

The Economic Might of Earth's Evolution: The Epic Promise of Knowledge

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Abstract

The article presents original economic and business models that, in their interplay, have the capacity to shepherd the sustainability and conservation legacy of the emerging global knowledge economy. These models are framed by an assertion that our planet holds a vast reserve that could define the 21st century as profoundly as oil has shaped the 20th century. They are premised on a comparison: Unlike oil or mineral ores whose global volume is just a sum of their deposits across the world, the 21st-century reserve—the yet-to-be-tapped scientific knowledge embedded in biologically opulent landscapes and seascapes—grows in volume and worth in the context of evolutionary, ecological, and other relationships that transcend regions and political borders. They are grounded in legacy-investment opportunities whose competitiveness and prestige grow along with the geographical footprint of the research they underwrite. While various stages of these models' conceptualization and validation have been published in scholarly journals and enriched with endorsements by several members and officers of the United States National Academy of Sciences and by heads of state and UNESCO (United Nations Educational, Scientific, and Cultural Organization) leaders, this article is the first comprehensive presentation of both. It pioneers their integration into a catalyst of a new economic geography. It charts a paradigm of “noble wealth,” not intended to replace oil wealth but to outperform it in endurance and lasting benefit to humanity.

Keywords

conservation, earth's evolution, knowledge economy, legacy investments, Pacific island region, science diplomacy, transnational research

Introduction

In his book *The Prize: The Epic Quest for Oil, Money & Power*, Yergin (2009) offers a masterly analysis of the immense influence that the economics of oil had on the 20th century. Oil became deeply intertwined with national strategies and global politics and power. To a large extent, national economies of the 20th century can be viewed as *oil economies*.

The onset of the 21st century is marked by a rapid transition of the global economy toward a *knowledge economy*, creating *knowledge societies* (United Nations Educational, Scientific, and Cultural Organization [UNESCO], 2005). The 21st century is also widely regarded as the *century of biology* (F. J. Ayala, 2007; Kafatos & Eisner, 2004). Major investments in education and science by Qatar (Clark, 2013), United Arab Emirates (Ahmed & Abdalla Alfaki, 2013), and other petroleum-rich countries striving to diversify their economies away from oil herald this trend. Novel tools such as the National Knowledge Assessment (National Research Council, 1996, 1999) have emerged to assist developing countries and other jurisdictions to analyze their capabilities for participating in the knowledge revolution. A restructuring of the innovation process is underway around the globe: New national and regional centers of relevant

research are emerging and, as a result, global interactions and knowledge sharing are accelerating, diversifying, and deepening (Ernst & Hart, 2008).

In their widely cited article, Powell and Snellman (2004) define the knowledge economy as “production and services based on knowledge-intensive activities that contribute to an accelerated pace of technical and scientific advance, as well as rapid obsolescence” (p. 199). While the descriptions of a knowledge-based economy continue to evolve, they converge in their core emphasis on the use of information resources (technologies, skills, and processes) to achieve and accelerate economic growth potential. A report by the Asian Development Bank (2014) extols this emphasis as an unprecedented opportunity for developing economies to step up competitiveness and move up in global value by leapfrogging certain technology cycles and catching up with the latest advances, such as moving to cloud computing solutions. Reflecting on its global

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dimension, Facebook's founder Mark Zuckerberg has lauded the knowledge economy for supporting a larger economic shift in the world based on information and ideas (Kelleher, 2013).

But is there a raw material that has the potential to propel and structure this new economy, just as oil shaped the industrial economy?

There is. I have argued that our planet holds a vast reserve that could define the 21st century—a reserve that ought to be mobilized and nurtured with the same vigor as are research parks, scientific cities, and knowledge-based industries in building viable and sustainable knowledge economies.

This reserve is embedded in the still largely unspoiled landscapes and seascapes of our planet, involving such features as rain forests, coral reefs, and other spectacularly biodiverse habitats and harboring geologic history rich in fossil records. These extraordinary natural environments, most opulent in the world's tropics and within the borders of developing countries, are treasuries of potential scientific knowledge. I view these natural assets as prime repositories of the knowledge *mineral*, the raw material for the knowledge economy. My basic claim is that countries abounding in biodiversity and other natural riches of scientific importance could achieve influence and wealth comparable in magnitude—and incomparably superior in endurance—with those that oil-rich countries have traditionally enjoyed.

This dramatic redefinition of the geography of wealth is conditioned on strategies that disregard national borders. A comparison between the geography of the knowledge mineral and the geography of oil reveals a striking difference. Whether we look at the global, regional, or national distribution of oil reserves, the overall amount of oil is no more than the sum of these reserves. Connecting two or more reserves does not increase the volume and quality of the oil contained in these reserves. In contrast, the knowledge-mineral resource can be fully assessed and valued only in the context of evolutionary, ecological, and other relationships that have and continue to distribute natural capital across geographies and political boundaries. These relationships—of conservation and scientific value—complement and enhance the knowledge content and worth of the individual natural heritage assets they conjoin.

Hence, I assert, the value of natural resources does not diminish in the knowledge economy; it may well increase, measured in terms of “knowledge content” and developed on scales that shift the emphasis to layers of knowledge mineral—*knowledge veins*—sculpted by correlations and relationships among multiple reservoirs of these resources.

