What’s the answer? Pray for rain? At this stage, even a good soaking winter will not be enough to end California’s drought. Moreover, rain will help only if it falls far enough north to be captured by the CVP and SWP reservoirs; rainfall in central or southern California would grant only a brief respite for local areas, or even create mudslides if rain falls intensely on slopes denuded of vegetation from drought or wildfires, as happened north of Los Angeles in mid-October. This drought might end only after a run of at least four years of above-average rainfall plus cold winters bringing deep, water-packed snow to the Cascades and Sierras—and also to mountains in other western states, if Los Angeles’s snowpack meltwater supply is to be ensured.

Droughts Likely to Increase
How likely is such a run of wet years? Not very. Computational climate simulations suggest that droughts are likely to increase in frequency and intensity. The Scripps Institution of Oceanography at UC San Diego estimates that by 2100, April 1 winter snowpack like 2015’s essentially will be the new normal. It’s happened before. That same study of tree rings from California’s centuries-old blue oaks that revealed this is a 1,200-year drought also reveals that between 800 and 1300 AD, before written meteorological records, California suffered two “megadroughts” of several decades each.2

So, one has to ask: what if California’s drought continues? A study with exactly that title published by the Public Policy Institute of California in August did not offer comfort about the economic impacts. Can technology help? According to some experts, engineering offers no silver bullet, but possibly offers “silver buckshot.”37 While high-tech desalination and potable reuse have grabbed headlines for new water supplies, several humbler but important approaches not yet widely implemented could offer significant savings in supplies the state already has.

You can’t manage what you don’t measure. Studies have repeatedly shown water use drops 15% to 25% if apartments are individually submetered and billed for water use rather than having water included in rent. In Los Angeles where 62% of residents rent—but 90% of apartment complexes have just a master meter—submetering could save huge volumes of water. Detecting and plugging leaks—especially underground leaks in utility systems—could yield a similar big win. But major water utilities don’t even have a handle on how much water is being lost from their urban distribution systems. Various analyses suggest urban utility losses could be 10% of deliveries, or some 1 million afy. Very likely it’s much higher. That magnitude of water leaked away statewide could supply all of Los Angeles with water for a year. Added to that should be untold leaks along California’s thousands of miles of aqueducts and canals, whose concrete is cracking and buckling because of age, earthquake tremors, and land subsidence.

But supply and conservation technologies can’t do it alone. Nor can urban areas. Truly needed are creative and fast industry-scale agricultural solutions that could slash the state’s water consumption by half or more. Some solutions are technological. Indeed, some already exist and are even partially implemented, such as highly efficient irrigation techniques (microsprinklers and drip irrigation). More universal acceptance is needed.

Other solutions involve policy and behavior. State agencies need to reevaluate the water rights granted against measured actual—and far less—surface water supplies. And they need to start tracking groundwater now. At current rates of consumption, California’s water supplies may not last for 25 years while waiting for the SGMA sustainability deadline. Right now, agricultural concerns must stop behaving as though groundwater supply were infinite—a situation described as “a slow-moving train wreck” by Richard Howitt, UC Davis professor emeritus of agricultural and resource economics and lead author of a 2014 study on the drought’s economic impact. “A well-managed basin is used like a reserve bank account,” he explains. Instead, “we’re acting like the super rich who have so much money they don’t need to balance their checkbook.”39

Moreover, just because a business plan looks profitable doesn’t mean it’s sane—not for the state, nor even for the survival of the business itself beyond the current
year or the next. Already the drought has forced farmers to stop watering entire orchards so they wither and die—a costly loss; but given the dry climate outlook, once those dead trees are ripped out, why repeat the mistake by planting yet more trees that lock in high water demand? Does raising cattle make sense in a region routinely so dry every summer that pasture land must be watered and cattle fed irrigated alfalfa? Already some California cattle concerns have realized that cows can graze more cost-effectively in parts of the nation where it rains year-round. And export California’s water as luxury crops or hay? Plug that drain.

Last, in light of the long-term prospect for increased western drought, the nation at large needs to drought-proof its food supply by rethinking its heavy reliance on the Central Valley. The water-rich Midwest and eastern states can—and used to—raise many of the vegetables and fruits now predominantly raised in California (California’s market edge is its ability to grow veggies in winter). Any durable, sustainable solution for both California and the U.S. must re-engineer national agricultural policies—notably removing subsidy disincentives to allow other states to turn away from corn and soybeans and return to diversified crops. It won’t be easy or cheap: the technologies for planting and harvesting other crops are not the same. But there is precedent: once tobacco subsidies were removed decades ago, the tobacco-growing states diversified their crops quite profitably.

After all, points out UC Berkeley’s visiting scholar Gray Brechin, “when there’s no water—well, there’s no water.”

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Nations around the world in an interconnected globalized 21st century aspire to establish their own local innovation ecosystems whose archetype is California’s Silicon Valley—that cauldron of cutting-edge technology change.

