I obtained when I broke up an old concrete pad I discovered under an old shed that I had moved 50 feet to make way for the arrival of my re-located travel-trailer home. The pile sat 15" (about 38 cm) from my doorstep, some of it for a year, while I worked around it and considered how I might best use the material, preferably somewhere close at hand. I was pretty sure I knew how I wanted to use the space the pile was occupying, but I certainly didn't want to move the slabs out of the way and make another pile of them while I was figuring out where their final resting place would be.

Their first use was for an herb spiral 5' (1.5 m) from my door; finally, the rest were used for edging around some small garden beds right at hand, and the largest pieces for flagstones for a close-by, very wet and muddy section of the principal approach to my abode.

Sometimes these overlapping and similar imperatives can be at odds with each other.

Waste not, want not

I learned this from my Dad—who homesteaded in northern Alberta during the Depression –and internalized the message. It is the same as "A penny saved is a penny earned." It is identical to Mollison's maxim "All pollution is waste; all waste is pollution." It goes hand-in-hand with voluntary poverty: I do not mend my socks because I am poor; I am rich because I mend my socks.

I have found that an important part of this maxim is separating materials and taking things apart. Both result in individual components that are often more useful and less of a hassle separated than when they were together in something broken, not used or wanted, or mixed in a jumble of parts—and components are what a permaculture design is composed of!

There are innumerable examples of this. Once or twice a year, I sift the floor of my wood shed for sawdust for my outhouse, soil mixtures, and to plant in (part of my Totally Weedless Gardening Strategy); and for the larger material to burn in my little stove, often for cooking during the summer. I usually take nails, screws, hinges, latches, and other hardware out of old lumber destined to be built or mulched with, or used as fuel. I have a Quonset hut filled with stuff I won't throw away because I know there are parts that could be used, and often are.

The henhouse palace nestled in its place.

Speaking of waste

One of my imperatives is to live and demonstrate living inexpensively for free; another, self-sufficient and free; another, how to survive various collapses, to unhook from the mainstream. Sometimes these overlapping and similar imperatives can be at odds with each other; other times they dovetail perfectly. I've recently been powerfully struck, for example, by a conundrum arising from a conflict between them, arising now that once again—since August 15, 2016—I have chickens as a principal component of my permaculture design. Once again, they are being free-ranged in a number of pastures; and once again, for now, at least, I am having to depend on some commercial feed for maximum production. Fortunately, egg sales from the 28 hens easily pay for that feed.

However, they *don't* have to pay for—and neither do I!—the great volume of fruit and vegetable scraps I acquire for them once or twice a week directly from the produce department of two or three local supermarkets. Once again, I am brought face-to-face with the waste of perfectly good food that accrues hour by hour at these outlets. Not only that, but much of it is organic!

Today, for example, I picked up four full plastic bags from two supermarkets, about 200 lb. (about 90 kg) of food, all of it edible. There is a minuscule amount of mould or rot—all of it today's fresh waste! It is impossible and silly not to divert the best for human use, but it is much more than I and my seven tenants can possibly consume. I'm thinking of starting a food bank and soup kitchen!

One could say that by introducing one element into my design—the chickens—I have eliminated the need to do

permaculture! I get to eat all the produce I could possibly want, including many kinds of fruits and vegetables I would not usually buy or even grow, for free and a few scant minutes of work. So I ask myself: Why bother to grow my own?

The only answer that really makes sense is that I will be no less vulnerable as the California drought continues, the water runs out, and the trucks stop rolling north. Although I would still be demonstrating an aspect of living cheap and free, I would not be showing how to prepare for survival by unhooking from mega mainstream agribusiness. And what would be left of my on-ground, beautiful, healthy, and rewarding lifestyle? Nevertheless, it is something I continue to ponder.

Chickens

I have chickens mainly for the work they do for me, eating and scratching their way through a landscape. Repeatedly, I have been unable to keep up with the rampant growth of various grasses, bedstraw, buttercup, and blackberry overwhelming the old orchard and environs in zone III that I have been developing and trying to maintain. I'd lost the battle at least three times before I got the chickens, at which point I could not even find the trails I had made, let alone walk them. Wood and branches were buried. Fallen apples hid in the weeds. I couldn't see the extent of the few but large blackberry vines snaking their way back into the space and through the tangle.

Dropping out with no or very few bucks is, in the beginning, similar to taking flight like a cormorant.

Within two months, the whole area had been transformed. Most of the species of grass—the principal weed of zones II and III—had been eaten, the others scratched and trampled into submission. So, too, the dense mats of buttercup, which the hens also hardly ate. As they worked, I was able to easily access the blackberry canes that I needed to remove. I recovered the firewood they uncovered, and piled up the branches they exposed. The 15 or 20 huge comfrey plants had been consumed down to their central leaf rib.

Wherever I wanted them to work more intensely, that is where I would throw a few handfuls of scratch. Any day now, I will be sowing Dutch white clover, crimson clover, kale, and mustards in all the runs; other useful plants have self-sown, including those pernicious grasses, now a problem made a solution: chicken food!

Hens & pastures

I'm housing my 28 hens in a 12'x12'x14' (about 3.5x3.5x4 m) pyramid. The beauty of this form of construction is that just four structural members—in this case a *single* 14'x12" length of western red cedar *(Thuja plicata),* quartered with sledge and wedge—frame the roof and walls!

I built the hen house over a pond I created with a spill-dam in a 4' (1.2 m) deep ditch. It is intended for ducks, to give them some protection from predators and, as part of a 75' (23 m) series of small ponds exposed to varying degrees of sunlight, for biomass production—for food for me, them, and the chickens; and for fertilizer and mulch: watercress excels for this purpose.

I am also in the middle of designing and putting together a pasture system for the poultry which will allow the birds to be ranged over a wide area all around my zone I in many, many runs of various shifting shapes and sizes. A version of a chicken tractor system, it is comprised of a half dozen or so 75' lengths of poultry wire that can be used separately or easily clipped together; and 10 or 12 10' (3 m) lengths of tunnel 12-18" (30-45 cm) in diameter and made of stucco wire that can also be clipped together, end-to-end, or to an opening in a pen cut to receive them.

The sections of fencing have bamboo poles woven through every 5-10' (1.5-3 m), with about a foot projecting at the top and the bottom. One end is slanted, the other flat across the top. Each section can be rolled up and carried by one person to an area to be enclosed. The tunnels are for moving the birds *from* their straw-yard immediately around the coop *through* a pasture or pastures that are not yet ready for them and need protecting, *to* one that is ready to be grazed and cultivated.

The flexibility of the fencing and the ease of driving the poles into the soil with a rubber mallet as it is unwound means that it can take any shape the landscape suggests and the designer wants. It can extend out to loop around an individual plant or guild, or bulge in to exclude it. Using the attachment point to the main run as a pivot, the fence can be shifted every few days to create multiple small plots of ground to be intensely grazed for a few days and then planted with cover crops or food-forest elements. With the addition of a length of tunnel, this range and flexibility is greatly increased. The fencing itself can even take the place of a tunnel at times by being moved into the shape of a 1' (30 cm) wide passageway running 35' (11 m) to another erected enclosure. The tunnels are light enough to carry one in each hand. I don't think I'll need many more than a dozen to connect to anywhere I want my birds to work for their meals.

Making it on the farm

Dropping out with no or very few bucks is, in the beginning, similar to taking flight like a cormorant. Launching from a low rock or floating log, at first you swear it's going to do a belly-flop, its little, short, skinny, barely feathered wings beating like crazy, its belly dragging on the water. When it finally gets truly airborne, you almost breath a sign of relief, you almost feel like cheering. It never gets very high, but it sure can skim along.

Finding your way financially by starting to do what you really want to do *first* is a lot like that, but something always

A room with a view.

presents itself. The few other folks up the inlet near where I lived in the 70s each found their way. One was a shake-splitter; one, a prawn fisher; a couple were on welfare for a while.

I met a farmer's son studying agriculture at a college in Olds—a prairie town in Alberta—when I was there to give a talk on permaculture. The two things that most excited him about my presentation was the idea of creating and using vertical space (he grew up and lived on flat land); and the thought that he could plant mint just outside his door, and later walk out from his kitchen, pick some, and go back inside and make tea from it, amazed him!

What stuck *me* most forcefully about *his* approach to agriculture was that he and his father were growing alfalfa and hay on 6,000 acres (2,400 ha)—2,000 owned, 4,000 leased—northeast of Saskatoon, Saskatchewan (even flatter than Alberta). They had realized a net income of $500 the previous year, and were $1 million in debt, while I was rapidly paying off a mortgage (in six years) with my old age pension and rent from a gaggle of tenants, and was earning enough to live on comfortably from just 35 plants in an area 20'x30' (55 sq. m), and—other than the mortgage—was *not* in debt.

I was able to do this because I chose to live a life of voluntary poverty; because I trusted that somehow the universe would provide; and because I selected and elected to grow a plant species of high economic value—one of Bill's suggestions for how to generate an income from the land. This plant grew out of my lifestyle long before I grew it out of the ground and, unbelievably, despite our almost non-existent flow of money for the first three years in Storm Bay—living on a child allowance of $6, and then $12 dollars a month, and happenstance—out of the ground for three years before it occurred to me that it could provide a living. I was just so excited to be able to follow the enjoiner, new and radical at the time, to "Grow yer own."

Impermanence

To add some perspective to our lives, it might be helpful though sobering, to remind ourselves of the likelihood that permaculture isn't—permanent. When designers walk away from a decade of work, or die after a lifetime of effort, the chance that they will leave anything more enduring than archeological traces (one of my permaculture teachers, Rick Valley, observed that a post hole would be recognized as such in 10,000 years) is slight. Here on the West Coast, grasses, bedstraw, and broom; Himalayan blackberry, and alder; wind and water; and rot and mould will initiate the conversion through successional changes back to a climax forest of fir, cedar, and hemlock. Only with the formation of truly viable intentional communities with a clear vision, many agreements, lots of tools to resolve conflict, a good location, and blind luck can we hope to have our designs prevail for more than one generation. But it is still not likely. Connections with essentials are long past. We can only practice being here now and non-attachment as we practice our permaculture craft, and congratulate ourselves that our footprints are so light that they will be hardly noticed, and will soon fade. Δ

Peter Light left the city in 1967, part of the back-to-the-land movement, and developed a lifestyle based on voluntary poverty and simplicity. His first and most fully expressed permaculture site was designed and lived in for 10 years before he had heard the word. He subsequently took two design courses and a 10-day hands-on, and has taught permaculture in a dozen or so workshops.

Incorporating Perennials in your Annual Garden

Eating Muscadines in Utopia

Chris Smith

Perennial-based food systems, one of the main goals of permaculture, conjures up utopic images of lounging in the sun eating grapes or plucking ripe pears from laden branches. "The designer becomes the recliner," is a lovely dream, but our current model of energy-intensive annual systems is entrenched, even in most of our own gardens. I understand the importance of goal setting and envisioning, but we also need to know how to get there from here—we need transitional strategies.

On one side of a chasm is our current annuals-based food system; on the other is a perennials-based system. If we try jumping from one side to the other, we'll most likely fall and be eaten by crocodiles (or whatever other sinister creature lives at the bottom of your imaginary great gulf of failure). We need a bridge, a translational strategy to get us from one place to another without failing or falling. This article offers some simple ideas on how to incorporate perennials into annual systems as we collectively shift from majority-annual to majority-perennial foods. The ideas can be applied in the home garden, the community garden, and even scaled to the farm system (especially if no-till methods are employed *[Permaculture Design* #104, May 2017, p. 38; also see Susana Lein's article in this issue].

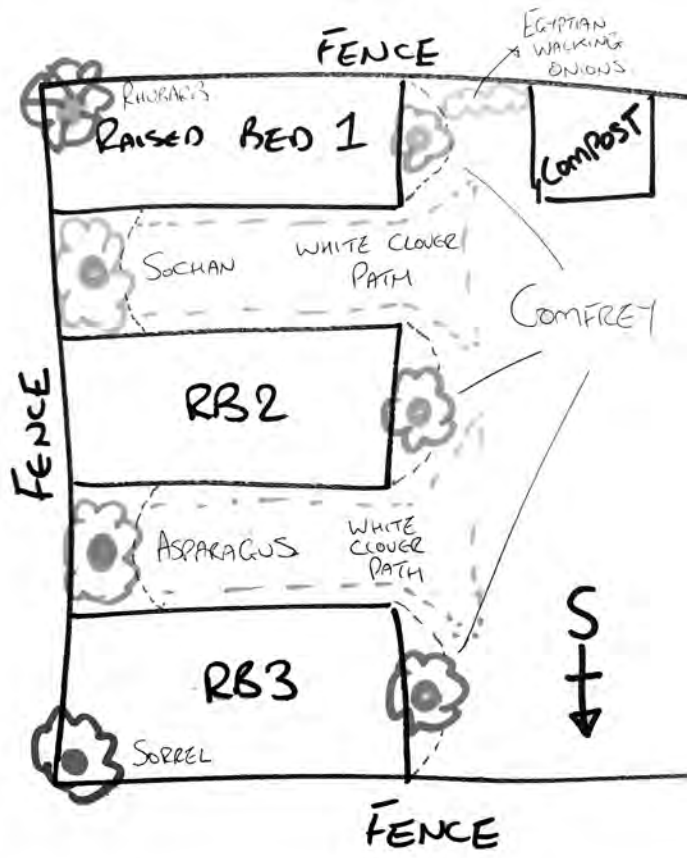
Opportunities for perennials in the annual garden

Our annual gardens always have prime planting spots: those areas of wonderfully loose soil, easy-to-access beds, or full sun exposure. If it's a good site with a well designed system, then a majority of the garden may be considered prime, but there will always be nooks and crannies: corners and edges that are hard to seed and harvest, useless gaps, and otherwise wasted spaces. These spaces are the first level where perennials can be utilized.

Below is a simple breakdown of some ways to get more perennials into your annual garden area, with a few species choices. When you start looking for perennials, you will realize that there are a lot more options, which will vary depending on your location. You'll often read the statement: "Perennials grown as annuals," for example peppers can overwinter in southern California, but not in the mountains of Western North Carolina. (I have to overwinter my pepper plants in pots in my basement, or start from seed each year.)

Perennial insectary plants for pollinators

Incorporating flowering perennials into your annual garden is a sensible move, even if you're currently relying on annuals. Increasing pollinator and insect habitat will increase your crop yields and encourage natural pest control. I love using wildflower borders in my annual garden areas, but bringing



small patches of flowers into the garden itself, at the ends of rows or corners of beds, will create visually beautiful and diverse gardens. I've used cinder blocks to border raised beds and planted perennial herbs and flowers in the blocks.

Comfrey is a wonder plant. I started with one comfrey plant. The second year I dug it up, hacked off some root chunks, and potted them on. I obliterated the rest of the root system with a spade and dug those small chunks into a long shallow trench along a fence line. The year after, I had a dense comfrey hedge. Comfrey has beautiful early pink-purple flowers that the bees love, and the deep tap roots mine nutrients and bring them into the leaves. I have a comfrey plant at the end of each raised bed and chop the larger leaves throughout the season to throw on the beds as a green manure. I also soak bunches of the leaves in buckets of water and use the (diluted) green-black liquid to water my heavy-feeding annuals.