The critical question becomes, “How are we to ignite and sustain the potential of the natural resource-based knowledge stock as a source of wealth, one not meant to replace oil wealth but to outperform it in lasting benefit to humanity?” The answer I propose might, at first, seem surprising, even startling: The international resort industry and resort-styled private estates, predisposed toward locations of outstanding

natural beauty and interest, are superbly positioned to become the principal business partner in this scientific consolidation of vast stores of new knowledge. Thus, while tourism-based economies and knowledge economies, viewed in conventional terms, seem to involve two dramatically different scenarios of economic development, I argue that they can be combined to yield a major new economic model because they share a resource base of critical importance to their strength and growth potential—yet under threat and gradually disappearing throughout the world.

The Vision, Proofs, and Guarantees: A Paradigm in Progress

The goal of this article is to consolidate the aforementioned positions by bridging a retrospective of their genesis and validation with the unfolding perspective of their translation into transnational sustainable-development strategies. Thus, a collective mission with the capacity to strengthen the role of science in international policy making and diplomacy is created along with the ability to engender legacy opportunities that invite both financial and intellectual investment that will produce major returns for humanity for generations to come. This goal defines the article's structure.

A prelude, “Nature and Knowledge: An Economic Frontier,” is a reflection on the existing interpretations and valuations of the relationship between natural resources and the knowledge economy. The original work presented in this article starts with the Retrospective that is divided into two sections and related to some of the latest market trends and advancements in the evolutionary sciences.

The first section, titled “The Economic Geography of Wonder,” revolves around insights I have charted into the untapped economic and social relevance of the dynamics and relationships that pervade the natural world within and across national jurisdictions. I demonstrate how these insights, and the development blueprints I devised around them, have bolstered national pride about natural wealth enclosed within a country's borders, increased the stature of science in the eyes and acts of political leaders, and laid foundations for science-fueled and conservation-benefiting economic collaborations on regional and trans-regional scales.

The second section, “Business Model With a Mission,” summarizes a complementary, multiyear effort I have carried out to devise and test an investment platform that redefines the worth, stature, and appreciation potential of properties located across the world's most naturally privileged locations—locations that are now entering the market greatly undervalued by being reduced to just prime real estate. This platform unlocks the potential of these properties to excel as highly privileged staging areas for a new breed of resort facilities catering to world travelers and invited to invest in scientific discoveries along far-reaching stretches of the earth's natural fabric on the premise of major business returns (including the capacity to offer unique, ever-changing experiences that are immune to

imitation and possess the ability to command ever-greater competitive strength and prestige). Importantly, these business returns are not conditioned on the investors' ownership of the unlocked knowledge as intellectual property and can be coupled with formidable legacy rewards if backed by assurances that the underwritten knowledge harvests will benefit the nations harboring the natural cradles of these harvests as well as the local communities as custodians of these cradles and as partners strengthened through conservation- and research-specific training and employment. These lofty goals converge in an ideal partnership, but there is nothing idealistic about their content. They are backed with a well-grounded business perspective for a powerful industry that will increasingly be driven by travelers' thirst for knowledge and has the potential to become the strongest conservation force in the world.

A paramount goal behind the synergistic efforts discussed in these two sections has been to empower conservation with economic foundations that guard against reducing nature to a commodity and that honor and value knowledge advanced through basic scientific research as public good. This goal—and the Retrospective—extend into the Perspective unveiled by this article and also subdivided into two highly synergistic sections.

The Perspective's first section, titled "Wealth Infrastructure Attuned to Nature," introduces a pilot transnational project, *The Pacific Bridge to Noble Wealth* (PBNW). The project's purpose is to engender and shepherd a sustainable multinational economy structured as innovative knowledge bridges that empower science diplomacy as the engine of the new economy's governance while guarding its precious stock of natural riches. The design of this megaproject revolves around building a *knowledge supra structure* that discloses and harnesses the *collective* scientific importance of the connections and dynamics that distinguish the Pacific Island Region's spectacularly diverse natural heritage and that expand further in their collective worth along affinities that tie islands and ecosystems of the Pacific coast of the Americas with those along the ocean-linked biological networks of the larger Indo-Pacific Region. This consolidation of a grand knowledge bank is intended to inspire an extension of the World Heritage recognition to relationships and processes that span multiple natural sites or regions and are of exceptional scientific value and to form a novel economic block with the formidable capacity to generate discoveries that will fuel major advances in science, medicine, and other fields of value to humanity.

The business model whose evolution is chronicled in this article's Retrospective enters the PBNW design on the premise of utmost selectivity: selectivity in terms of the magnitude of the environmental and social benefit that each investment will spur and, deservedly, will capitalize on by acquiring limitless potential to appreciate in stature, market worth, and legacy rewards. This model is employed to yield a portfolio of *legacy investments* in hospitality–science partnerships that is master-planned to function as a self-sustaining system through which research funding and expertise

flow into the most precious reservoirs of this planet's heritage, injecting economic justification into their protection and converting the guardianship of humankind's most irreplaceable possessions into a vibrant job market that benefits the neediest. A top priority is to use this system to ignite a shift from the traditional development scenario of "tourism for tourism-economy" to a new-generation alternative, "tourism for knowledge-economy" that is a trail-blazer in terms of international competitiveness and environmental sustainability with widely shared benefits. The endorsements and support that this pilot project has already received from leaders of several Pacific Island nations, UNESCO, and the University of the South Pacific, and the project's inauguration at the Arnold and Mabel Beckman Center of the United States National Academies of Sciences, Engineering, and Medicine—the West Coast Headquarters of the National Academies—have laid the ground for an unprecedented sustainable-development teamwork.