Thus, India has Bangalore, China Beijing and Shenzhen, Germany has Berlin, Kenya has Konza Technology City, Chile Santiago, Russia has Skolkovo, Israel Tel Aviv, and the United Arab Emirates has Dubai, to name a few.

Not to be outdone, a group of American cities are also hard at work to create their own Silicon Valleys. These include Boston, New York, Los Angeles, Chicago, Austin, Las Vegas, Denver, Phoenix, and even Detroit.

Nations and cities around the globe covet the building of such thriving innovation ecosystems because they are veritable value creators; with jobs, wealth and development.

But what is history’s earliest such ecosystem and what shaped its breakthrough? The intriguing answers to these questions came to me fortuitously as I was ruminating on the results of my own DNA test.

Journey into Deep Time: While I am an American citizen and have now lived in the United States for more than half of my life, I was born and grew up in the Philippines, that geographical crossroads in Southeast Asia—a former Spanish and American colony—where different peoples, ideas, cultures, languages and religions have come together over millennia.

My brain cannot conjure up the thousand-year ancestral trail that led me here. However, its map is deeply etched in the big data of my DNA, the global positioning system that I share with my forebears as they migrated across continents through deep time.

To unlock the memories embedded in every cell that makes up my body, I had a sample of my DNA deciphered for its ancestral linkages.

As I had anticipated, my genome laid bare the fact that I share genes with different peoples—70% with East Asians (China, Russia, Japan, Korea, Mongolia, Thailand, Indonesia), 25% with Pacific Islanders (Samoa, Tonga, Fiji, New Zealand [Maori], Hawaii), 4% with South Asians (India, Pakistan, Nepal, Bangladesh) and about 1% with Africans.

The report that I am 25% Pacific Islander was a bit unexpected. That I am 4% South Asian and 1% African, however, caught me by complete surprise.

More stunning, however, was the gradual realization that indeed my genetic makeup subtly unveiled the molecular mileposts established by my ancient forebears during their odyssey across continents that thousands of years had shrouded...
and almost buried. What's more, the ancestral migration paths retraced by my molecular GPS align with the external fossil and archaeological evidence mapping out the migration of modern humans out of Africa into the Arabian Peninsula, South Asia, East Asia and beyond.

Out of Africa: Evidence points to the emergence of modern humans (*Homo sapiens*) in Africa around 200,000 years ago. Trekking out of Africa, they reached the Arabian Peninsula as early as 100,000 years ago. Some of them continued their journey on to South Asia and reached East Asia as early as 60,000 years ago. The oldest remains of modern human (the Tabon man) found in the Philippines date back to 50,000 years ago. This was approximately the same time that modern humans reached Australia, or about 10,000 years before *Homo sapiens* set foot in Europe, and about 40,000 years before modern humans arrived in North America. Humanity was an unstoppable river that flowed out of Africa into the other five continents that we now fully inhabit.

The double-helix record of my ancestral origin more specifically points to Africa’s south-central hunter-gatherers region around South Africa, Namibia and Botswana as my primeval cradle in deep time. From there, my ancient forebears migrated out of Africa likely through Ethiopia, crossed the Red Sea into the Arabian Peninsula and traversed the Persian Gulf into South Asia (India). One line likely continued journeying through Thailand, Indonesia, and into the Philippines, while another probably migrated through China, Taiwan, and into the Philippines. Some of my direct forebears stayed in the Philippines, but others continued their migration by sailing into the Pacific islands of Samoa and Tonga. Some probably reached New Zealand, some perhaps reached Hawaii.

Thousands of years later during the latter part of the 20th century, I resumed this epic ancient odyssey, starting off from the Philippines, and migrated into North America.

Humanity is not a noun. Humanity is a verb. And this perhaps accounts in part for my own peripatetic predilection and tendencies.

Surprisingly, I feel a sense of wholeness if not pride in discovering that I retain, however vestigially, an African heritage in 1% of my genes, which is almost a molecular mark of distinction for my forebears’ intrepid trans-continental journeys.

An Unheralded Fact: But why did my ancestors, having migrated out of Africa, continue journeying while others stayed in and around the Middle East? And, more important, what subsequently made those first modern humans abandon their nomadic ways of life as hunter-gatherers, stay put and transition into sedentary agrarian communities?

These questions are not new, and have been addressed substantially by anthropologists based on archaeological evidence. What is intriguing, however, is that the specific community of modern humans to make the first collective decision to cease from wandering and settle as a permanent agricultural community constituted the world’s first de facto technology innovation ecosystem. How so?

Prelude to Innovation: Archaeological evidence locates the first sedentary or semi-sedentary settlements by modern humans in the western part of the Fertile Crescent, which comprises today’s Jordan, the Palestinian West Bank, Israel, Lebanon and Syria, beginning around 14,000 years ago. With a warmer and moister climate in the region owing to the ending of the last ice age, the place was fecund with plant life, including cereal grasses (wheat, barley), as well as animal life.

With bountiful food available for foraging, the region attracted bands of nomadic hunter-gatherers, of whom the most important were the Natufians. They settled in villages around the region, most notably in an oasis in...