Sochan, aka green-headed coneflower *(Rudbeckia laciniata),* is another flowering plant that can be easily incorporated into an annual garden. I plant sochan on northern corners or edges as it can get quite tall once established. The edible leaves arrive early and last all summer, and the multi-headed flowers are great pollinator attractors. I've found sochan growing in shaded understories and woodland edges, so it could be a good contender for any shaded areas in the annual garden.

Sochan was reportedly eaten by the Cherokee and is related to the familiar wildflower, black-eyed susan *(Rubeckia hirta)*. Once you've experienced sochan, you'll certainly want more of it. While fairly easy to start from seed (it requires cold stratification), sochan can also be propagated by root division.

Perennial herbs

I like to see multifunctionality in everything and often don't distinguish between herbs and flowers. Many flowers have medicinal and culinary functions, and many herbs have beautiful flowers. It is worth noting that the strong aromatic qualities of many herbs can have a deterring effect on some garden pests, which is a good reason to tightly integrate them into the annual garden.

Trellised plants like grapes and blackberries make good use of garden fence…

Creeping thyme is a wonderful herb to work with because it can grow as a living path. You'll have weed suppression, soil stabilization, and a heavenly fragrance with every step (How about that for utopian dreams!). Another perennial I love to use for similar purposes is Dutch white clover. White clover makes a good living mulch between my raised beds. It requires some level of control to prevent unwanted spread, but the bees love the flowers. It also fixes nitrogen and suppresses weeds. Note: Dutch white clover fits into many guilds as a groundcover. I use it between rows of blackberries and as understory for fruit trees.

Perennial herbs include some small woody shrubs, which can add structure and dimension to an annual garden. My mom roots lavender cuttings and lines her main pathways with them. When they flower, walking down a lavender-bordered path can be like entering a wind tunnel with all the buzzing of pollinators. Rosemary can achieve a similar effect. I used these shrubs to mark entrances; a rosemary gateway to welcome me to my garden.

Then there are the classic beneficial relationships between vegetables and herbs, many of which are perennial: bee balm for tomatoes (thought to improve growth and flavor); catnip to control aphids (or rather, control the ants that are farming the aphids!); chives for carrots (thought to improve growth and flavor); oregano with broccoli (to repel the cabbage moth). Instead of having a dedicated herb garden, interplant herbs throughout your vegetable plot for the flowers, the fragrance, and the farmacy!

A quick shout out to sorrel—several good variety options for this perennial green are now available. I love the way it tastes—especially cooked up with scrambled eggs! I'll sneak sorrel into the garden wherever I can, and it's another good candidate for semi-shaded areas.

Perennial vegetables

Eric Toensmeier's *Perennial Vegetables* lists over 100 perennial vegetables and their growing conditions and uses. I'm just going to cover a few common options, but I highly recommend this book for delving more deeply into edible perennials.

Most people who grow perennial vegetables cultivate a separate bed or garden area for their perennials. I encourage you to diversify AND integrate. There is nothing that makes me happier than great stalks of red rhubarb sprouting at the end of my cabbage row. Crop rotation and row cultivation are still an option, but leaving an end block on each row or a corner in each bed is an easy way to incorporate perennials.

Asparagus needn't have its own patch. The crowns prefer wide spacing, which offers the opportunity to interplant quick growing early spring edibles like radish, beets, and greens. Think of this as a miniature form of alley cropping (a technique where farms can slowly transition from annual production to perennial by sowing annual rows between tree crop rows until the trees grow to fill the space). Later in the season, asparagus benefits from tomato and basil companionship, which will ward off asparagus beetles. Asparagus in turn can deter nematodes.

Asparagus and rhubarb are long-lived perennials. When I was nine months old, my family moved to a house with an established patch of rhubarb. It's still productive over 30 years later.

Horseradish has a bad reputation for taking over garden spaces, but I don't mind it. The leaves are edible and medicinal, and the root makes the best vinegar for fiery salad dressings. The plant is quite stunning with long tropical-esque leaves. If the unwanted spread is a major concern, or you are operating in a tight space, then horseradish will grow in containers. I have an edgeline that is being invaded by bermudagrass, and I decided to fight fire with fire by planting horseradish against that edge—I'm in the second season, and it seems to be working.

Yacon (aka Bolivian sunroot) and Jerusalem artichoke (aka sunchoke) both grow edible tubers below ground and beautiful foliage and flowers above ground. Sunchokes can spread quite rapidly and are a good option for pioneer cropping in poor soil. Bolivian sunroot requires a little more care (in Western North Carolina, I have to overwinter the crowns in buckets of sand in my basement). Both these plants produce winter storage tubers, which make them a strong candidate for any edible landscape.

I've saved my favorite for last: Egyptian walking onions. Everything about this plant is edible, and it just keeps growing. The green shoots are harvested as scallions through fall and winter. The flowering heads produce small onion bulbs, which then send up more scallion-like shoots, which then produce more little bulbs (eventually falling to the ground under the weight and putting down roots to start a new plant, hence the name "walking onions"). The main bulbs can be harvested much like shallots or perennial onions. Being alliums they make good companions to most of the cabbage family (Brassicaceae). I tend to border one or two edges of a growing bed with Egyptian walking onions and plant my brassicas inside.

Incorporating fruit

Fruit trees and shrubs certainly have a place in the annual garden. I have apple trees on the north side of my annual garden, so their taller branching growth doesn't shade the annuals. I'm building a guild that will grow into the annual area and have incorporated asparagus, planted in a wide circle around the apple tree (with the earlier mentioned annuals between the asparagus). Early spring-flowering bulbs are planted in a tighter

circle, and saffron (fall-flowering) is planted in a wider circle. I started off scatter-seeding borage, but it has since self-seeded and comes back each year.

Trellised plants like grapes and blackberries make good use of garden fencelines and don't normally get tall enough to block the high summer sun. I like to plant micro strawberry patches everywhere instead of maintaining a whole bed—they put out new runners so readily that I find this an easy way to keep a fresh, productive population.

Opportunities for annuals in the perennial garden

Along with the many ways you can incorporate perennials in your annual garden, the converse is also possible. There are some great advantages to adding annuals to perennial plantings.

Perennials often require multiple years to become productive, whereas annuals will produce in the year the seed is sown.

Perennials often start off small and dramatically increase in size as they mature. Appropriate spacing for mature growth will offer large areas of growing land in the interim. Perennials often have deeper root networks, tapping into different nutrient and water layers than do annuals.

I have a variety of tomato called Matt's Wild Cherry. It was so aggressive and self-seeded so readily that I knew it would be a good candidate to truly return to the wild. I now let it do its thing between my berry plants as they grow to fill the space. We had this variety in our Sow True Seed gardens where it scaled a nearby dogwood tree (we actually had to climb the tree to harvest the fruit). In the Southeast, I see ground cherries growing wild along roadsides, another good self-seeding annual to incorporate into transitional areas.

Annual cover crops make good additions for soil building. I like using daikon (good eating) or Nitro Radish for compacted soil areas. There are some great cover crop mixes that I sometimes let flower. I'm using a Summer Cover Crop Mix this year from Sow True Seed that has cowpea, sunn hemp *(Crotalaria juncea),* pearl millet, flax, oats, sunflower, and radish.

Long-season roaming crops like sweet potatoes (technically a perennial in warmer climates) make great pioneer crops for in-between spaces. I've found that sweet potatoes will produce respectfully in poor soil (and even compacted soil), and the roaming vines help with weed pressure.

Self-seeding herbs and flowers can fill gaps in the perennial landscape (chamomile in the foreground).

I'm all about being creative with plants and space in the garden. Over time, we should see a blurring of the distinction between annual and perennial garden spaces, between farmland and forest. And with any luck, perhaps one day we'll find ourselves eating muscadines in Utopia. Δ

Chris Smith is an enthusiastic grower and permaculturist from a green-thumbed family. He has immersed himself into the world of seeds and Southern growing. On his urban homestead, Chris is experimenting with landraces, selective seed-saving, crop trials, grow-outs, and edible seed oils! Chris works for Sow True Seed, an Asheville, NC-based, open-pollinated seed company committed to sovereign and secure seed and food systems (www.sowtrueseed.com).

Social Forestry

The Project at Little Wolf Gulch

Tom Ward, aka Hazel

LITTLE WOLF GULCH (LWG) is a 40-acre (16 ha) section of Wolf Gulch Ranch in the Little Applegate Valley of Southern Oregon. Wolf Gulch Ranch includes Wolf Gulch Farm where a community-supported agriculture and seed growing business has been ongoing since 2000. The community of seasonal workers and residents varies between eight and 20 people—a small hamlet. The ranch is located in a pocket desert, the driest place in western Oregon, and sees as little as 10" (25 cm) of rain a year and as much as 30" (76 cm). Three gulches cross the ranch: Wolf Gulch itself, in the middle, has 13 head gullies. The east gulch is almost always dry and is undeveloped with a short drainage basin. Little Wolf Gulch is on the west and has four head gullies that start on the ridge of Little Bear Butte. The modest story of Hazel's life goes like this: Hazel has a little cabin in Little Wolf Gulch just below Little Bear Butte and just above the Little Applegate River, and we have a little bit of fun there, but we do not brag about it. We ask visitors to not wax too glorious when reporting their experience; perhaps it would be better to tell about all the challenges?

Challenges include very high wildfire potential, rattlesnakes, ticks, and poison oak; mountain lions and perhaps wolves already; isolation, peace and quiet (hard on some people); no cell phone service; difficult to find as even GPS does not work here (one needs to read maps and follow directions) in our "low signal environment;" dirt road with blind hairpin curves; hunters, loggers, pot growers, and radical hippies; hardworking farmers.

When we found this derelict ranch in the late 90s, it was a mess with a view. The gulches all run to the south, and the view is of the Siskiyou Crest where the Pacific Crest Trail runs along a 6,000' (1,800 m) ridge line with 7,000' mountains; Dutchman's Peak is due south. The Powells and their extended family wanted to find a farm that no one thought could be successful after Tom and Maud had been to Ladakh in northwest India where they were impressed with the difficult but farmed landscapes. We like to modestly suggest that there is nothing at Wolf Gulch Ranch that anyone thought was valuable: no water, no timber, no gold, no aggregates—just lots of star thistle and rundown buildings. The ranch was first homesteaded in the 1880s, and the Sterling Ditch (a mining canal) that was constructed on the range above the ranch provided irrigation water to all three gulches until 1962 when the diversion was closed. After the end of irrigation water, the ranch was largely abandoned, and we bought it for less than any other properties that we looked at. After a lot of planning and heavy equipment and a big construction project, we were able to start farming with water from a spring in Wolf Gulch, and we got a winter diversion permit to fill our ponds.

Social forestry class learning to split logs on site. Photo by Melanie Mindlin.

After we got the farm going, Hazel negotiated for a life lease in LWG. This 40-acre section of the ranch is classified as wilderness, but we have developed a net of trails and a small forestry camp to support the farm and reduce fire hazards. LWG is a fire laboratory: the Cantrell Gulch fire burned half of LWG in 1987, and we have since restored and under-burned acres of remnant oak/pine savannah. This landscape was burned regularly (every three to five years) by the Dakubetede indigenous people who were removed during the gold rush of the mid-1800s. Tree rings show fires since the removals on a 20-year cycle. There is a lot of remnant ethnobotany still persistent, especially geophytes and basketry stools. This landscape is fire-explosive with thick chaparral grown up since regular broad-scale burning ended with the removals. We have two charcoal kilns and multiple burn pile sites.

LWG is also a laboratory for simple living and post-fossil-carbon lifestyles. The vision is that small organic farms in the larger Applegate Valley could have small forestry operations that provide biochar while doing fuel reduction to protect the farms. Alternative forestry products can be marketed to support the forest workers. Oregon has a history of laws and principles that support forestry such as "access to economic opportunities," "temporary housing for seasonal workers," and "work camps for forestry activities." We are hoping to demonstrate ways to support people and farms while we restore periodic "cool burning" fire to the landscape and thus avoid catastrophic hot wildfires. We also hope to demonstrate how we might have humans living again in close relationship to place while doing this restoration and stabilization work.

The daunting future of climate change and the backlog of excess fuel on this landscape suggest a re-indigenation culture. We have been teaching about this and envisioning through Siskiyou

Permaculture with our Permaculture Design Course and our advanced permaculture courses, including Social Forestry, Optical Surveying, and Ethnobotany. We have also been developing value-added products and tools that support de-consumerization and low imported energy systems of living. This is ambitious and not very lucrative, but it does get humans back on the land and in close contact with nature and healthy living. So far, we have produced several types and grades of charcoal, firewood, building poles, baskets, natural buildings from on-site materials, and decorative products (ornamentation) that celebrate place: vernacular living appropriate to what we have where we are.

Our working season is late fall, winter, and early spring. The article "Social Forestry in the Shasta Bioregion" (siskiyoupermaculture.com) details the sequence and science of seasonal work. We mostly use hand tools and only occasionally a small chainsaw (while we still have gasoline). One of our goals is to preserve wilderness quality and wildlife while working in the complex ecological mosaic that wraps the various aspect slopes in these side gulches of the Little Applegate canyon. We are also very involved with many local farms and businesses. The opportunity for students and interns is to practice appropriate lifestyles while doing useful ecological work. Students camp out during our courses and cooperate in meals and camp chores. Interns are more involved with day-to-day routines and projects as the weather dictates. We have a small extra cabin and a tipi in LWG and a campground in Wolf Gulch.

Water on this desert is part of our challenge.

A day in the life of LWG re-indigenation

After an intern completes the application process and goes through the get-to-know-you trial and orientation, the intern sets up house holding. We have found that the chores of "simple living" take about four hours a day, and so we are lucky to get four to six hours a day work on projects. During breakfast, we discuss the plans for the day after we have assessed the weather and opportunities.

If there are one or two interns, they can stay in LWG. Three to six interns can form their own temporary "family" at the camp facilities in Wolf Gulch. Hazel needs some private time, (don't we all?), and a critical mass of interns forming their own community gives Hazel some space and time off. Meals are the best time for planning, reports, and sharing. At least one meal a day is a community meal. When there are one or two interns, breakfast is hosted in one cabin and dinner in the other. Lunches are usually personal snacks prepared in the morning or the night before. Meal planning and preparation are part of the daily chores. We mostly eat meals that take some preparation ahead of time. Perhaps we have to soak something, or grind something, or cook for a while, or get some vegetables from the farm. The cabins in LWG and the classroom in Wolf Gulch have wood

Hazel felling a tree. Photo by Karen Taylor.

stoves, and we try to avoid using propane or butane stoves. In warm weather we can cook on charcoal stoves in open shelters.

Water on this desert is part of our challenge. Some spring water is imported from off the ranch, but mostly we use rain water from barrels and tanks and mineral-rich spring water stored in a tank at LWG from the few months that the gulch spring runs (March through June). Housing codes for small un-permitted buildings do not allow indoor plumbing: so all our water is hauled in buckets and jugs. The tank-stored water needs to be filtered or boiled—or both. Bathing is done in warm weather with solar shower bags and in cold weather with sponge baths in the cabins. There is a sauna at the Wolf Gulch house, but that is a mile away from LWG. We started yarding materials in hopes of building a sauna in LWG.