"Turning a Vision Into a Sustainability Partnership," the Perspective's second section, reveals a strategy to reinforce this teamwork's promise and endurance and to stimulate its outgrowth into a global opportunity. Novel environmental, legal, business, and other aspects and their interface will define the implementation of the PBNW—and of my entire mission and aspiration to help chart a new geography, diplomacy, and legacy for the knowledge economy. Equipping all these efforts with perpetual assurances of academic preeminence and receptivity to new opportunities became imperative. Acting on behalf of the Pangea World organization I founded, I have been honored to initiate a strategic alliance with the University of California (UC), anchored by UC Irvine and fortified in its potency by the presence of the West Coast Headquarters of the National Academies adjacent to the campus. This nascent alliance has the capacity—and the opportunity—to ensure that knowledge derived from natural resources in a particular country is shared with and benefits that country, while the knowledge yielded by research insights into transnational threads of the earth's evolutionary and ecological fabric is treated as a global asset that benefits all of humanity. I convey my commitment to this opportunity with a tribute to the late Ralph Cicerone, former National Academy of Sciences President and UC Irvine Chancellor, whose advice and encouragement have greatly enriched the Pangea World journey since its formative stages.

Nature and Knowledge: An Economic Frontier

The relationship between natural resources and the knowledge economy has, thus far, been largely a function of improvements in exploration and extraction techniques vis-à-vis the stock of economically useful oil or mineral reserves or productive land. A 2002 World Bank study well defines this relationship and offers numerous supporting examples (de Ferranti, Perry, Lederman, & Maloney, 2002). Application

of knowledge can even create new natural resources, as demonstrated by Norway's accomplishment in transforming waterfalls into hydropower (Ville & Wicken, 2015).

Brazil deserves a special look, for it challenges the continued perception of knowledge economies and natural resource economies as being at two ends of a continuum of economic development. Bound (2008) deems Brazil a *natural knowledge-economy* on the premise that Brazil's bounty of natural resources, assets, and endowments is a key area of opportunity for science and innovation. She observes that Brazil's competitive advantage as a natural knowledge economy gains vigor and momentum as climate change, the environment, food scarcity, and rising worldwide energy demand are moving to the forefront of global consciousness. While in large part physically enclosed within Brazil's national borders, the Amazon rain forest ecosystem is boundless as a crucial factor in the global climate equilibrium. Similarly, the Amazon's biodiversity is of irreplaceable value to all of humanity as one of the most significant resources for the active ingredients for new medicines and cures. And these two universal values of the Amazon asset are deeply intertwined, thus offering a high-profile manifestation of the globally meaningful relationship between biodiversity, ecosystems, and the economy. Heal (2007) summarizes this relationship as follows:

. . . biodiversity is a fundamental part of an ecosystem, and its loss is thought by biologists to affect mainly the robustness and productivity of ecosystems. We can think of ecosystems as capital assets. Ecosystems matter economically because they provide services that are of great value to human societies. (p. 15)

This brings me to a relatively new focus of environmental economics that, albeit not identified with or confined to the knowledge-based economy, is of direct relevance to the subject of this article, for it bridges national and global perspectives. At the heart of this focus is the imperative that we think of ecosystems as providers of services crucial to the functioning of the earth's life support systems. In addition, we must quantify the contribution of these services to human well-being—also as returns on investment in conserving or restoring the natural capital (for an overview and key references, see Barbier, 2014). For example, the capacity to consume carbon during photosynthesis and, thus, reduce greenhouse gas emissions is now a pivotal argument in support of rain forest conservation. This argument, premised on the enormous environmental services these biodiversity-rich ecosystems provide to the rest of the world, gained an unprecedented political backing from the world's governments at the global climate agreement adopted by 195 countries in Paris in December 2015. Article 5 of the Paris Agreement sets the stage for forests to play a major role in the fight against climate change, financed by results-based payments from developed to developing countries (United

Nations/Framework Convention on Climate Change/Conference of the Parties, 2015).

The launch, in 2012, of the *Ecosystem Services* journal has added a voice and publication channel to the quest for better knowledge of the ecological systems that provide the services, of the economic systems that benefit from them, and of the institutions that ought to be established to develop effective codes for sustainable use (Braat & de Groot, 2012). Estimation of the global accounting value of ecosystem services in monetary units is a particularly daunting task (de Groot et al., 2012). From the pioneer estimate of US\$33 trillion as the economic value of 17 ecosystem services for 16 biomes (Costanza et al., 1997) to the estimated loss of between US\$4.3 and US\$20.2 trillion/year due to the loss of ecosystem services caused by global land-use changes between 1997 and 2011 (Costanza et al., 2014), these approximations of the magnitude of global ecosystem services are invaluable for raising global awareness about the unsustainability of these services' present location largely outside the market.

My own search for a globally relevant model and strategy for reckoning the natural capital's value for enlightened economic development that would yield lasting benefits for the environment and humanity has centered on the economically uncharted yet uniquely unifying territory of the earth's evolutionary and ecological fabric and on the priceless *knowledge resource* woven into this fabric. This focus—and the actions it has engendered—is not meant to replace or denigrate any of the existing directions and achievements in environmental economics, science diplomacy, international conservation, or any other field or discipline. It seeks to complement and, hopefully, enrich and accelerate the existing efforts and their convergence in facilitating the world's journey toward knowledge-powered sustainable prosperity and environmental security.

The Economic Geography of Wonder

A National Perspective

Invitations from two nations—Fiji and Panama, respectively and consecutively—presented extraordinary opportunities for refining in concept (in Fiji) and validating (in Panama) an economic-development model I built on the assertion that the scientific value of a nation's heritage bounty could become the nation's principal economic resource (H. Ayala, 1997).

Fiji, the South Pacific nation comprised of more than 350 islands, boasts a myriad of island types, ecologies, geological formations, and fossil records that together offer unparalleled, yet largely overlooked testimony to the evolution of islands and coral reefs over millions of years. Panama is a geological wonderland packed with marine fossils that chronicle the bonding of a vast archipelago into the present-day isthmus that divides oceans and unites continents and along which

countless plant and animal species have migrated and intermingled between the Americas, endowing it with breathtaking botanical and faunal diversity.

Examined nationwide, the spectra of Fiji's and Panama's respective natural diversities position these two countries ahead of most of the world's nations as mega-reserves of knowledge for deciphering the planet's past and planning its future. This astonishing potential of added value reveals itself—in both cases—only at the level of the entire country. Rigorous research themes that would crisscross the country in search of novel and vital linkages among areas possessed of natural legacies would captivate the growing environmental and learning interests of international leisure travelers while consolidating a knowledge resource of global significance. They would provide a unique foundation upon which "Tourism, Conservation, and Research" (TCR) could be master-planned to grow together and become a catalyst of national well-being and international prestige fed by a laboratory of knowledge valuable to multiple sectors of the economy.

The Fiji I deemed an unparalleled heritage bank and ecological theater—in contrast with the existing, homogenized market image of that country as an *island paradise*—inspired the TCR economic-development platform (H. Ayala, 1995b, 1995c). Panama served as the ideal receptor for the TCR platform's validation via the *TCR Action Plan for Panama*, which I carried out from April 1998 through March 2000 (H. Ayala, 1999, 2000a, 2004). The location, in Panama, of the renowned Smithsonian Tropical Research Institute (STRI) complemented that country's heritage bounty with another singular asset that had also been entirely omitted in the traditional economic-development plan and outlook. STRI's world-class research, I argued, embodied an outstanding business value in view of the global recognition and lasting appeal it would inject into a TCR platform for Panama's sustainable future. Ira Rubinoff (1998), STRI director (1974-2008), remarks upon this:

Did she mean that STRI would be expected to give practical advice upon which other people would be making substantial financial investment? . . . Here our work is expected to have an immediate relevance to society . . . I am happy to pledge STRI's participation. (pp. 2-3, 5)

The involvement of STRI's executives and experts contributed cutting-edge substance to the TCR Action Plan's key outcome: a nationwide network of 23 heritage routes based on themes that span Panama on various spatial scales, reach millions of years back in time, and simultaneously profile and strengthen the economic, conservation, and research values of the heritage assets they interlink. For example, *The Route of the Three Oceans* exalts the discovery that—on the Pacific side—Panama adjoins two distinctive oceanographic zones. These two zones, in terms of their ecology, represent two different *oceans* and, thus, paired with the Atlantic,

endow the country with three oceans. Comparative genetic studies that would be carried out simultaneously in these three oceans of Panama would be of extraordinary significance for deciphering species evolution and adaptation. Apart from its obvious scientific and conservation importance, the three-ocean theme offers an effective tool for positioning Panama as an international leisure destination.

The heritage-theme network has anchored a pilot union of hotel partners (H. Ayala, 2000b) and inspired novel architectural, legal, and capacity-building models and strategies (Aguilar & Saied, 2004; Ayers, 1999; Hogrefe, 1999-2000; Miller, 1999; Nemecek, 1999). Sánchez (1998), who—as then National Secretary of Science, Technology, and Innovation—led the Panamanian Government's support and involvement, defined this pilot national project's overall value as follows:

The Tourism-Conservation-Research Action Plan is an innovative opportunity . . . in which our country's natural capital, geographical features, cultural heritage, and geological history are conjoined to generate sustainable tourism development, a solvent conservation policy, and an ever-increasing knowledge base of our nation's assets. (p. 76)

Formally endorsing the TCR model and its pilot application in Panama on behalf of the American Association for the Advancement of Science (AAAS), Nicholson (1999) highlights this model's potential to use science in the promotion of human welfare and human progress on a scale that could not otherwise happen. Yet, using a scale defined by a nation's borders only scratches the surface of this opportunity. A political line cannot define a geographical area within which to appreciate, engage, and guard a data bank pool fashioned by nature.

A Regional Perspective

Panama's natural capital and its knowledge content are intertwined with those of the entire Central American land bridge that harbors some 10% of the world's biodiversity. In the marine realm, they are an integral part of a *biological corridor* engendered by the convergence of major oceanic currents, nurturing an exceptional spectrum of marine life, and reaching deep into the Pacific. Similarly, Fiji's treasure trove of evolutionary and ecological legacies contributes to and grows in prominence amid the daunting diversity and complementarity of natural environments all across the Pacific island ecosystems—a diversity currently outside traditional economic-development strategies.

At the invitation of the UNESCO Office for the Pacific States, I prepared a study that recognized the South Pacific Island Region as an exquisite candidate for a development strategy that would interlink, value, and protect the region's geological formations, archaeological legacies, and land and marine ecosystems (H. Ayala, 2005). Ranked as the biologically most

opulent places on earth, many of these areas would serve as immense data banks that are systematically unlocked through scientific exploration in concert with developing a regional tourism industry second to none. Noteworthy is this strategy's synergy with "*Vaka Moana—Ocean Roads of the Pacific*," a cultural program of UNESCO that seeks to assist the Pacific peoples to further develop their shared heritage and to promote economic development consistent with the conservation and careful use of the region's resources (Voi, 2005).