In our PDC, we talk about CLP: convenience, license, and privilege. These are attitudes that need examination to prepare for the post-fossil-fuel future. The industrial expectations of moderns expect shortcuts in order to meet the hurry-up demands of financial capital and global trade, but these expectations are killing the biosphere. The very old Zen saying "chop wood, carry water" is very much our practice at LWG. This at best can lead to enlightenment. Meanwhile we have some attitude adjustments to practice. When one is truly present and aware of what it takes to live a good life, slowing down and paying attention have their own rewards. We try to avoid waste. We only go to town for special extras twice a month. This takes some planning. When we need something, we don't just go to a store—we need to figure out how to do without, repair a tool, search our stashes, or use local materials.

Communications out here can be a challenge for folks who are used to checking their screens constantly. We are "off the grid" at LWG. There is no cell phone reception. We have a satellite dish for internet powered by solar power. Because we are using stand-alone small solar systems, we do not have surplus power, and that means we use very small area lights for reading, and we only check e-mail once or twice a day depending on cloud cover. Our battery banks have to be carried in by wheelbarrow, and that means we do not have huge power reserves. All our cabins and the classroom have lights, but they are small and we have to budget our power uses. That includes re-charging devices. This is righteous simplicity as well as learn-

Forest Camp in Little Wolf Gulch. Photo by Karen Taylor.

ing to budget. There is a land line at the main barn and house in Wolf Gulch but that, as we have already noted, is a mile away and uphill. The closest cell phone reception is eight miles away by road, and that means driving and using fossil fuel. The rural mailboxes are two miles away and down-canyon, which is an athletic bike ride—then perhaps someone has already picked it up, and we have to go to the farm and search. We tend to get our mail in town from a Post Office box twice a month!

We prefer to have interns stay at least a month in order to get into the routine and become comfortable with all the new skills of off-grid living. Once an intern is accustomed to our ways, they are always welcome to return for a visit as they already know how to fit in and have a good time of it. Sometimes, we have special short intern programs, and those are more intensive as folks have to get with the program fast. We prefer that short-time interns have already been to Wolf Gulch for a course so that they have some idea what to expect.

The toilet systems are called dry because they do not flush. That means human manure composting and urine composting. We also compost all our food scraps. We do not want to tempt wildlife with messes, especially the bears and raccoons. Clean culture requires some learning. We clean up fast and we take out any smelly garbage (packaging) that we cannot compost (see "Wild Animals Tell Us" on the Siskiyou Permaculture website). There is a lot to learn about not interfering with wildlife while camping in the wilderness. Avoid temptation is our motto! Healthy sanitation is our learning challenge. Wash hands with minimum use of water! Avoid waste and messes!

Then there are the forestry work projects. We emphasize safe and skilled use of hand tools. We also emphasize attention to detail. We are doing complex forestry here, and that means sorting the wood we are cutting into several categories. We are also using a lot of fire, so we have to be prepared to avoid any escapes (the ranch needs protection) and to avoid any injuries (we do not have extensive liability insurance, and we expect interns to be responsible for their own safety!). Our work is not industrial or continuous and unvaried; we take lots of breaks to discuss what we see going on and to plan our next moves. There is a lot to learn about identifying species, protecting sensitive ecological features, understanding the effects of our work, and finessing perfect timing.

The social aspect of our forestry includes getting along with each other and learning to coordinate our activities, as well as getting along with nature and noticing subtleties. The forest misses humans, and modern humans are mostly disconnected from the wildness that we evolved with for so many eons. This is a big part of social forestry, and we all have a lot to learn about getting along with the landscape and with each other. Hyper-individualistic moderns are insensitive to others and self-centered in their priorities. Social Forestry widens our priorities and emphasizes reciprocation and gratitude. We will be suggesting a lot of reading in order to redirect our attentions and values. The direct experience of nature talking back to us is the most powerful re-connection with our deep heritage. Reading the land and learning to talk back to and listen to all our wild neighbors is polite and kind. We hope that everyone who spends some time in this special place-ness grows into maturity with full hearts, ears, breath, touch, and taste. Δ

Tom Ward, aka Hazel, is a long time resident of the Southern Oregon bioregion and has been advising farms and teaching permaculture for over 35 years. He has degrees in Forestry and Botany from Syracuse University and has taught at Laney College in Oakland CA, D-Q University in Davis, CA, and at Thlolego Learning Centre in South Africa, among many other institutes and communities. He is presently managing a Social Forestry experimental station in Little Wolf Gulch near Ruch, Oregon, where he is demonstrating natural building, fuel hazard materials utilization, multiple products woods-crafting, wildlife enhancement, and desert forest water management.

He is a member of the Siskiyou Permaculture collaborative team, who teach the PDC and advanced courses in Optical Surveying, Social Forestry, Design, and Ethnobotany. Tom holds permaculture diplomas from Bill Mollison's Institute, as well as from the Permaculture Institute of North America. To find out more about internships or courses, go to siskiyoupermaculture.com.

Fire Pig Charcoal Kiln. Photo by Karen Taylor.

Interview with Jerome Osentowski
CRMPI and the Perennial Economy

Rhonda Baird

This article is based on an interview of Jerome Osentowski of the Central Rocky Mountain Permaculture Institute (CRMPI) in Basalt, Colorado by Rhonda Baird, editor, in June 2017.

RB: Jerome, the Central Rocky Mountain Permaculture Institute is one of the most famous permaculture sites in the US, and it has one of the longest running annual PDCs and an amazing forest garden, and greenhouses incorporated into it. Can you tell us a bit more about what CRMPI does?

JO: Well, we are a demonstration site for permaculture and forest gardening and for greenhouse design. We have 5,000 sq ft. (450 sq. m) of greenhouse: five different ones. One is a tropical greenhouse (Phoenix). We have a Mediterranean greenhouse (Moana) which is an attached structure with a huge fig tree in it. Other smaller greenhouses we use for annual cropping, nursery, and a lot of other different uses. We teach greenhouse workshops, and a greenhouse academy of four days. People can come to kick the tires of the various greenhouses; and we have several in the valley here that we tour. So our greenhouse development has been a big part of CRMPI over the years, going from very simple techniques to, now, our company, EcoSystems Design, that designs greenhouses all around the world: Canada, Uzbekistan, Italy. So that's been a kind of offshoot of my initial growing of salad greens back in the 80s, and it evolved out of that. That's just one facet of how permaculture is so resilient and so diverse.

RB: We're talking the Central Rocky Mountains, so the context that the site has developed in has some very specific limits, right? Ecologically, can you describe the landscape where you are situated and where you are?

JO: Yes, well we're at 7,200' (2,200 m) in the central Rockies in a Piñon and juniper forest on a south-facing slope. We have a huge volcanic mountain to the back of us (north) so basically, we have a sun trap. Very moderate winds. We are actually Zone 6 here, so my microclimates that I have built on this one acre are 6b just because of thermal mass, and ponds, and rock terraces. With climate change, we have already moved 1 to 2 USDA climate zones. We used to be Zone 4 and now Zone 6 but there are still places in the valley that are Zone 4, and this has been a particularly bad spring. But we are lucky to be in a spot where we have natural protection and then through permaculture design and permaculture strategy, we can protect ourselves against crazy weather, frosts, etc., to a certain degree. With our culture of using compost tea, we don't have to use wind right now to move frost around. We can strengthen the plants using compost tea before frosts and lessen the damage. So, we have about 200 varieties here outside in one acre that are all hardy to -20F. (almost -30C).

Nursery plants framed by CRMPI's mountain setting.

RB: So, a part of your vision and work at CRMPI is to just demonstrate what's possible; to teach permaculture and support farming. What are some lessons that you have learned from your 40 years of growing food ?

JO: I think about the progress we have made here in the valley in the last 40 years supporting young farmers and getting produce in the farmers markets. It has increased substantially from when I started. There were one or two growers doing market farming here in the late 80s, and now there are dozens of people growing vegetables. But it's a struggle; it's an uphill struggle, because pretty much it's left to the marketplace. And it's not a level playing field. So, these young farmers may be struggling to get land. They have to pay for all of their startup costs. Especially if they are first or second year farmers, it's very difficult to get the right land, and to get water, and have

to grow the vegetables--and then have to have another job where you are selling the vegetables at the farmers' market all by yourself or with your partner. It's not an easy job, and young people get burned out, because there is a lot of competition out there for cheap food. I just think they have not given enough effort, spent enough time to understand how do you support these young farmers to get 50 years down the road. Do they have a plan? If they don't have a piece of land that they own, where are they going to be in that timeframe. Are they going to be struggling just selling annual vegetables? I try to encourage people to start looking at moving to perennial systems as soon as they can—at least part of it, so they can transition into a lower maintenance type of agriculture.

RB: Do you really think that perennial systems are less maintenance than annual systems? How does it change the workload or how the land responds?

JO: Well, you know there just has not been enough effort to perennialize. There are not that many mature forest gardens or alley cropping systems. In the states, I am going to a conference at the end of this month at Virginia Tech and there seems to be a fair amount of experimentation in agroforestry and alley cropping in the US, and I am hoping to look and see what's there. Eric Toensmeier is presenting as well—and I think his *Carbon Farming Solution* is going to be the textbook for the next generation of alley cropping and agroforestry. So, while there are books and some scattered examples, using agroforestry is still on the edge for most people.

RB: I hear you were at the Roaring Fork meeting and you had some advice for them. Can you share that with us?

JO: Well I do go to the meeting because it is encouraging to see what some of the young farmers have done here. I mentioned earlier that it is a struggle, but they have made some good progress. I like to keep encouraging them to plant perennial crops, but it's difficult when they only have between two and five acres; and they don't even own the land or know how long they can stay there. Perennial cropping does not bring in money right away—so that's an issue—and then there are the startup costs. I try to keep them looking long-term. I have been fortunate to have the piece of land that I have had here for 45 years. It's not the best of piece of land, but it's mine, and I don't have to move. Those are all the issues out there when you leave growing food to the marketplace. You know they have to give some long-term lease so that they can plan long-term. I think most farmers should have that long-term plan as soon as they can because it's going to feel more comfortable and make things easier and resilient if they diversify their crops.

There was a lot of frost this year, and this spring many orchard people lost ½ or sometimes all of their cherries or grapes. This happens almost every year now. That happens also with annual crops. Hail can wipe you out, and rainstorms can really damage your crops. The more diversity you have, the more you can value-add to the products you are growing. This makes you more resilient to climate change and events.

We are very protected here as we don't really sell our produce any more. We actually value-add it, freeze it and use it ourselves, or use it as demonstration. We may bring some fruit to the farmers' market to give to people. Then, if they like it, we will sell them the tree that is grafted to that variety. That's the way we have evolved to not be so vulnerable to the marketplace right now. I would like to encourage all of the farmers to see the bigger picture. We document that in the *Forest Garden Greenhouse* book.

The Perennial Economy is probably not going to look like what we have today.

RB: You shared with me that you are working on a new book about what you call the Perennial Economy. What are some ingredients when you are talking with farmers that they need to think about when they are thinking about a perennial economy?

JO: Well, pretty much what I just said. We can't just grow radishes and sell them at the farmers' market. We need to be thinking about crop diversity—resilient crops that are not so vulnerable to climate change, market shifts, and weather patterns. We need to grow a certain amount of vegetables, but my annual crops are getting more into garlics, grains, and fruit production. We have 200 varieties of fruit here. We don't have enough of one particular variety to take to market—but we've been experimenting.

So, the Perennial Economy is probably not going to look like what we have today. What we have today is disaster capitalism and free market. The free market does not help the small farmer: it helps the large farmer with crop insurance, startup costs, and bail-out costs. It doesn't look good for now with the new administration in that the head of the USDA is not going to be funding small farmers. He has a whole lifetime with working in the chicken industry.

So, I don't see where that is going to be easy but it's

going to be up to each farmer to design their own perennial economic system within the farm, working the way nature does it. The Aspen forest manages everything on its own, and perennial systems generally do that. So, if we can build one of those systems where are going to get many different yields from that system, it won't just be annuals. And I think that is what we have done at CRMPI, indoor and outdoor. We have education. We have consulting and demonstration. Those are all income sources. So even young farmers need to be thinking that they need to be teaching agriculture after a few years when they get good enough. We don't have enough people teaching agriculture. They should be doing tours. They should be doing farm-to-table. There are lots of different ways to offset the work of growing vegetables and going to the farmers' market. We need to diversify right away and get the community involved. Start a nonprofit so that you can access funds from multiple sources. You have to just play the game. I think a lot of the young farmers are really energetic but naïve in thinking that they can get there by selling annual vegetables.

RB: The county that I am in is a lot like that. We have a lot of small market farmers, hilly land, and a history of small farms who did or did not make it in the past. The farmers are here because there is demand for fresh, local food. There is a food culture around restaurants. And the food culture and market have created possibilities for livelihoods. How are the livelihoods at CRMPI shaping up?

JO: We do have what I am calling "livelihoods" and the nursery livelihood is up and running. Vanessa Harmony came 18 months ago, and she started working in the nursery last year and now has taken it over and is leasing it from me and making a pretty good income. She also feeds back into CRMPI and runs our admin right now, as well as teaching and consulting. So, she has created a livelihood here from all of the different aspects and diversity that goes on at CRMPI, but she is focused on the nursery. We also have a composting tea operation that we can turn into a livelihood. We have other plant sales. Teaching is one of our livelihoods here. We have frozen all of the fruit and berries from last year to make jams, so that can be a livelihood. We also have a tincture business here where we grow medicinal herbs in the greenhouse and outdoors. You can put two or three of those together and make another livelihood. The education is already bringing in a substantial amount of money with the course.

I am planning to create another livelihood along with the teaching, and then I can kind of step back from the operation of CRMPI, while some younger people take over the other three livelihoods. They will then be operating three cooperatives that will be under the umbrella of a nonprofit. I am willing the property and all of my businesses to the nonprofit. My legacy is to have this place move on and operate and keep going for another 100 years, and that is how I am structuring it. We have the first livelihood up and running and working; and we are very close to having the other one working as well. There is also the nonprofit that can be another livelihood. When you have a nonprofit, you can generate other income by grants and working on foundations. So those are all of the tools we have that are all legal, and we are working like any other corporation would work. We have an S-Corp here, based around ecosystem design which is our consulting business. We have a nonprofit which is CRMPI. We have a sole proprietorship which is Jerome's organics. They all have separate tax returns, and Vanessa has her own LLC. She leases from me. Other people will have their own LLC, and they will be cooperative. So, I think every farm that wants to go off and continue to grow and be diverse and provide livelihoods for farmers could use this as a model; and that is what we will be writing about in the Perennial Economy book. It's only part of the picture. There are so many good things already happening that it would be 100% better than what we have now, which is disaster capitalism. Naomi Klein just came out with another book, her 2nd book was the *Shock Doctrine* and this one is called *No is Not Enough*—meaning that we can't just say, "No, we don't want this." We have to come up with the solution of how we are going to restructure our economy. There are lots of good examples out there—people have written about it. There are pieces here and there, but we need more. It's exciting for me to be able to take this piece of land and work. It's been a lot of hit-and-miss over the last 10-15 years trying to do this. So at 76, I need to be moving on to minor work. It's really difficult, and I need to pace myself and get out of the day-to-day and give it over to other people as soon as possible.