However, the boundaries of the Pacific Island nations' portfolio represented by the UNESCO Pacific Office are not the final markers of a geographical area within which to appreciate, engage, and guard nature's data bank pool. Recent studies of the geography of coral reef diversity (i.e., of the pattern of species richness on coral reefs, which is a fundamental precondition for informed decisions regarding the conservation and management of these globally threatened and declining hotbeds of biodiversity) are disclosing a fascinating mosaic of cradles of species richness and of dispersal routes that draw affinities among variously distant ocean regions and archipelagos. Major contributions along these lines (Reaka & Lombardi, 2011; Reaka, Rodgers, & Kudla, 2008) have revealed that the diversity of the primary groups of contemporary Indo-West Pacific coral reef organisms peaks in the *East Indies triangle* (Malaysia, Indonesia, New Guinea, and the Philippines) of the Indo-Australian Archipelago, reaches a lower peak in East Africa and Madagascar, and declines in the central Indian Ocean and central Pacific. What a splendid, yet untapped, resource this exploration reveals for the development of intellectual delights that would give a visitor to any one of these diversity hotspots insights into the coral reef heritage of the entire Indo-Pacific. What an opportunity this resource opens for positioning the rarity, inspiration, and educational value of such insights as business incentives for investments in the continuation of this ground-breaking research and its translation into conservation and sustainable-management measures of international scope and influence.

A global scale is the only scale with which to fully disclose, consolidate, value, and protect the natural reserves of the knowledge stock, within a multiplicity of overlaying units delimited by geological, evolutionary, and ecological markers.

A Transnational/Global Perspective

The subject of *connectivity* is becoming ever more prominent and relevant as a conservation imperative. Based on their study of *connectivity conservation* projects and experiences throughout the world, Worboys, Francis, and Lockwood (2010) offer guidance for national and international connectivity conservation initiatives, with emphasis on large-scale, naturally interconnected areas—also as critical strategic and adaptive responses to climate change. They demonstrate the importance of connectivity conservation for sustaining the

ecosystem services of terrestrial and marine environments and for enabling plant and animal movement between habitat patches as well as for preserving connectedness required by spatially dependent evolutionary processes.

There is another dimension of connectivity that could be referred to as contextual connectivity and that both shapes and is shaped by bold research endeavors of transnational scales but of trajectories that are spatially patchy in the present world. Reaka's (2014) novel approach to deciphering the patterns of global endemism and diversity brings to light evolutionary linkages that tie various ocean biotas to ancient marine-diversity centers elsewhere in the world. These linkages do not entail any physical or functional connectivity at present, but they are of immense value to science and conservation as well as of considerable potential to boost the worth and stature of currently overlooked heritage assets and their locales. Reaka confirms that, today, the pinnacles of global marine and terrestrial diversity occur in the Old World Indo-Australian tropics, the New World tropics, and, to a lesser extent, the southwestern Indian Ocean. But it was not always so, she asserts. Two hundred million years ago, a single global center of diversity occurred in the Tethys Seaway (Europe, North Africa, and the contiguous Americas). This fertile center of endemism and diversity spawned most of our modern marine and terrestrial organisms. It is within this retrospective that some endemic corals in Brazil, found to belong to old relict lineages known from fossil representatives in the Tethys Seaway, acquire a universal-legacy rank. More disclosures of such priceless living relics can also be expected in retracing a second center of diversity and endemism that arose (~100-50 million years ago) in the New World tropics as the Atlantic Ocean opened and as Africa and the southern continents crashed northward into Eurasia. The eastern Tethyan species migrated south and east, forming new centers of diversity in the southwestern Indian Ocean and Southeast Asia as recently as 20 million years ago. Understanding the dynamics of speciation and extinction across these ancient gateways—with their *legacy biotas* as well as their newly sprouted species—by using recently available genetic techniques is, according to Reaka, one of the greatest challenges and opportunities of the 21st century.

The concept of Pleistocene Parks or Phylogeographic Sanctuaries (Avice, 2008) dovetails a visionary, cutting-edge science with another contextually blended yet now spatially fragmented perspective synergistic with Reaka's. Researching and interpreting the spatial distribution of genealogical lineages, especially within and among closely related species—which is the essence of phylogeography, a biological field he founded—Avice has discovered that many of these distinctive lineages began diverging from one another in unglaciated biological refugia of the Pleistocene Epoch or earlier. The aggregate scientific and conservation importance of these *legacy biotas* underpins his call for a carefully designed network of phylogeographic reserves on each continent and in each marine region that could be

promoted and distinguished in a similar fashion as historical landmarks honoring important events in human affairs.

Comparative phylogeography is shedding a new light on the origins of marine biodiversity. Across the world's tropical oceans, the biodiversity hotspots (prominently the already mentioned East Indies Coral Triangle, as well as the Caribbean) have been widely recognized as evolutionary incubators of new species and contrasted with endemism hotspots (such as Hawaii and Red Sea). Phylogeographic studies are now shattering this distinction: Both biodiversity hotspots and endemism hotspots are important in producing novel evolutionary lineages and may work together to enhance biodiversity on the ocean planet (Bowen et al., 2016).

The connectivity-enhanced appreciation and mutual reinforcement of the natural knowledge banks will unfold along paths that stretch beyond national jurisdictions. This poses a unique challenge, underscored by the following excerpt from the January 2010 report on *New Frontiers in Science Diplomacy* (Koppelman, Day, Davison, Elliott, & Wilsdon, 2010), an international event hosted by the Royal Society of London in partnership with the AAAS:

International spaces beyond national jurisdictions—including Antarctica, the high seas, the deep sea and outer space—cannot be managed through conventional models of governance and diplomacy, and will require flexible approaches to international cooperation, informed by scientific evidence and underpinned by practical scientific partnerships. (p. 18)

I would add that these international spaces will also require novel, internationally viable, and sustainable strategies of basic research funding.

Basic scientific research is largely the domain of government funding; it does not involve capital market valuation. It has been bypassed by the recent boom in science philanthropy spearheaded by some of the richest Americans (Broad, 2014). The dependence on government funding can and often does become a major hindrance to the ambition and execution of research visions, particularly in basic science projects that transcend national borders.

The knowledge resource pool rooted in earth's evolutionary and ecological fabric is transnational. While knowledge derived from natural resources in a particular country should be shared with and benefit that country, the knowledge yielded by research insights into transnational threads of earth's natural fabric ought to be treated as a global asset that benefits all of humanity. I conceived this position with a business model in mind and have made this model's refinement—and empowerment via science diplomacy—the centerpieces of my work on the geography of wonder for some 20 years.

Business Model With a Mission

In their pioneer assessment of the value of the world's ecosystem services and natural capital, Costanza et al. (1997) make the following point:

If ecosystem services were actually paid for, in terms of their value contribution to the global economy, the global price system would be very different from what it is today. The price of commodities using ecosystem services directly or indirectly would be much greater. (p. 259)

An analogy can be drawn in the context of the global repository of the knowledge mineral. The world over, hotspots for resort ventures and for investments in resort-styled private retreats coincide with some of the most diverse, biologically rich, and often intricately linked ecosystems that are yet to be revealed as treasure troves of currently undiscovered knowledge. These exceptional locations are entering the global market as merely premier real estate, grossly underappreciated and undervalued as contributors to a knowledge economy. Both the host countries and the investors bear the loss, which opens a unique opportunity for changing the status quo on the premise of hard-nosed economics.

The resort industry's enthusiasm for capitalizing on the *wonder* premium found in many of its information-dense settings to create experiences that engage the intellect is in its infancy compared with the sophistication achieved in the concept and delivery of hospitality and service. Entirely dormant, in business capitalization, are many of these settings' links to much larger realms of wonder.

Peer-reviewed tourism and hospitality publications have become venues for a series of articles in which I first defined this argument; suggested planning, design, and management philosophies that would translate it into solutions; and demonstrated the benefits on a pilot hotel portfolio I guided in Panama (H. Ayala 1991a, 1991b, 1993, 1995a, 1996, 2000b). The objective, limned in my continued work on the subject, has been to bring science—and, through science, conservation—into the heart of a business model in which product quality, competitiveness, and prestige grow along with the geographical footprint of the underwritten research. Here is how.

Science holds the key to unlocking the *context* of the resort's setting. One dimension of this context is the setting's connection to a larger ecosystem. Moreover, science can reveal affinities (evolutionary, ecological, and other) that connect the destination's natural heritage resources with those found in various parts of the destination's broader region and elsewhere in the world. Through such revelations, science can empower the resort to capitalize on its setting as a window into a far-reaching labyrinth of wonder. The experience—*live*, uniquely meaningful, and uniquely immune to imitation by being offered from a vantage point inside this labyrinth—will be profoundly different from experiences gained in a museum. A strategic alliance that would enable the resort to nourish this experience with ongoing access to scientific exploration would offer to reward patrons with first-class intellectual pleasures and to continuously upgrade—with the help of exhibits, images, and other tools—the novelty and educational value of these delights through access to a flow of discoveries.

This business strategy generates robust incentives for an infusion of investments—not donations—into research, training, development of scientific infrastructures (such as research stations), conservation-tailored employment, and other safeguards of the project's business performance across vast landscapes and seascapes—beyond the resort's property lines—where traditional models of economic development would collide with the carrying capacities of these environments. This creates benefit zones that surpass, in scale and capacity for sustainable development, existing approaches to linking business models with destinations' conservation and social priorities. And this also opens new frontiers for the work in economics that has explored the distinctive properties of knowledge as a public good.

In their influential articles, Nelson (1959) and Arrow (1962) reveal the limitations of private profit opportunities to draw socially desirable quantity of resources into basic research—limitations fueled by the business value of monopoly over the funded research findings. Making the case for basic scientific research as the prime source of significant advances in knowledge, Nelson (1959) notes,

Often the new knowledge is of greatest value as a key input of other research projects . . . For this reason scientists have long argued for free and wide communication of research results, and for this reason natural "laws" and facts are not patentable. (p. 302)

As Arrow (1962) explains, appreciating and capitalizing on knowledge as a precursor of future knowledge does not align with the operation of private enterprise system and its emphasis on property rights:

To appropriate information for use as a basis for further research is much more difficult than to appropriate it for use in producing commodities; and the value of information for use in developing further information is much more conjectural than the value of its use in production and therefore much more likely to be underestimated. (p. 618)

I assert that the international resort enterprise is well positioned and economically motivated to defy the free-enterprise economics of basic research and to become the principal business partner in science-oriented valuation and consolidation of the geographies-bridging knowledge-mineral veins. Worthy of emphasis is the fact that the extraction and appreciation of the knowledge resource in the context of tourism, which is primarily an exercise in interpretation, does not involve the ownership of knowledge as intellectual property and, thus, is fully compatible with the underwritten scientific discoveries' sharing and conducive to their cross-fertilization—as seeds of new harvests of wonder—within multiple research endeavors. The more prominent and "expansive" would the scale and scientific importance of a resort-engaged knowledge vein be, the greater would also be the business incentive to help value and protect large swaths of naturally

privileged areas across the world, without depriving the host countries of their ownership and without denying conservation-minded access to these areas by others. As a result, the returns on investment would encompass a formidable legacy.