How are we going to restructure our economy?

RB: So, here we are in 2017. You are celebrating your 76th birthday, and CRMPI is having its 31st anniversary. We were just talking about the businesses and livelihoods and how they were structured as LLCs or S-Corps or nonprofits. This seems to mirror what we were talking about in the beginning about being in a place and just trying a bunch of things and seeing

what sticks. When we think about 8 acres on a slope in the Central Rocky Mountains with an acre of forest gardens developed intensively generating all of these livelihoods, how does this show what you want to bring forward in the future?

JO: The book has a chapter about the ark. Phoenix is an ark–well, our whole one acre of edible landscaping is an ark. I think a lot of people are scared of where their food is coming from and what the economy is going to do. To have an acre of edible landscaping or your backyard full of edible plants and have some annual beds and have some friends with whom you can swap or be part of a CSA. Those are all really great security things that people can do with food production. We kind of went overboard to create an acre. It does not have to be that large to be useful: to give you that sense of security.

So, that is what we have been doing is to try to meet people where they are. We can workshop, and maybe they have a backyard garden, or maybe they have 200 acres. We try to zone in on "What do they see here?" that will work in that situation. And that goes for greenhouses as well. What can they build on a shoestring? Or can they hire us to build a really expensive one or find an answer in between? That's what we can provide here, and we need more places that can provide good ideas. People can come in and do farm tours, and farm-to-table, and if something is working, then maybe you pick it up and do it again. I am excited that I can hold on here for another two or three years, but I really need to downsize my activity as soon as possible. I can walk up the mountain: three hours up and back, but I can't do stupid things on the farm any more.

We just have to get the community thing.

RB: You are just at that place. I am thinking of those young farmers that you are talking to, and they are just getting started. Twenty to 50 years down the road, they're going to be in a similar position. What advice would you give to them, or I also know people in their 50-60s who are making the investment now while they can. What advice would you give them thinking about the future?

JO: Well, I am hoping that they don't have to struggle individually, because it is an uphill battle, and they won't win if they are trying to compete with each other and not support each other. What we need are food hubs and food processing plants in every small town and every valley, where farmers can co-op and bring their products to a place to package. They would only be doing one part of the picture. If they have to grow it and sell it, it's just too much. They can't value-add it, and they can't store it. There should be a lot of funding to come in and help build these food hubs. There are a few in the country. Restaurants can support them, and they know they can get a regular supply of things. Food is distributed, packaged, and washed by somebody else, not by the farmer. So, we are also creating more jobs and security. Towns should actually be funding these food hubs or counties because it's one thing to get yourself energy-free. If you have not done anything for your food security, that's the last thing people are thinking about right now—putting money into food security at the government level. It's all up to the farmers and individuals doing the work. And that would be part of the Perennial Economy.

RB: I am feeling a lot of gratitude for your decades of investment in a space and your experimentation. I recognize that the people and farmers and the people of the future are going to rely on the research and experience and the things that you found out. As to a next step, I would ask people to visit CRMPI, see what is possible there, see what has been developed, read your books, and look for this next book to come out from the perennial economy. I am really curious to see how it all comes together and what is included.

JO: Well, you know there are lot of other books out there if you are in a different climate zone. Ben Falk's book, Mark Shephard, The *Forest Garden* books, Eric Toensmeier's new book, Michael Phillips, etc…. There are so many great books that Chelsea Green has written about permaculture and permaculture-related topics that I am excited that so many people have had the success that I have had. They are a lot younger and have been able to write a book about it and get in out there. Sepp Holzer is another, and there are endless examples when you go back to Fukuoka with *One Straw Revolution*. But there are examples of how to do great work, and Chelsea Green and others have been great about being upfront in publishing and looking for new ideas. I think it is encouraging. I think there is a lot of information out there, and we just have to get the community thing—and the towns, counties, and states because we are probably not going to get any capital for small farms in the next year or 10 years. It seems like everyone is resolved to doing it locally now, whether because of climate change or other reasons. We are just going to have to do it on a local level. And that fits right into our plan anyway. Δ

Visit www.crmpi.org to learn more about Jerome's work.

Hierarchies and Networks

The Yin and Yang of Social Dynamics

Adam Brock

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WE CAN'T MAKE SOCIAL CHANGE ALONE. Even at the community scale, creating a lasting, positive difference requires dozens of people acting in collaboration. It requires compassionate, driven leaders and team members with a diversity of skills. It requires dealing with uncomfortable issues like conflict resolution, apathy, burnout, and member turnover. In other words, it requires organization.

A church group, a business, and a protest movement each have vastly different objectives, norms, and cultures, but they all share some common challenges. Many institutions, for instance, are catalyzed by a single charismatic leader—yet most of them struggle to survive after that leader steps down. Though a great number of organizations are arranged in some form of hierarchy, many would like to make their participants feel empowered as co-creators. And nearly every group engaged in defending acts of self-determination against the greed of corporations must reckon with the tension between earning revenue and fulfilling their mission.

Networks exist in situations where unpredictability is unavoidable.

Clearly, then, it's important for the social designer to have a good understanding of the patterns that allow groups to function at their highest potential and coalesce into "organizations that live." Two of the most fundamental patterns of group dynamics can be seen in the hierarchy and the network: the yin and yang of organizations. Hierarchy tends to be rigidly structured, with a multilayered chain of command that often gives rise to bloated bureaucracies. Networks, meanwhile, tend to be much more informal, with looser roles, smaller groups, and more democratic decision-making.

Incidentally, it doesn't take much searching to find both of these structures represented in natural systems across the scales of place and time. Hierarchies take the physical form of branching structures such as our lungs, watersheds, tree roots, or even the branches of the tree of life. Each of these structures demonstrates remarkable efficiency at collecting or distributing: our lungs collect oxygen, and a river system collects water. A tree's roots collect nutrients from the soil and distribute sugars to its fungal partners, while the leaves on its branches collect sunlight.

Networks, meanwhile, are somewhat less visible, but no less impactful. The cells in our brains form an intricate network of neural pathways, and underground, microscopic strands of fungi form networks that can transport nutrients hundreds of feet. Spiderwebs are iconic networks, and the complex web of relationships among species within an ecosystem is one as well. If branching patterns are efficient, networks are resilient. Each one, in its own way, is able to withstand disturbance and create new solutions to complex problems. Yet this ability to innovate comes at a cost. Maintaining all those interconnections takes a lot of energy. The human brain, for example, requires ten percent of the oxygen in our blood despite being only two percent of the body's weight.

Back in the social world, these patterns play out with remarkable similarity. Most of our present-day institutions are organized as hierarchies, designed for scale and efficiency at collection and distribution. Businesses collect profits. Public school systems distribute social norms to impressionable youth. Government agencies distribute public services to citizens. Like the branches and canyons found in nature, these hierarchies tend to be resistant to change once they form and can be prone to weakness or collapse if one of the branches is cut off from the rest of the unit.

Anthropogenic networks, meanwhile, share the same traits for innovation and energy demand as their ecological cousins. Just like our brains, the internet—society's cranium—requires about a tenth of our energy supply to sustain itself, yet the innovations it yields are impossible to quantify. It takes much more time for a group to arrive at consensus than it does for a manager to make a unilateral decision, but the trust and

enthusiasm gained by a group decision might very well make it worth it. Whereas hierarchies tend to circumvent forces of friction that might slow their progress, networks exist in situations where unpredictability is unavoidable. In fact, it's this continuous presence of challenge and conflict that often allows networks to come up with novel solutions.

Whether in nature or culture, neither of these patterns exist in an isolated, "pure" form. Tree roots form cellular connections with mycelial networks to maximize their nutrient absorption. Within the levels of bureaucracy in a big business, there are usually formal or informal teams that function as networks. Networks are often more common in the early life of an organization, when many different ways of doing things are helpful. As it matures, the organization settles on a main set of activities and processes and, seeking to make them efficient, solidifies into a hierarchy. Rather than an either/or situation, then, it's more of a both/and opportunity.

Let's explore networks and hierarchies in greater detail, with particular attention paid to the conditions that make each one more or less effective.

	HIERARCHIES	NETWORKS
Natural Examples	• Watersheds • Lungs • Tree roots and branches • Circulatory and nervous systems • Wolf packs, primates	• Neurons • Mycelia • Spiderwebs
Cultural Examples	• Governments • Armies • Corporations • School systems	• The internet • Networks of friends • Grassroots social movements
Characteristics	• Energy efficient • Energy and information flows in just one direction • Vulnerable to disturbance • Found across scales • Resistant to change	• Uses lots of energy • Energy and information flows in all directions • Resilient • Limited in size • Adapts quickly

Consensual hierarchies

Bureaucracy is a ubiquitous presence in our culture. Many of the institutions we interact with on a daily basis—the public school system, the bank, the grocery store, the federal government—have some form of many-leveled hierarchy. All share the same pyramidal organizational arrangement and, not coincidentally, the same resistance to change, exploitative character, and lack of accountability. With this preponderance of unresponsive institutions, it's easy to jump to the conclusion that hierarchies are necessarily a destructive force and have no place in an equitable society. And yet, there are countless examples of hierarchical organizations that have been effective, accountable—and yes, even empowering. Small businesses, food cooperatives, sports teams, and local trade unions are just a few examples of hierarchically structured organizations that frequently work in a satisfactory way for everyone involved.

Natural systems would also seem to support the theory of the healthy hierarchy. While we have much to learn from biological systems that operate via emergence—the phenomenon of the "hive mind" or the "wisdom of the crowd," in which decisions spring naturally from a group—they're hardly the animal kingdom's only model for group decision-making. Plenty of species exhibit hierarchical behavior, with a small group making decisions on behalf of a much larger pack. In a 2014 paper, Princeton researchers Iain Couzin and Albert Kao developed a statistical model to examine the effectiveness of group decisions in chaotic, "real-world" contexts. After exploring several different variables, Couzin found a distinct evolutionary advantage to hierarchies in cases where there were many kinds of information to process. "Smaller groups actually tend to make more accurate decisions," he explains, "while larger assemblies may become excessively focused on only certain pieces of information." But "smaller groups" doesn't mean that the size of the whole pack or herd is small—just the decision-making

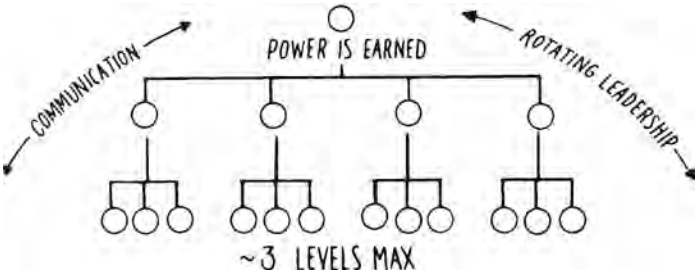
All too often, we think "no authority" means "no leadership."

group: "Organisms can exhibit highly coordinated movements despite vast numbers of individuals…. Even when groups are large, the number of individuals contributing to a group's decision may be relatively small."

The question isn't "Are hierarchies evil?" but rather "When are hierarchies evil—and when are they helpful?" Fortunately, organizational psychologists have been asking variations on that question for decades. Although their findings haven't always been adopted by the institutions that surround us, they offer key insights to the social designer. According to these findings, a few key elements are necessary in order for hierarchies to remain healthy:

- **Power must be earned**. Members of a group must trust the people making decisions on their behalf. That means, presumably, that the decision makers are well known among the group and that they have a track record of making good decisions. It also means that the group has the ability to remove a decision maker who isn't meeting its long-term needs, whether through a regularly scheduled election or a vote of no confidence.
- **Power must be shared**. No matter how much trust and support any given decision-maker earns, no single person can be expected to completely understand the needs of a community. History tells us, moreover, that power held too long decays into a tool for corruption and personal gain. Contemporary hierarchies use tools like term limits, boards of directors, and co-leadership to encourage diverse leadership and protect against abuse of power. Tomorrow's hierarchies might employ any of these tools and more to ensure that authority doesn't stagnate in any one person or group.
- **Communication must be open** throughout all levels of the hierarchy. Hierarchies, by nature, tend to excel at one-too-many pronouncements. But in order for hierarchies to be consensual, communication needs to be able to

move in the other direction as well, from the bottom to the top. Every member of a hierarchy, no matter how lowly their status, should feel empowered to access the



decision-makers. This creates very real constraints on the total size of the hierarchy, limiting it to Dunbar's number of 150 people or so. Time and time again, organizational psychologists and management consultants have found that larger hierarchies, blanketed with too many layers of bureaucracy, are breeding grounds for disengagement and corruption.

Nurtured networks

The Occupy movement of 2011 will be remembered for many things, including the resurgence of the radical Left and the injection of income inequality into the national conversation. But for all these achievements, many Occupy chapters were fraught with a frustrating lack of momentum. Saddled with long-winded public meetings and constant bickering, the movement eventually splintered under the weight of its own vague ambitions. As is often the case, these flaws came from the noblest of intentions. Starting from the astute observation that our society's top-down institutions systematically disempower those at the bottom, Occupy's organizers established as their decision-making process consensus-based general assemblies—a form of radical decentralization in which every voice has the opportunity to be heard. While righteous in theory, this move to abolish power structures ended up backfiring, as meeting after meeting was derailed by newbies with naïve ideas and disgruntled citizens using their time in the spotlight to rant about their own private causes. With no clear leader to guide the process, power struggles became a continual source of rancor and frustration.

Occupy was hardly alone. Time after time, activists fed up with the rigid, slow-moving hierarchies of corporations and government have turned to horizontal networks to embody romantic ideals of a fully participatory society. These kinds of leaderless groups can be powerful and innovative in the right contexts, but all too often, we think "no authority" means "no leadership" and allow these groups to be tanked by large personalities, unproductive bickering, and passive-aggressive behavior.

In her classic 1972 essay "The Tyranny of Structurelessness," feminist Jo Freeman argued persuasively against the perils of leaderless groups (www.jofreeman.com/joreen/tyranny.htm). "A 'laissez faire' group is about as realistic as a 'laissez faire' society," Freeman quipped. "The idea becomes a smokescreen for the strong or the lucky to establish unquestioned hegemony over others. This hegemony can be so easily established because the idea of 'structurelessness' does not prevent the formation of informal structures, only formal ones."

Getting rid of hierarchy, in other words, doesn't actually erase unequal power dynamics. It just makes those dynamics less obvious. Without any rules for engagement, power rather quickly accrues to the loudest voices in the room, regardless of whether those voices actually have the best ideas.

In the last several years, social psychologists have begun to confirm Freeman's anecdotal warnings with data. In a series of studies at Ohio State University, Professor Amy Brunell tried to quantify the impact of narcissism on group dynamics. Simulating situations as diverse as class elections and desert-island survival strategies, Brunell and her colleagues found that people who scored highly in narcissistic traits such as self-esteem and a desire for power were much more likely to end up in leadership positions—despite the fact that they were no more likely to make wiser decisions than others.

Some of us have stronger opinions. Some of us are more likely to speak up. And some can be very long-winded. Whether due to genetics, personality, or just how much sleep we had the night before, power imbalances are likely to exist in even the most tightly knit groups. That's just how community works. But rather than let these imbalances wreck the group, smart leaders are able to cultivate "nurtured networks:" horizontal groups that have just the right amount of structure to thrive. These groups engage in naming group norms at the beginning and throughout the process. They employ skilled facilitation to ensure everyone's voice is heard. They apply the permaculture design process to the group itself, setting clear goals and engaging in defined phases of various streams of engagement. They create mechanisms for people to be held accountable to their actions, and for the group to converge and disperse as necessary.

With these structures in place, the horizontal groups we cherish actually do have a fighting chance against the top-heavy bureaucracies of antimarket forces—and a truly democratic society might just come with it. Δ

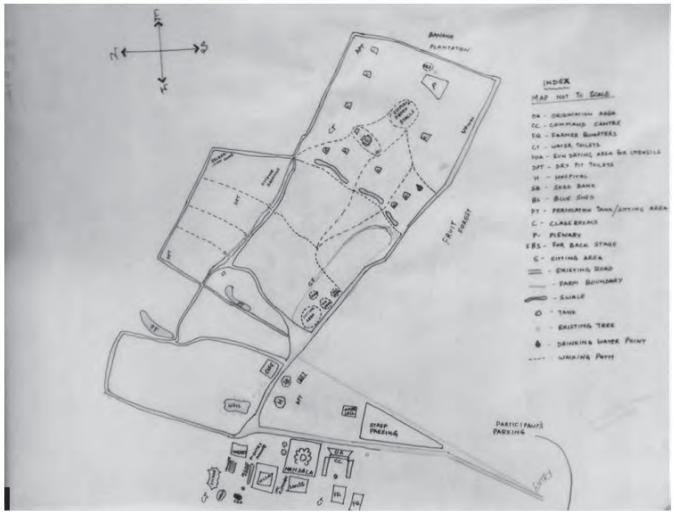
Adam Brock is a Denver-based permaculture designer, facilitator, and author. As co-founder of The GrowHaus, Adam led the transformation of an abandoned half-acre greenhouse into an award-winning hub for food justice and aquaponics. He is one of the lead instructors for the Denver Permaculture Design Course, co-founder of the Denver Permaculture Guild, and served on the organizing committee of the 2014 North American Permaculture Convergence.

Adam is a co-chair of Denver's Sustainable Food Policy Council, a TEDxMileHigh speaker, and has been named one of "Colorado's Top Thinkers" by the Denver Post. *In addition to his solo facilitation and consulting work, Adam currently serves as Director of Social Enterprise at Joining Vision and Action, Denver's premier consulting firm for social change organizations.*

Mapping IPC India 2017

Annaik Le Net, edited by Smriti Agarwal

IN PERMACULTURE, there is a great feeling that seizes you when you're about to start designing your project. You've observed for long, wind, sun, plants, animals, people, and so on, have done your site assessment, and asked yourself or the person you're guiding questions about your/their vision, needs, and expectations. Excitement is building up in front of all the opportunities that you have to draw the place as you would like to see it, as you dream it, and as Bill Mollison said: "the only limit to yield is the designer's imagination." Unlike writers, permaculturists do not fear the blank page—they love it. They are about to map their aspirations and inspirations and enjoy the whole thinking process that goes into it. When you're about to host an International Permaculture Convergence (IPC), there's a huge blank page in front of you, and lot of passion and experience are required to lead your thoughts and decisions. Maps are piling up on the desk to create this reunion of seasoned and new permies and without giving away all the secrets, we'll tell you a bit about some of them.



Map of Polam farm, venue of the Convergence part of IPC India 2017.

It all starts in Aranya Agricultural Alternatives' office, Hyderabad, Telangana, India. Both Padma and Narsanna Koppula, hosts of the coming IPC India 2017 scheduled from November 25th to December 2nd, have been getting ready for more than two years to welcome the international permie community in their region and prepare this event with their own Indian touch. The site assessment is intense; Narsanna who attended several IPCs and Padma who joined him for the last one in the UK in 2015 recall their best memories and capture the key elements which would contribute to the success of such an event: bring new knowledge and skills to the participants, create new bridges across cultures and connections between areas of application of permaculture, explore new paths to be taken by the movement and, last but not the least, have fun! They also rely on their long-term experience of working with more than 250,000 farmers in the states of Telangana and Andhra Pradesh introducing permaculture in their practices and their recent experience of organizing the first ever National Permaculture Convergence in February 2016, which gathered 1,200 delegates from all across the country including many foreigners who have already developed a strong relationship with the country and keep coming and going or staying to work in India. During three days of conference, thinkers, researchers, and practitioners in the rapidly growing fields of permaculture, ecological agricultural practices, and sustainability composed together their image of what would it mean to move towards and live one day in healthy societies. IPC India 2017 will be the occasion to put their ideas of a better and greener future to the test and discuss them with permaculturists from all across the globe, looking out for synergies and brainstorming in collaboration. Since sketching enthusiastically in their notebooks the first outlines of the convergence two years ago, it is now smoothly taking shape, and the maps have more and more detail.

Maps contain a strong projection feature; they give you a sense of the look of an area, of the shape of a piece of land, and then suddenly, you feel as if you were belonging to the place, as if you could observe what would be happening when what's on the map will become reality. More than the physical map of the Conference venue, Professor Jayashankar Telangana State Agricultural University, the "office team" (a multicultural committed body) is fully dedicated to another kind of mapping: the outline of the Conference and Convergence programme, and inviting representatives from as many countries as possible to showcase their work and share their stories. If you read this article to the end, you'll definitely know more about who has already confirmed that they would join the festivities. Not only do Padma and Narsanna envision welcoming people working with nature to build regenerative systems but also treasure holders of the country's traditional practices which are described, nowadays, as sustainable living skills: oil processing, basket weaving, grain winnowing, seed-saving, cotton clothes making or even wood stove cooking demonstrations will provide a lot of relevant learning. It is key to revive these practices, preserve them, build pride around them, and ensure to close the generation gap that seems to be present at the moment especially in farming practices. The mind map of the event wouldn't be complete without the entertaining animations that

We seek to revive traditional practices, preserve them, and build pride around them.

will take place in the evenings blending folk dances and music with more engaged performances.

Shyammama and Baghetamma winnowing rice

Meanwhile, another part of the core team, the "farms team" (a flexible entity of local workers and happy international volunteers), is working tremendously hard to achieve two key goals: producing 90% of the food that will be served during the seven days of the main event and setting up a welcoming IPC village from scratch that will be the Convergence venue. Farms we said? Yes, one of them is Aranya farm, a 10-acre (4 ha) 20-year old abundant food forest giving fruits 365 days a year was designed by Padma and Narsanna to be a one-family model farm. Aranya farm's team is working with their larger community around Bidakanne village to do their share of food production. For instance, recently, a specific variety of mangoes has been harvested from amongst the 32 varieties available, to prepare pickles and preserve it until the Convergence. The second farm has a very interesting story: "Polam" is a new 96-acre (about 40 ha) permaculture farm situated 100 km (60 mi.) from Hyderabad alongside a beautiful body of water providing drinking water to Hyderabadis and welcoming the local biodiversity including flamingoes. Polam, the Telugu word for farm, was a fallow land for more than 25 years after a village was submerged by water, leaving it with high salinity on one part of the land. When two former PDC students of Narsanna discovered that place, they fell in love with it and believed that it would be an ideal site to set up a permaculture farm, and they soon became its custodians. In 2015, Aranya started to look for a site big enough to host the next International Permaculture Convergence with the strong wish to host the event on a farm, which would at the same time benefit from hosting such an event with so many permaculture experts coming on the site. With the participation of his PDC students, Narsanna Koppula soon drew the design of the Convergence venue. Since August 2016, Polam farm's team has worked on the development of this site with a huge and exciting challenge: be ready to receive about 800 participants for five days and provide them with food, some of which has been grown at the farm. Through the map at the beginning of this article, it is easy for one to imagine him(her)self meandering through the IPC Village between thatch roof classrooms in which bright permies will talk about their experiences, cob sitting areas for long chats with newly met people, bamboo geodesic dome welcoming a seed bank, a library or a cafe, the mandala garden giving year-round delicious veggies, the young food forest now ready to welcome again new trees at the beginning of the monsoon season, tent area for resting and digesting all the content shared, and diverse type of toilets and washing areas to match everyone's expectations. Can you now picture yourself as part of it as well? The power of maps!

Flamingoes at the Singur reservoir, spotted from Polam farm

All along the event, presentations will be articulated around six subthemes, directly supporting the main theme "Towards healthy societies" and related to Aranya Agricultural Alternatives' work in the region for the past 20 years. As Dr. Venkat, permaculture pioneer in India who invited Bill Mollison and Robyn Francis 30 years ago in the country for the first ever permaculture design course, mentioned "… Ecology itself, environmental awareness and activity by itself, nor even sustainable agricultural by itself, can ever be an end in themselves. All these have to be the necessary framework for the wider struggle of humankind in ushering in a new harmonious, non-exploitative, cooperative relationship between individual to individual, individual to society and People to Nature—i.e. sustainable societies." This is the reason why the subthemes of this new IPC will cover social skills and savoir-faire, focusing on sharing collective responsibility, both interweaving together in the numerous presentations during the Conference and the Convergence.

"Women as agents of change" is one of the main subthemes as the shift needed in women consideration around the world could have one of the greatest impacts in numerous areas. Thus, Vandana Shiva will be addressing the audience during the opening ceremony on the role of women in communities, followed by Robyn Francis who will bespeak worldwide women in permaculture conveying their experiences while the topic will be taken from a research angle by Marty Branaghan during the Convergence where he will account for "The Overlooked Role of Women in Environmental Nonviolent Movements."

On one hand, more and more permaculture ethics and principles are unfolding in new fields, continuously adjusting to the global situation and contributing to a new paradigm helping to answer the question of what our societies tomorrow will look like. These contributions will be highlighted with

the two subthemes "Permaculture as a social responsibility" and "Grassroots permaculture in action," under which Amani Dagher and Ghassan Al Salman from Lebanon will present "Implementing micro gardens in Syrian refugee camps," Nicholas McGuigan and Thomas Kern from Australia will share their views on "Designing the accountable accountant: utilizing permaculture principles to create a language of regenerative business," and Tierra Martinez and Beatriz Ramirez Cruz from Argentina and Mexico will look at the topic "Building a new paradigm: Permaculture as a dream of peace," and many more speakers who are devoting their time and energy everyday to more social justice using permaculture as a tool for empowerment will come on the stage including Pandora Thomas (US), Andy Goldring (UK), Farida Akther (Bangladesh), Manish Jain (India), Walter Nyika (Zimbabwe), and Stuart Muir Wilson (Australia).

On the other hand, experts working with nature will share their technical knowledge blending traditional practices and new discoveries, and the IPC will include demonstrations and hands-on experience at the forefront especially during the Convergence. These presentations will be articulated around three subthemes that are particularly relevant to the needs of the hour, both in India and in many more places around the globe and have been at the heart of Aranya Agricultural Alternatives work for the past 20 years. Under the banner of "Sustainable water resource management," Jeremiah Kidd from the US will speak about "Community drought solutions—building resilience and abundance through a holistic design approach," and Manisha Lath Gupta will share her experiences on "water management in alternating flash flood and drought" she's had at her farm in Haryana, India. Such an event wouldn't be complete without addressing one of the biggest challenges our planet and humanity is witnessing every day: climate change. Many of our speakers are highly inspired by our subtheme "Permaculture and climate change adaptations," amongst which Christopher Nesbitt from Belize will speak about "Permaculture as a tool for climate change mitigation and poverty alleviation," Starhawk from the US will guide us through "Permaculture and climate change activism," and Brett Pritchard from Australia will share the outcome of his recent work in Asia on "Probiotic microbials to turn traditional wet paddy rice fields from methane emitters into carbon and nitrogen sinks." Last but not least, in addition to the many Indian speakers still confirming their attendance who will draw attention to the ingenuity and appropriateness of some of their ancient technologies, Raya and Freedom Cole from the US, Chris Evans living in Nepal and Julia Wright from the UK will respectively talk about "Ancient Indian agriculture: a look at Sanskrit arboriculture text history and practices and ancient treatment of plant pathology," "Integrated rural community development using permaculture principles in remote and challenging environments," and "Quantum-based agriculture: It's time for permaculturists to embrace the invisible."

Invisible? This word in relation to IPC India 2017 could lead to a whole new mapping and a new article. Have you ever applied permaculture to invisible structures? During a PDC held in January at Polam, a group of students decided to take their practical group projects to the invisible side: looking at flows of people and information coming in and going out of the event, nodes in which interactions and knowledge exchanges would take place, functions as the various types of connections that could result for the meeting of two flows in one node, yields in terms of new connections and new skills both in the short and long term. They were looking for ways to integrate everyone, harness all the flowing energies for the benefit of the permaculture movement, value, as much as possible, the beautiful diversity of people and approaches that will gather in India, and not let any of the magic go to waste. We look forward to sharing the stories in greater detail with all of you during the nippy times of the event over a cup of chai! Δ

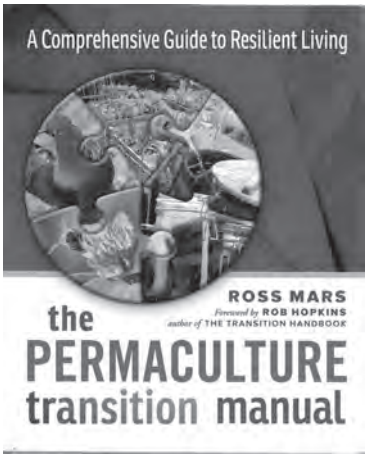
Harness all the flowing energies for the benefit of the permaculture movement.

"Permaculture is information and imagination intensive," Bill Mollison.

Reviews

A Permaculture Deluge

Mini-reviews by John Wages



ROSS MARS

The Permaculture Transition Manual: A Comprehensive Guide to Resilient Living
New Society Publishers. Gabriola Island, BC (2016).
277 pp. Softcover. $34.95

HOLISTIC SOLUTIONS rather than piecemeal fixes are required to address the many converging crises in our world. The *Permaculture Transition Manual* reviews the problems we face, then builds on the view from 30,000 feet with an excellent exploration of the permaculture design process, peppered with information on compost, greywater, alternative energy, and much more.

With the traditional permaculture emphasis on gardening, the author spends 11 of 16 chapters addressing garden design, soil regeneration, annual and perennial food plants and herbs, water management, urban vs. rural strategies, and hand tools. Overall, he has written an excellent, concise introduction to permaculture and gardening for the beginner. Without reviewing the Table of Contents, one might not realize the heavy emphasis on growing one's own food. While wholly appropriate in any sustainable lifestyle, gardening is just the beginning, and the author moves from growing food to using food (a little on food preservation, some recipes, and fermentation), and then to broader topics: energy and appropriate technology. While there is a great section on passive solar design, natural building techniques like straw-bale or light clay-straw are not covered.