It is the legacy reward that aligns the momentous trend of ecophilanthropic ventures with this immense opportunity waiting to be tapped. Ecophilanthropy, which counts some of the world's wealthiest individuals including high-profile corporate leaders and celebrities among its champions, involves purchases of natural areas to protect them or to restore their ecosystems. Increasingly, these land acquisitions or private concessions, often of daunting scales, are introducing and underwriting biological and ecological research programs within their boundaries. More and more frequently, they also include luxury hotel projects intended to both support and be supported by these private natural reserves and are master-planned to become vanguard models of environmental sensitivity and sustainability (Bell & Bristow, 2013; Doerr, 2011; Rush, 2005). One can observe a growing synergy and progressively blurred line between these hotel-anchored ecophilanthropic ventures and the sustainability theme embracing *trophy* purchases of private islands and other exceptional properties in naturally prominent settings, such as the recent purchases of Lana'i by Oracle's Chief Larry Ellison (Mooallem, 2014) and of Blackadore Caye off the coast of Belize by the actor and environmental activist Leonardo DiCaprio (Satow, 2015).

However, these laudable development models and their research missions do not recognize or capitalize on their potential to acquire an entirely enhanced spatial dimension and generate business and legacy premiums on the wings of ecological, evolutionary, and other affinities that tie the tourism- and philanthropy-courting property with its larger ecosystem and with natural legacies elsewhere in the world. The pursuit of such contextual amplification—amplification that would be mapped by science and achieved and enjoyed through interpretive tools—would not be conditioned on purchasing any additional real estate. It would be entirely exempt from the backlash that some of the large-scale ecophilanthropic acquisitions have encountered in the host countries and local communities that become suspicious about the motives behind them (Wolford, 2012). The contextually amplified properties would also be eminently primed for partnerships of shared capacity to champion daring cross-national science and conservation initiatives in a pragmatically effective and economically sustainable fashion. Such joined endeavors would empower each participating property to develop intellectual bounty nurtured by multiple wonder hotspots, prompting ever more ambitious research questions and, with them, ever more intriguing insights into various global ecosystem networks that entail ever grander legacy opportunities. They would be highly conducive to treating the knowledge mobilized through transnational research of natural legacies as a global asset destined to

benefit all of humanity, because such an approach and its stewardship would further augment the stature of the participating estates and their owners.

Central to this perspective and strategy is the disclosure of the unmatched potential of the resort enterprise to reap major business dividends from investments in geographically unrestrained, monopoly-free basic research endeavors and, in the process, to facilitate the transformative scale of the economic model that treats the knowledge-rich natural capital as a life-line of the global knowledge economy. The pursuit of this potential will in no way diminish the prospective benefits that the knowledge exploited to enrich the rewards of world travel may carry for the agricultural and fishing industries, for education, as well as for other sectors of the destinations' economies. No doubt, the discoveries brought to light along the global paths of knowledge veins, through comparisons and correlations among multiple research sites and themes, will generate unprecedented opportunities for investigating and employing natural substances to foster human well-being. Countries transected by these veins of discoveries will gain a strong standing as partners in potential wider exploitation of the unearthed knowledge by the medical (pharmaceutical) or other global industries.

Awise (2008) commends this business-model-with-a-mission for its capacity to promote science and protect biodiversity as an integral part of the business plan itself, yielding "a global archipelago of interconnected 'wonder sites' where the scientific study and preservation of nature are the explicit and formal motivation for linking sustainable economics with science" (p. 11567). The road map for employing this business model is embedded within a still larger ambition to awaken the extraordinary potential of the global crop of environmentally progressive resort and private estates collectively to provide an economic and logistical foundation for building transnational knowledge economies that both draw strength from and strengthen the world's premier natural heritage reserves. Integral to this ambition is to demonstrate that blocks of natural heritage-rich countries, shaped by tectonic activity, evolution, and other forces that have molded the world's most opulent veins of the knowledge mineral, could shape this emerging knowledge economy as profoundly as oil-rich countries have influenced the traditional economy.

I have embarked on the pursuit of this ambition backed by the Pangea World organization I founded to serve as a catalyst (H. Ayala, 2003; Lempinen, 2006; Lew, 2007; Loose, 2013; Wiesnerová, 2013). The Pacific has become, once again, the focal point.

Wealth Infrastructure Attuned to Nature

A formalized partnership between the UNESCO Office for the Pacific States and Pangea World (ratified on October 9, 2008) set the stage for the launch—at the West Coast

Headquarters of the National Academies on April 15, 2009—of Pangea World's pilot transnational project (Brennan, 2009). Named *The Pacific Bridge to Noble Wealth*, this project singles out the Pacific as a superb cross-roads of heritage themes of global significance. It seeks to build a *knowledge supra structure* that will release, harness, and value the *collective* reservoir of dormant scientific knowledge enclosed in the past and present connections, dynamics, and relationships that transcend the mega-diverse natural heritage of the island-dotted tropical Pacific; that reach to and interface with islands and ecosystems of the Pacific coast of the Americas; and that further augment this collective natural reservoir of knowledge capital along the ocean-linked biological networks of the larger Indo-Pacific region. It offers a platform for combining the argument about the economic value of ecosystem services with the argument about the economic potential of the veins of the knowledge mineral as repositories of the raw material for the knowledge economy that double in market worth as sources of wonder for high-value experiences of the Pacific's—and the world's—natural splendors.