The *Transition Manual* is a useful guide to re-orienting one's life. It is not a community transition manual, but a guidebook for personal change. The title of the first publication of this work, *How to Permaculture Your Life,* reflects this focus. Many of the sections as well as the illustrations, like the ones depicting microclimates and sectors, are evocative of the *Permaculture Designer's Manual.* Filled with practical tips and guidelines, the book shows us how to make the changes that result in a satisfying, sustainable, and resilient way of life. Δ

JENNI BLACKMORE

The Food Lover's Garden: Growing, Cooking, and Eating Well.
New Society Publishers. Gabriola Island, BC (2017).
179 pp. Softcover. $29.99

THE FOOD LOVER'S GARDEN joyfully and succinctly covers growing and using fresh vegetables and herbs from the garden. It is not a detailed manual, but more of an introduction for someone with little to no experience with food gardening. The chapter, "How to Grow Potatoes," is full of good advice and anecdotes like growing potatoes in banks of eelgrass from the seashore in Nova Scotia.

The book is divided into two main sections: "In the Garden" and "In the Kitchen." Potatoes are paired with leeks in the gardening section of the book, as well as in the kitchen. The author seems to have particular fondness for leeks. Other vegetables are similarly paired in logical fashion, according to their use. This organizational approach is probably the most unique thing about this book, and in many ways, it's a refreshing approach. After all, how many gardeners plant without considering what will be eaten and how much of it the household needs? Harvesting tips and general guidelines for dealing with pests convey much useful information.The kitchen section discusses basic kitchen tools and cooking approaches. The author's suggestions are very practical and decidedly non-dogmatic, making room for such things as canned beans for quick meal preparation. Of note is the great introduction to natural foods cooking, covering tabouleh, hummus, curries, salad dressing, the difference between pilaf and biryani, and much more—again from a very practical standpoint and valuable for a novice. This is not a cookbook, although some interesting recipes do pepper the text throughout. The kitchen section also deals briefly with preserving the harvest.

A few unusual vegetables are presented, including the English marrow. Marrows are essentially zucchini-like summer squash that are allowed to grow quite large before harvest. Typically, they are stuffed and cooked. I have to confess I've never seen marrows covered in a gardening book. I learned about them myself through perusing British seed catalogs.

Reflecting the author's own gardening experience in maritime Canada, and possibly that of the publisher in coastal British Columbia, the book has many tips that simply won't work in warmer climes. The idea of planting potatoes in the spring, then harvesting in the fall, for example, is utterly foreign to my Southern ears. Potato vines are indeed long dried up before midsummer in the South. Geographic differences are important to keep in mind, especially if you're new to the world of growing your own food. But, as with other gardening books for more Northerly gardeners, the abundance of generally applicable knowledge in these pages makes an entertaining read worthwhile. Δ

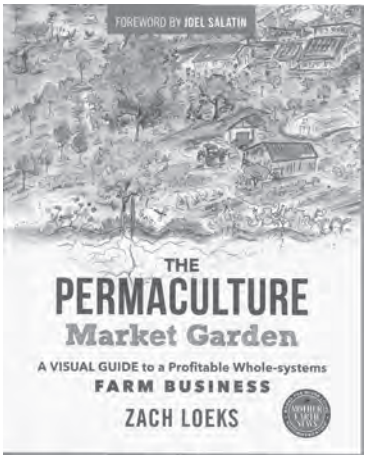
ZACH LOEKS

The Permaculture Market Garden: A Visual Guide to a Profitable Whole-systems Farm Business
New Society Publishers. Gabriola Island, BC (2017).
273 pp. Softcover. Color illustrations. $39.95

THIS BOOK PRESENTS Zach Loeks' approach to permaculture market farming. In many ways, it complements Richard Perkins' *Making Small Farms Work* (reviewed in the May issue of *Permaculture Design),* and the no-till methods of Patrice Gros' Foundation Farm

(also in the May issue). Like Perkins, the author understands the importance of profitability. Without profitability, there is no sustainability. The system ("permabeds") he describes resemble in many ways the no-till beds of Foundation Farm, but Loeks goes beyond organic no-till into hard-core design.

The author presents a very systematic approach, the basic unit of which is the "permabed." An explanation of the system also forms the core of the book. A permabed is a growing bed that is fixed in space, although it may be reformed annually or as needed. Like the Foundation Farm system, the permabed receives the benefit of all the amendments and non-compaction, but differs in being a raised



bed. It would seem to be the raised nature of the permabed that necessitates periodic reforming.

Important as the permabed concept may be, the really unique aspect of this book is the emphasis on the importance of design and holistic thinking. "Farm Ecosystem," "Whole Farm Mapping," "Holistic Planning," and "Design Management" take up the first half of the book.

Loeks emphasizes the importance of preparation, recommending a three-year sequence of manuring and cover-cropping before planting. Although he farms in the Ottawa Valley of Ontario, he speaks from experience gained there and elsewhere on how to eliminate weeds. His approach to soil solarization uses black tarps to kill tough perennial grasses and weeds. Following this treatment, he uses false sowing (preparing a seedbed to induce weed seeds to germinate, followed by shallow cultivation—repeated cycles deplete the soil's seed bank of weeds) and cover-cropping, before ever planting the permabeds. Too many market farming books gloss over the impact of weed pressure and underestimate the tenacity of perennial grasses. One of the strengths of this book is its practical solutions, obviously translated from the author's experience as a market grower himself.

A second differentiating feature of this book is its emphasis on perennials. How do we begin to transition from annuals to perennials, while still generating an income? Why perennials? Loeks makes a strong case that perennial plantings should be seen as three-to-six-year investments, which differ from similar-term investments in farming such as field equipment in the interim benefits and some income they can provide: soil improvement, beneficial insect habitat, microclimates, nitrogen fixation, nursery income, and agrotourism. Also of interest is the concept of "index guilds." These are plantings, often in hugelkultur beds, in Zones 1 and 2 that are used to trial new crops and combinations (guilds), as well as to generate propagation material for later planting out in permabeds.

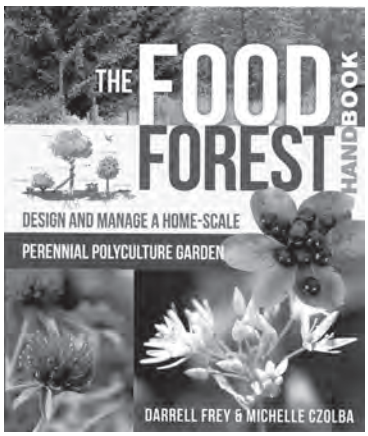
The emphasis on design and perennials make this truly a permacultural approach to market farming. The design focus, plus the permabed approach to no-till (or minimum-till), set this book apart from others in its genre. If you're considering farming for a livelihood, this book should be on your shelf. Δ

DARRELL FREY & MICHELLE CZOLBA

The Food Forest Handbook: Design and Manage a Home-scale Polyculture Garden

New Society Publishers. Gabriola Island, BC (2017).
239 pp. Softcover. Black and white photographs and illustrations. $29.95

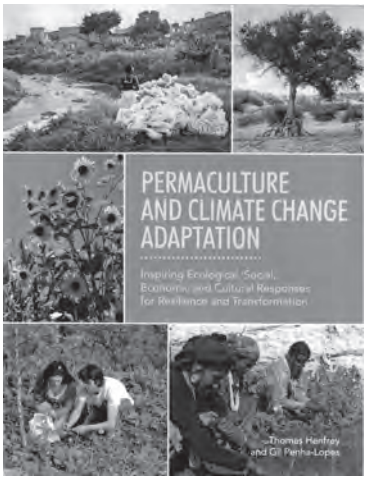
NEARER TO THE permaculture ideal of perennial polycultures, food forests have the potential to feed humans while maintaining the wider ecosystem services that only forests can provide. Here, Darrell Frey, author of the *Bioshelter Market Farm,* and his co-author Michelle Czolba, review the antecedents of the modern food forest: the English potager garden, the Mayan food forests (and modern-day shade-grown cacao), and others, before setting the stage with descriptions of guilds, agroforestry, and the benefits of forests in general. Memorable is the passage about French Creek, in today's Pennsylvania. Early settlers, writing in 1792, described a site of several hundred acres with all the components of a deliberately planted and tended food forest, from its acorn-yielding oak canopy along with butternut, vining wild grapes, understory crops of hazelnuts and various berries, and the herbaceous layer with ramps, ginseng, and many more edible and medicinal species. The potential of such a system to alleviate the devastation and sheer tedium of today's monocrop farming and pine plantations makes one wonder why North America is not covered today with such productive forests. In part, the answer involves patience, or lack thereof, as it takes longer for a food forest to even begin to yield, much less reach its peak productivity, than the single season needed for corn or wheat. Another reason is the general lack of knowledge about how to create such a forest. Here,



the *Food Forest Handbook* shines, as it delivers a practical design approach, geared toward temperate climates, but adaptable to others.

The species lists cover the universal tree crops (apples, pears, pecans…) and, befitting a permaculture tome, introduce a few new ones (hog peanut, *Amphicarpaea bracteata;* staghorn sumac, *Rhus typhina),* together with a palette of functional species needed for a self-sustaining forest. A diagram of the food forest plantings at Frey's Three Sisters Farm complements photos of the forest from planting to early productive maturity. While the *Handbook* provides all the information a

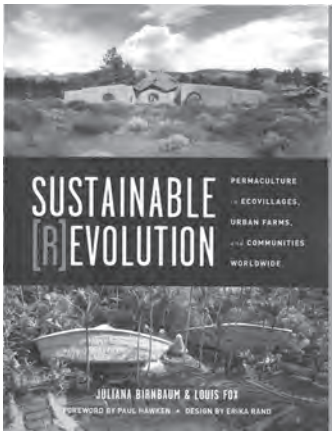
novice would need to design and plant a food forest, there are many more species that could be explored. In this sense, the book is more of a detailed introduction—a handbook—than a detailed, in-depth manual. If you have a place to plant a perennial polyculture guild, *The Food Forest Handbook* can help you get started and improve your chances of success. Δ



THOMAS HENFRY & GIL PENHA-LOPES
Permaculture and Climate Change Adaptation: Inspiring Ecological, Social, Economic and Cultural Responses for Resilience and Transformation
Permanent Publications. East Meon, UK (2015).
107 pp. Softcover. Color illustrations. $15.99

CLIMATE CHANGE is well underway, and no one knows for sure how fast or how far it will go. What we do know is that the conditions humankind has depended on for 10,000 years to grow our food are changing faster and faster. *The Old Farmer's Almanac* is out the window. Dreams of engineering the genes of our food crops to resist drought or heat exemplify the hubris that brought civilization to this point in the first place. More likely solutions are found in nature, which has after all contended with climate change since the beginnings of life on Earth. Genetic diversity allows evolution to stand new players on the stage, where natural selection can work its magic. Genetic diversity of crop species—rice, wheat, corn—is likewise the key to resilience in the face of changing weather patterns.

This book presents a series of permaculture strategies for dealing with rapidly changing climate. These begin with water management and cover soil regeneration, agroecology, reforestation, and more. Nine of the 17 strategies could be characterized as social permaculture, with titles such as "Changing Worldviews," "Regenerative Enterprise," and more. Concluding with the Climate Change Statement and Action Plan agreed at the 2015 Permaculture Convergence in London, this book is a blueprint for climate change action. Δ



JULIANA BIRNBAUM & LOUIS FOX
Sustainable [R]evolution: Permaculture in Ecovillages, Urban Farms, and Communities Worldwide
North Atlantic Books. Berkeley, CA (2014).
352 pp. Softcover. Color illustrations. $39.95

If you need inspiration or some cheering up, this is the book for you. A comprehensive overview of the "ecological design revolution" (aka permaculture) in a mere 25 pages covers zonation at both the homestead and community/region scales, the twelve principles, and more, with an appropriate credit to indigenous cultures. Following this brief, but excellent, introduction, the book takes us on a tour of notable permaculture sites, ecovillages, and various demonstration sites around the world from equatorial Africa to Iceland. These are organized by climate zones: tropical/equatorial, arid/desert, temperate/subtropical-humid + highlands, temperate/subtropical-Mediterranean and maritime, and continental ("snow climate"). Within each climate zone, people are applying permaculture design far, far beyond their gardens. For example, an interview with Brock Dolman of Occidental Arts & Ecology Center (OAEC) in northern California explains the importance of addressing community relations and land ownership (particularly important with long-lived sites like food forests). Other sites apply various techniques, from natural building to greywater, as part of the design of sustainable communities. Before and after photos show the power of permaculture to regenerate landscapes.

Colorful illustrations, including a map of climate zones which marks the sites the book covers, are wonderful. A few pages are printed in white text on a light background, which makes it slightly difficult to read, but this is a minor distraction.

If you're wondering if permaculture is ever going to lead to real cultural change, take a look at this book. Permaculture is already making a difference, right now, all around the world! Δ

THOMAS HENFRY, GESA MASCHKOWSKI, & GIL PENHA-LOPES, eds.
Resilience, Community Action, and Societal Transformation: People, Place, Practice, Power, Politics, and Possibility in Transition
Permanent Publications. East Meon, UK (2017).
213 pp. Softcover. Color illustrations. $24.95.

Like *Sustainable [R]evolution*, this book presents case studies and perspectives on transition. It differs from the former in being more extensively referenced in the typical fashion of academic writings. It is an excellent research tool for anyone interested in transition initiatives around the world, with an emphasis on Europe, the UK, and Canada. Δ

EVENTS

Permaculture Design Course
Ireland

Dates: August 11-21
Location: Cloughjordan EcoVillage, Cloughjordan, Ireland
Description: Organized by Cultivate, hosted in association with Cloughjordan Community Farm, and fully accredited by the Permaculture Assn., this 10-day immersive course is set in one of Ireland's leading examples of an ecosystem of innovation. Through a balanced mix of theory and practice, participants will learn to apply the principles of permaculture to their own lives and communities. Focused sessions on natural building, local economics, forest gardening, renewable energy, ponds and aquaculture, ecovillage and bio-regional design along with specialist knowledge from our local expert on digitial fabrication, permafacture, and open-source distributed production—the indoor sessions are held in one of Ireland's only FabLabs.
Instructors: Aranya (hosting online session), Albert Bates, and our ecovillage resident tuturs
Cost: €550.00 includes a hearty lunch each day. €45camping, €165 hostel, other B&B
Contact: PDC@cultivate.ie
Philippa +353 505 56060
www.cultivate.ie

Permaculture Teacher Training
Spain

Dates: October 6-15, 2017
Location: La Loma Viva, Granada, Spain
Description: La Loma is proud to collaborate with Jude Hobbs (Cascadia Permaculture) & Rico Zook (Itinerant Permaculture) to host an exciting Teacher Training, helping you to awaken the tools to spread the knowledge of permaculture to others. This course will be a pre-event for the International Permaculture Conference (IPC 2017).
Contact: www.lalomaviva.com/permaculture-teacher-training-course-1/

Permaculture Teacher Training
India

Dates: October 21-30
Location: Polam Farm, Manthoor Village, Telangana, INDIA
Description: One-week Permaculture Teacher Training: Empower yourself to advocate for change through whole systems design and teaching! This Permaculture Teacher Training course will improve and expand your abilities and make you a more versatile, engaging and effective educator. In this dynamic and interactive course, you will learn significant teaching techniques to communicate permaculture principles and strategies in a wide variety of educational settings. Our goal is to encourage and inspire your unique strengths and talents by demonstrating diverse teaching modalities such as lecture, facilitating class discussions, storytelling, and using visual aids. In this setting of active learning, you will experience essential hands-on practice by preparing and co-teaching several presentations. Prerequisite: Permaculture Design Course Certificate or instructor's approval.
Instructors: Jude Hobbs, Robyn Francis, Rico Zook
Cost: $ 1,000. Includes course materials, camping or shared dormitory, & three deliciously local meals a day, Scholarships available
Contact: Roman, ttipcindia@permaculturеindia.org; http://ipcindia2017.org

13th International Permaculture Conference and Convergence
India

Dates: November 25-December 13
Location: Polam Farm, Manthoor Village, Telangana, INDIA
Description: TOWARDS HEALTHY SOCIETIES/Subtheme- Women as Change Agents
CONFERENCE :November 25 - 26, 2017 @ Hyderabad, Telangana
CONVERGENCE :November 27 - December 2, 2017 @ Medak district, Telangana

IPCC will guide and inspire more than 1200 participants from 100 countries and also give a significant impetus to the permaculture movement in India and around the world. Individuals, farmers, policy makers, researchers, academia sharing a strong interest in sustainable farming practices like permaculture, natural and ecological farming as well as in other kind of initiatives contributing to sustainable livelihood will come together to think, share, innovate, learn, and dialogue in a diverse and engaging programme.

Be part of us and grab this unique opportunity to meet and connect with people passionate about permaculture and sustainable living in general. IPC offers you a rare experience to gain access to the whole philosophy of permaculture, acquire new technical skills from experienced and renowned practitioners, showcase your work, learn and revive ancient Indian agricultural practices and bolster a positive global movement already underway.
Contact: http://ipcindia2017.org/registerpage.php

Permaculture Design Course
Finland

Dates: August 26-September 7
Location: Elontila, Lahti, Finland
Instructors: George Sobol
Contact: www.permacourses.com

Permaculture Design Course
India

Dates: November 3-22
Location: Polam Farm, Manthoor Village, Telangana, INDIA
Description: Happening in the year of the 30th anniversary of the first ever PDC in India that was conducted by Bill Mollison and Robyn Francis in 1987 at the University of Hyderabad, this course is a first of its kind, introducing a new, expanded course format over 20 days with a total of over 100 hours of curriculum and hands-on work: Expanded 72+ hour PDC program – Four focus streams to choose from: Agriculture, Water and Earthworks, Urban, Social.
Instructors: Robyn Francis, Rico Zook, Clea Chandmal, Govinda Sharma, Gopi Sankarasubramani, Narsanna Koppula, Starhawk, Roshan P Rai, Jude Hobbs, Hui-i Chiang and local guests.
Contact: http://ipcindia2017.org

Send Event and Calendar Listings for Issue #106 (November 2017)
The Doorstep
by the September 1st deadline
events@permaculturedesignmagazine.com

Permaculture Convergence

Inland Pacific Northwest

Dates: September 1-3
Location: Hot Springs, MT
Description: The 7th annual Inland Northwest Permaculture Convergence will take place in the abundant, beautiful and welcoming community of Hot Springs, MT, between Kalispell and Missoula, on Labor Day weekend, September 1-3, 2017. The approximate schedule includes tours and hands-on permaculture classes and demonstrations all day Friday, with opening circle and dinner on Friday evening. A full schedule of workshops and speakers begins after dinner Friday and ends Sunday night with a bonfire and community and regional planning discussions. Stay tuned to the website and Facebook for details on the schedule.

Live music happens every night at Symes Hot Springs Hotel, and numerous hot springs soaking options abound in the surrounding township, as the convergence takes place in the heart of Hot Springs.

We encourage you to bring your kids, as we have an exciting opportunity for them to join the Ravenwood Outdoor Learning Center for daily excursions on both Saturday and Sunday (for ages 6-12) and a full two day and overnight excursion for teens aged 13-17. Please check the website for how to register, pre-pay, and complete your child's paperwork. We have only 30 slots for the younger kids' program and 16 for the teen program, so register now! For more details, visit the Inland Northwest Permaculture Guild Website.

Contact: http://www.inlandnorthwestpermaculture.com

Advanced Permaculture Design Course

Washington

Dates: August 19-26 **Location:** Bullock's Homestead, Orcas Island, WA
Description: This course is an excellent follow-up to a Permaculture Design Course. Join the team of Terra Phoenix Design and the Bullock's Permaculture Homestead for this excellent follow-up to your Permaculture Design Course. During this course you can expect to run through the design process several times to build competence and confidence. We will also have "choose-your-own-adventure" sessions where you select an educational pathway that matches your specific interests. Examples of sessions include: software for design, the business end of running a design consultancy, plant species deep-dive, a landscape graphics primer, etc. Topic specific design sessions will go deep on water systems, shops and work areas, and nurseries. There will also be open studio time for you to get feedback on your own designs. Finally, real-world design project walkthroughs from the Terra Phoenix portfolio will allow you to see what finished designs look like and how to assemble a quality package of deliverables for your client.
Instructors: Douglas Bullock, Samuel Bullock, Dave Boehnlein & Paul Kearsley
Cost: $1200. A $250 non-refundable deposit is required for registration.
Contact: Dave Boehnlein; 360-840-8483; info@permacultureportal.com

Permaculture Design Course

Oregon

Dates: August 6-September 16. **Location:**Aprovecho Educ. Ctr., Cottage Grove, OR
Description: Join us for 6 weeks of empowering and practical solutions at Aprovecho, a site renowned for over 30 years of work in Permaculture and sustainable development while learning from an assemblage of many of the best teachers throughout the Pacific Northwest. Teachers for this course include Jude Hobbs, Marisha Auerbach, Rick Valley, Andrew Millison, Tao Orion, Chris Foraker, Abel Kloster, and Mike Hatfield.

Aprovecho's Sustainable Living Skills Immersion is the oldest program of its kind in the Northwest and includes hands on training in appropriate technology, sustainable forestry, natural building, water harvesting, sustainable agriculture, and Permaculture.

The Permaculture Design curriculum is woven throughout the program, leaving students with a framework for integrating the learned strategies and techniques into cohesive designs for sustainable human settlement. The internationally recognized certificate in Permaculture Design is presented at the end of the program. While a typical Permaculture Design Course runs for two weeks, this course contains 200+ hours of classroom and hands-on time.
Instructors: Jude Hobbs, Marisha Auerbach, Abel Kloster
Cost: $1,900-$2,400 sliding scale. Course tuition does not include room and board, which is optional. Interest-free tuition financing available.
Contact: Maryam Mathieu; maryam@aprovecho.net; http://www.aprovecho.net

8-Week Permaculture Practicum in Water and Forestry Systems

Oregon

Dates: Sept. 24-Nov. 11 **Location:** Aprovecho Education Ctr., Cottage Grove, OR
Description: Join us for eight weeks of applied hands on education as we explore the regenerative power of trees and water to restore landscapes, increase farm resilience, and increase economic health. This course is designed for farmers, land owners, contractors, and students seeking to deepen their on-the-ground permaculture skill-set at a level that empowers them to design and install regenerative forest and water systems on their land and within their communities. This program is suitable for both someone new to permaculture or someone with prior education and experience wanting to take the next step in their permaculture studies.

This program embeds students within three integrated focus areas: agroforestry and perennial food systems, timber based forest management, and water harvesting.

An array of hands-on projects empowers students to take an active roll in the development and stewardship of the landscapes they work in.

Cost: $2,500 - 3,800 sliding scale. Course tuition does not include room and board which is optional. Interest-free tuition financing is available.

Contact: Maryam Mathieu; maryam@aprovecho.net; http://www.aprovecho.net

Advanced Permaculture Optical Survey Course

Oregon

Dates: October 10-15
Location: Southern Oregon
Description: Take your permaculture design practice to a new level with this course in basic surveying and layout which are essential skillsets for every farmer, homesteader, designer, and consultant. This course will teach the use of many types of analog (non-battery operated) surveying tools, along with advanced skills in keyline, pond and swale layout, mapping, and other core knowledge necessary for design and execution of permaculture projects.

Students will become familiar with swale, terrace, ditch and pond layout, profile cross-section drawing, keyline and trail system locating, solar assessment, small cabin orientation and pad layout, staking, note taking, and compass and map reading. We will use hand tools such as sight levels, compasses, pocket transits, builders levels, A-frames, rods, measuring tapes and wheels. This is the 10th time we've offered the course, and lots of additional information is available including reviews, advanced reading and more through the Siskiyou Permaculture website at siskiyoupermaculture.com.

Instructors: Tom Ward and the Siskiyou Permaculture team
Cost: $625, includes camping. Early registration by September 10 is $525.
Contact: siskiyoupermaculture.com

Permaculture Design Course
Colorado

Dates: March 17-October 21, 2018
Location: Pikes Peak, CO
Description: Join us for a Through the Seasons Permaculture Design Certification Course! Learn and apply the principles and ethics of permaculture design, earth-centered education, living natural buildings, integrated food systems and power down your energy needs. Permaculture offers real solutions for the future, as we seek to heal ourselves and heal the land.

We will cover topics including ecosystems and forestry, rainwater harvesting, small animal husbandry, bee keeping, food forests and growing food, appropriate technology, urban permaculture, greenhouse design, aquaculture, community building and more! Exceptional instructors teach you how to apply permaculture to everyday living and you will actively plan and design a project site as well how to take what you've learned into your community. Field trips, educational hands-on projects and inspiring lectures. This beautiful course will change your life!

Instructors: Becky Elder & other Front Range Permaculture guests
Cost: $1,350 tuition includes course book, materials and healthy locally sourced and organic food. Work-trade, early bird before September 30, 2017, couples discount
Contact: Becky Elder
719-685-0290
rselder@comcast.net

Water Management Weekend
Michigan

Dates: August 18-20
Location: Traverse City, MI
Description: A family-friendly educational camping event PACKED with valuable info and hands-on activities focused on being good stewards of our precious waters.

Topics: All living things depend on a healthy hydrologic cycle; Water solutions to climate change; how to build a rain barrel and rainwater catchment; DIY garden ponds; strategies to capture, store, and re-use water; water-wise gardening and irrigation methods; introduction to permaculture design of water systems; our personal, practical relationship and gratitude for water; and more…

Instructors: Peter Bane, Keith Johnson, Rhonda Baird, Penny Krebiehl, Levi Meewuenberg
Cost: $150 individual; $325 family
Contact: NMI Permaculture
nmipermaculture.org

Permaculture Design Course
Online

Dates: Ongoing
Location: Online
Description: Our course is the classic, official 72-hour Permaculture Design Certificate Course (PDC) as taught by the founders of permaculture – Bill Mollison and David Holmgren.

The full Permaculture Design Course (PDC) is a 72- hour intensive program. This course involves study modules supported by practical exercises, photos, fieldwork and videos.

Upon successful completion of the Permaculture Design Certificate (PDC) course, graduates receive the official, internationally-recognized Permaculture Design Certificate.

Instructors: Dr. Alan Enzo, Jessica Enzo, Art Freeman, Ben Bishop
Cost: $550
Contact: info@PermacultureEducation.com
PermacultureEducation.com

Advanced Design Course
Wisconsin

Dates: Autumn Course: Oct 4-8 **Location:** Kinstone, Fountain City, WI
Description: This 5-day advanced, applied Permaculture Design Course is for anyone looking to study permaculture design at a deeper level beyond the PDC. Students focus on a detailed design project of their choosing. This course is an in-depth practicum of the process and concept of designing; it is not a how-to technical drawing course. Gain the skills and confidence needed to take your permaculture design skills beyond your own backyard. Forest gardening, landscape design techniques, professional permaculture design & consulting, site assessments, urban and rural design projects, project presentation and other topics covered in this course offer a life-changing experience and provide enhanced skills for ecological design. Most students in this course design with pencil and paper; however, those skilled in design software are welcome to use such software that they have available to bring with them on their own computer. Pre-requisite: PDC Certificate or equivalent experience. Course size is limited to 15 students. Limited onsite camping available.

Instructors: Wayne Weiseman **Cost:** $750
Contact: Kristine Beck, kristine@kinstonecircle.com, www.kinstonecircle.com

Advanced Design Course
Illinois

Dates: October 14, 20-22; November 11-12**Location:** Chicagoland, IL
Description: Have you taken your PDC and are looking for a next step in permaculture design? Come deepen your understanding of permaculture: assess your skills; create a plan for self-empowerment; learn new skills and insights to enliven your permaculture practice. Use your permaculture education to leverage a regenerative community.

This course empowers you to: Work fluently and appropriately with the contexts of design. Deepen the integration of permaculture into your life.Understand the matrix of your own skills and be able to apply them to your design work. Extend your design skills including: mapping/imaging; surveying work; patterning; specifics for selection (plant, etc…). Work better with collaborators, clients, contractors, and local authorities. Build a plan to increase your competencies.. Effectively share your knowledge of permaculture. Students must have completed their permaculture design course. There will be a 90 minute call 1PM Central, October 14, to cover introductory material and meet each other. There will extensive material to cover before each weekend in addition to design projects.

Instructors: William Faith, Rhonda Baird, Milton Dixon
Cost: $750 early bird discount paid in full before course start; $900 after 8/14, $250 non-refundable deposit req., payment plan available. **Contact:** www.glpdc.info

Forest Garden Design Intensive
Pennsylvania

Dates: October 13-22
Location: Mount Joy, PA
Description: Forest ecosystems exhibit many beneficial properties we humans could stand to emulate in our culture, agriculture, and horticulture: they maintain, renew, fertilize, and propagate themselves. They build, store, and conserve clean air, clean water, nutrients, soil quality, and biodiversity.

In this nine-day intensive course, you will dive deeply into the vision, theory, and practice of designing wholesome, dynamic, and resilient edible ecosystems using temperate deciduous forests as models. Dave Jacke and his teaching team will offer lectures, site walks, and experiential classes to help you understand how the architecture, social structure, underground economics, and successional processes of natural forests apply to the design of edible ecosystems of all kinds. You'll learn a variety of ecological design processes while designing a range of food-producing ecosystems at Heritage Creek Farm Camp. Design projects could include designing forest gardens for: urban or suburban homesteads, an educational summer camp, farm-scale (up to 20 acres), or an edible stream corridor. We'll also engage with issues of garden management, economics, and the deep paradigmatic shifts required to succeed at co-creating "humanatural" landscapes and cultures. You will leave inspired and empowered to design food forests at home for yourself, and your friends, neighbors, and clients.

Instructors: Dave Jacke, Juliette Olshock, Seth Nyer, Jon Darby
Cost: $1,200-$1,600;
Contact: www.hornfarmcenter.org/FGDI

Permaculture Educator Training
New York

Dates: August 18-27
Location: Omega Inst., Rhinebeck, NY
Description: This intensive permaculture educator training embodies and explores this educational approach. Learn how to design and run permaculture workshops, courses, and other educational experiences as ecosystems—by designing and running them! Learn to assess and design for students' learning niches; create effective learning environments; plan for, budget, and market an event; and devise multifunctional, functionally interconnected courses where the whole experience is greater than the sum of the sessions.

Together, we face fears, transform inhibiting narratives, share constructively, and grow deeply in a healthy, safe, supportive, and fun learning environment. We also engage with the business of teaching, among other practical aspects. This rigorous course culminates with you designing and coteaching a daylong public permaculture workshop series along with your peers. You will leave with new skills and experiences under your belt, and feel empowered to teach permaculture and embody the change you want to see in the world. Attendance requires prior completion of a PDC and an application and acceptance process; there is pre-course homework and a webinar. Scholarships are available

Instructors: Dave Jacke, Chris Jackson, Kim Almeida.
Contact: https://www.eomega.org/pttc

Permaculture Practicum
Massachusetts

Dates: September 9-12, October 14-16, November 10-13
Location: Sowing Seeds Shelburne Falls, MA
Description: Based out of our community permaculture hub in the village of Shelburne Falls, MA. Practice ecological design alongside leading designers and educators in the northeast; Gain your permaculture design certificate with Sowing Solutions who is celebrating over 10 years of permaculture education; Visit numerous demonstration sites such as Sirius EcoVillage, Hickory Gardens, Wildside Cottages & Gardens.
Instructors: Kay Cafasso, Keith Zaltzberg, Llani Davidson, Walker Korby, and guests
Contact: www.PermacultureSeries.org

Agro-Ecosystem Series
Tennessee

Dates: October 8-15
Location: Summertown, TN
Description: This series is a conscious effort to provide on-the-ground training in regenerative land management and cultural repair for permaculture practitioners. An agro-ecosystem is a dynamic association of crops, pastures, livestock, other flora and fauna, soils, water, and the atmosphere. It is agriculture functioning as an ecosystem in and of itself, but also with the surrounding environment. In this training, you will develop your skills and gain hands-on experience as you build a small scale regenerative farming system. You will help design and implement an integrated agro-ecosystem. This system is designed to supply the homestead with fuelwood, animal fodder, food, craft material, and more. It will include design/implementation of earthworks, soil testing and building, design and layout of multiple agroforestry systems integrated with animals. This series is three classes in one. Earthworks, Agroforestry and Mushrooms, Molds, and Mycorrhizae with Tradd Cotter. This is Spiral Ridge's 6th annual Earthworks course...the longest, continuously offered earthworks course in the states.
Instructors: Cliff Davis for Earthworks & Agroforestry with a webinar presented by Eric Toensmeier and Tradd Cotter for Mushrooms. Mix and match discounts. Take all together or separately
Cost: $1,300 early bird; $1,500 Meals & camping included.
Contact: 931-231-4099 spiralridgepermaculture@gmail.com www.spiralridgepermaculture.com

Intensive Permaculture Design Course
Florida

Dates: Oct 25 - Nov 5, 2017
Location: Brooksville, FL
Description: PDC with internationally recognized certificate. This is an intensive two-week course held at our permaculture farm north of Tampa. Students will participate with and observe permaculture systems installation and operate in an immersive environment, including appropriate tech, innovative greenhouse solutions, perennial food systems, animals, solar, and more. This is a small, diverse farm with many different elements and examples of permaculture that can be translated to a wide variety of settings, urban or rural. The course will address strategies and techniques for both urban and rural areas in different climates and circumstances. We will be in the midst of setting up new food production and water catchment systems during the course (with our staff and volunteer crew), and students will have the opportunity for daily hands-on involvement with a number of farm tasks and ongoing installations.
Instructors: Koreen Brennan
Cost: $1,050 (early bird) / $1,395
Contact: Koreen Brennan. 727-495-6145. koreenbrennan@gmail.com. growpermaculture.com

Permaculture Design Course
Kentucky

Dates: September-November, six weekends.
Location: Louisville, KY
Description: Immerse yourself in a fast-paced, active class full of discussion and hands-on activities. Learn to use permaculture design in almost any setting from urban to rural and household to regional planning for regenerative systems. Readings and active design projects throughout the course apply your learning to landscape and social systems. Instructors use their own experiences with design and implementation to support your learning, as well as many other skills.
Instructors: Rhonda Baird, Gabriel Hahn, and guests.
Contact: shelteirnghills@gmail.com www.shelteringhills.net

Permaculture Practicum
Kentucky

Dates: Septemeber 16-17
Location: Berea, KY
Description: Learn to live from locally cycled resources! Build living soils with sustained fertility using contour swales, permanent no-till beds (including hugelcultur), the 3-Sisters cornfields, no-till grain & bean fields (patterned on Masanobu Fukuoka's work), including integration of poultry forages & cover crops. As rice paddies are under construction, you'll learn about those, too. The September workshop also includes small group practicums (4-6 people/group) based on participant interests. Past examples have included seed saving, humanure, polyculture food forest, orchard & nut trees, spring water, greywater and pond catchment systems, wild forage, locally-sourced natural building with clay, wood & natural fibers, passive solar building, renewable energy & off-grid living. Limited to 12 participants for hands-on learning.
Cost: $1,200-$1,600
Contact: 859-893-3360**;** www.LocalHarvest.org/farms/M5606

Permaculture Foundation Course
North Carolina

Dates: October 15 - October 21
Location: The Eco-Institute, Carrboro, NC
Description: Join renowned instructor Will Hooker to explore the foundations of permaculture through presentations, discussions, field trips, and hands-on building experiences. This in-depth course offers practical methods to help your yard, landscape, or community garden become a part of the global movement of ecological design. Discover the ways in which you can apply permaculture principles on any scale to the landscapes where you live. Explore natural building projects, energy use practices, water management, and other principles of permaculture. This course includes three fresh, farm inspired meals a day. Limited to 25 participants. To get certified in permaculture design, extend your stay to the following week and join the PDC intensive, which happens back to back with this course.
Instructors: Will Hooker & Megan Toben
Cost: $690 - plus camping fees. For work-trade options, inquire by August 15.
Contact: Brenna Carpenter - info@eco-institute.org; www.eco-institute.org/permaculture

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Permaculture Design Course
Tennessee

Dates: September 23-Oct. 6
Location: Summertown, TN
Description: In this 14-day Permaculture Design Course, you will be learning the tools, guiding principles, and strategies that create lush productive landscapes, reduce your energy use, and create more stability and security for you and your loved ones. We will be focusing on how to ecologically design farms & homesteads, building skills and participating in hands on projects. Students will complete a design with our guidance from making holistic goals, mapping and analyzing the landscape to presenting their designs complete with graphics and getting feedback. This course takes place on an 8 year 9 acre family homestead turning clear cut land into a fertile, integrated landscape with animals, earthworks, organic gardens and agroforestry systems. Instructors include herbalists, organic farmers, compost/tea specialists, regenerative business owners, professional designers and more.
Instructors: Cliff Davis, Jennifer Albanese; 10+ guests
Cost: $1,300 early bird; $1,500. Meals & camping included.
Contact: 931-231-4099 spiralridgepermaculture@gmail.com; www.spiralridgepermaculture.com

Permaculture Design Course
North Carolina

Dates: October 22 - October 28
Location: The Eco-Institute, Carrboro, NC
Description: Many people have taken a PFC Class or even earned a PDC, but still lack the skills to execute a professional design. This is an in-depth, design-centric course featuring the whole process of permaculture design. We explore consultation, site assessment, and advanced practice in visualization, design creation, and project presentation. By the end of the course, students will complete 3 real-life permaculture design projects to show how a space can become more useful, beautiful and ecologically inspired. There is lots of direct personal feedback for each student at every stage of the process with the goal of supporting professional competence in permaculture design. Join us at the Eco-Institute for six days of fun, intensive, hands-on measuring, base-mapping, dreaming, designing, and drawing beautiful landscape plans. After one week, you will be better able to design your home, school, or business landscape employing the principles of permaculture to their best advantage. Limited to 15 participants. To earn a certificate through this course, students must have either a PFC or a previous PDC. You can come early and fulfill your prerequisite at the Eco-Institute on Oct. 15-21. **Instructor:** Will Hooker
Cost: $690 - plus camping fees. For work-trade options, inquire by August 15
Contact: Brenna - info@eco-institute.org; www.eco-institute.org/permaculture

Calendar

August

Aug. 7-18. CRMPI, Basalt, CO. PDC. Jerome Osentowski, jerome@crmpi.org.
Aug. 11-21. Cloughjordan, IRELAND. PDC. PDC@cultivate.ie, Philippa +353 505 56060, www.cultivate.ie.
Aug. 13-26. Winlaw, BC. PDC. Kootenay Pc Inst., spiralfarm@yahoo.com, www.kootenay-permaculture.ca.
Aug. 18-20. Traverse City, MI. Water Management Weekend. nmipermaculture.org.
Aug. 18-27. Rhinebeck, NY. Permaculture Educator Training. www.eomega.org/pctt.
Aug. 19-26. Orcas Island, WA. Advanced Design Course. Dave Boehnlein, 360-840-8483, info@permacultureportal.com.
Aug. 26-Sept. 7. Lahti, FINLAND. PDC. www.permacourses.com.

September

Sept. 1-3. Hot Springs, MT. Inland Pacific Northwest Permaculture Convergence. www.inlandnorthwestpermaculture.com.
Sept. 2-3. Cincinnati, OH. Regional Confer-

ence. greatriversandlakes.org.
Sept. 9-12, Oct. 14-16, Nov. 10-13. Shelburne Falls, MA. PDC. www.Permaculture-Series.org.
Sept. 16-17. Berea, KY. Permaculture Practicum. Susana Lein, 859-893-3360, www.localharvest.org/farms/M5606.
Sept. 23-Oct. 6. Summertown, TN. PDC. spiralridgepermaculture@gmail.com, www.spiralridgepermaculture.com.
Sept. 24-Nov. 11. Cottage Grove, OR. Practicum in Water & Forestry Systems. maryam@aprovecho.net; www.aprovecho.net.

October

Oct. 4-8. Fountain City, WI. Advanced Design Course. Kristine Beck, kristine@kinstonecircle.com, www.kinstonecircle.com.
Oct. 8-15. Summertown, TN. Agro-Ecosystem Series. spiralridgepermaculture@gmail.com. www.spiralridgepermaculture.com.
Oct. 10-15. Southern Oregon. Advanced Permaculture: Optical Surveying Course. siskiyoupermaculture.com.
Oct. 13-20. Mount Joy, PA. Forest Garden Intensive. www.hornfarmcenter.org/FGDI
Oct. 14, 20-22; Nov. 11-12. Chicagoland, IL. Advanced PDC. glpdc.info.
Oct. 21-30. Pc Teacher Training, Telangana, INDIA. permaculturainfo@gmail.com.

November

Nov. 3-26. Permaculture Design Course. INDIA. ipcindia.2017.org.
Nov. 25-26. International Conference, INDIA; Nov. 27-Dec. 2. International Convergence, on the Farm, ipcindia2017.org.

2018

Mar.-Oct. Pikes Peak, CO. PDC. Becky Elder , 719-685-0290, rselder@comcast.net.

Ongoing

Online. PDC. info@PermacultureEducation.com, PermacultureEducation.com.
Online. Mentoring before or after the PDC. shelteringhills@gmail.com. www.shelteringhills.net/mentoring/

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EDUCATIONAL OPPORTUNITIES

FARM MANAGER APPRENTICESHIP IN SOUTHERNMOST ILLINOIS. Seeking individual or couple to participate in sustaining permaculture/agroforestry practices on a small farm near Olive Branch, Illinois. This farm is off-grid and utilizes rain and pond water sourcing . An organic garden and orchard complement pasture-raised cattle, sheep and goats. Forest products include medicinal plants, native edibles, shitake logs, maple syrup, and bandsaw lumber. Additional Organic Energy farm information: http://www.fwsoil.org/field-days.html

Housing and modest stipend available. Please call 618-776-5416.

FARM AND FOOD SYSTEMS INTERN OPPORTUNITY AT SUSTAINABLE HOTEL IN SOUTHERN MEXICO

We're a sustainable farm-to-table boutique hotel in Juluchuca, Mexico operating under the model of regeneration, whereby our mission is to revitalize, regenerate and restore a vibrant and diverse ecosystem and simultaneously foster sustainable economic opportunities in our surrounding community.

For more information and instructions on how to apply, visit http://www.idealist.org/view/internship/PxMPMBNc5kMD/

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LIVE WELL WITH OR WITHOUT THE GRID. Resilient permaculture suburban microfarm Bloomington, IN. Ten years organic cultivation, zone 7a. Ideal for home business, extended family, rentals, Air-BnB. Two houses w/central air, and a large studio/workshop, all with woodstoves, totaling 2950sf, plus greenhouse, outdoor patio, large porch, many fruiting trees and shrubs. 3BR/1.5BA, 9 rooms in all plus baths and laundry. Lg. kitchen, open plan, wood and tile floors, new appliances, grid-tied 2.4kW solar PV, low taxes and utilities, renewable energy income. Fully fenced, paved driveway pad, excellent insulation, MANY energy efficiency features, . $250,000. $1,500 reward for referral leading to sale or discount for PDM subscriber citing this ad. Call Peter, 812-335-0383.

NOVA SCOTIA MULTI-USE FARM: barn is new construction, state-of-the-art passive solar on south facing slope in temperate zone on 59 acres with year-round spring, new well & driveway, and septic design & permit. 5 kilometers from year-round farmers market. About 30 acres in timber and 5+ acres flat and cropable. The province is putting their $ in to supporting local agriculture and good stewardship grants available. rose@masoncreekfarm.com , Listing: https://www.tradewindsrealty.com/listing.php?id=9997

98 ACRES IN CLAY COUNTY, WEST VIRGINIA. Five bedroom farmhouse with barn and three outbuildings. Low taxes. 90-acre mature woodlot includes a diversity of medium to large caliper hardwoods (black walnut, black locust, hickory, beech, oak, maple, and tulip poplar), and several high-value medicinal plants. Bearing hardy kiwi and apples. Two spring-fed ponds with creek below main barn. Zone 6a. Small goat herd operation at present. jkertesz@gmail.com

LETTERBOX

Just finished reading the latest *Permaculture Design*. So much really helpful, concrete information in well-written articles. Bravo!

Michael Welber
Bloomington, IN

I could spend the rest of my life reading on your site. I have to ration you. The sample you sent was a major read, and I read it all. Good stuff. Keep up the good work.

Subscriber
Wimberley, TX

I so appreciate the last issue of *Permaculture Design* magazine. The article by Peter Bane was magical. The quote that made my heart feel so deeply-was "the holistic way of knowing is knowledge based in love, and a big enough portal for the birth of a new world."

Wes Roe
Santa Cruz, CA

Several of us have visited the old Hershey Nursery in Downingtown, PA, that was featured in the article *(Permaculture Design* #99, Feb. 2016) and have seeds from several items going. Yesterday was fun—we reveled in mulberry diversity.

Dale Hendricks

Networking

DO YOU LIVE in Ohio, Indiana, Kentucky, Illinois, Michigan, or Wisconsin? If you do, the Great Rivers and Lakes Permaculture Institute invites you to join us for a weekend of networking, workshops, and tours of permaculture in Cincinnati Ohio, September 2-3; hosted by the Cincinnati Permaculture Guild.

GRLPI offers programs that engage our communities; we design and build living systems, write books and essays, make art, teach children. We are nationally and internationally known leaders in permaculture design, education, village design, and professional development. Join us as we expand this conversation about the world we want to live in. Tell us what you are called to do, what you want to see!

We have come together to nurture leadership, express our vision for repair of the land and communities, gain allies, and rebuild a common culture that honors past struggles as it prepares for a just and healthy future.

Whether you can join us or not, you are invited to join the institute and support permaculture projects in our region. You can find out more information at www.greatriversandlakes.org. Δ

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Issue #105

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