A core task behind the envisioned supra structure of knowledge is to engender a development model that contrasts with the conflict-ridden contests over the use of natural resources that plague many parts of the world and are often compounded by competing views of what is desirable: economic development for immediate wealth creation versus conservation of resources for the benefit of future generations. The PBNW multinational supra structure of knowledge veins is master-planned from its earliest conceptual stage on proactive guarantees of borderless social benefit, economic energy, and political support.

The PBNW master plan invites the University of the South Pacific—an international teaching and research body owned by and spread across 12 Pacific Island countries—to become a prominent partner in the mapping and exploration of these countries' knowledge veins and, in the process, to further develop the university's research might and its capacity to shape the region's future. The master plan also revives my earlier proposal to UNESCO that they consider extending the World Heritage designation to heritage themes and relationships of exceptional scientific and conservation importance, anchored by networks of heritage assets that reveal them (H. Ayala, 2005). Even though they will initially radiate from and across the Pacific region, these relationships are expected to disclose value-adding affinities among heritage sites on trans-regional and global scales.

This strategy in no way substitutes, compromises, interferes, or competes with national, regional, or global conservation efforts and laws, nor with the existing protection status of a heritage resource. In fact, quite the opposite will occur in terms of contributions toward the economic security of conservation. In the PBNW context, the delimitation of knowledge veins and their positioning as *routes of wonder* entails a financial mechanism that will systematically

encourage the open-ended, geographically unrestrained scientific exploration that is beyond the reach of the conventional government-based research grants and beyond the focus of the corporate funding of immediate profit-making ideas. It entails a proactive layout of an investment network of staging areas, that is, sites selected because of their ideal locations at the crossroads of future insights into multiple routes of wonder and, to the maximum degree possible, also because of their overlay with properties that currently are or likely will be promoted and traded as high-value real estate assets. This investment scenario enjoys a considerable momentum because it is tailored to an investment trend that already exists, namely, the rise—and vanishing line—between ecophilanthropic ventures, which are increasingly combined with luxury hospitality projects, and purchases of private islands and other valuable natural properties for upscale ecoresort developments that increasingly support their image of exclusivity with sustainability initiatives. It offers to take the transformative influence of this unfolding investment trend to an entirely new level of benefit and prestige. This focus is pragmatic in that it treats the wealth that defines the high-end market pool behind this trend as an opportunity to launch projects of the stature and power to make environmental and social contributions of a magnitude that will draw international attention and seed inspiration across the world.

Embedded in the expansive supra structure of routes of wonder, the staging areas will endow the facilities they support—be it private estates or resort operations—with the capacity to pursue unprecedented ecophilanthropic aspirations and to appeal to the deep curiosity of people about the world we live in, without sacrificing the traditional pleasures of present-day luxury resorts and private retreats. Individually and collectively, these facilities will have the capacity to set new standards of excellence in experience management by processing and packaging the science-mediated revelation of wonder in a manner that generates economic energy, facilitates new scientific breakthroughs, creates novel employment opportunities in resource conservation, and portrays investments in knowledge-weighted appreciation of natural capital as emblems of business stewardship. The wonder-route matrix with its clusters of staging areas are especially devised to ensure that the science-mapped, interpretation-consolidated routes across ecologically sensitive ecosystems and into economically depressed and remote rural areas do not subject them to harmful visitor traffic while opening them to social and environmental benefits whose spectrum will be optimized in consultation with UNESCO Pacific. A key objective and function of the staging areas is to encourage and facilitate the setup of research stations and laboratories along the routes of wonder, thus building and strengthening the host countries' own capacity to utilize their knowledge mineral while producing a lasting economic incentive to protect the prime natural repositories of this resource. As a result, each route of wonder, which will typically wind across multiple

countries, will become a potent catalyst of a “cross-national unit of sustainable development.”

This offer of robust appreciation of the staging-area investment in stature, market worth, and legacy rewards is guided by utmost selectivity: selectivity in terms of the magnitude of the environmental and social benefits that the investment will spur along the paths of contextual access exclusive to each staging area. This notion and execution of exclusivity is most inclusive in that it strengthens the natural treasuries of the knowledge capital that belong to the host nations and, at the transnational level, to humanity. It offers to empower these nations to move from their current dependency on donations and foreign aid to true independence and economic stewardship, fueled by high-quality investments that both nurture and are nurtured by the region's collective heritage bounty.

According to Pongi (2009), the approach shepherded by the PBNW project

integrates UNESCO's goals into a broader aspiration to plant, across the Pacific Island Region, a model sustainable economy that derives strength from the spectacular scientific value of the region's natural heritage. It seeks to employ Pangea's tool of the “Hospitality-Science” alliance as a strategic and investment framework for interlinking and accelerating the pursuits of the region's development needs and conservation priorities.

This approach also stimulates a paradigm change of immense promise for sustainable development: a change from the established practice of protecting natural assets by setting them aside from the economy to bringing them into the very heart of economic-development strategies in a manner that guarantees their protection.

The implementation path is strongly grounded in science diplomacy. A gathering of Pacific Island leaders titled *Engaging With the Pacific* was held in Fiji in July 2010. On July 23, this gathering hosted the regional unveiling of the Pacific Bridge vision and strategy (Fiji's Ministry of Information, 2010). The political support engendered by this unveiling gave birth to an important alliance. Speaking at an international event at the United Nations International School (UNIS) in New York on September 19, 2010, Fiji's President Ratu Epeli Nailatikau (2010) confirms the announcement he made at the Fiji gathering 2 months earlier:

I accepted the invitation to become Chair of the initiative to extend The Pacific Bridge to Noble Wealth right across the entire region of the Pacific Island nations. The regional leaders at that meeting honored me with their support . . . I accepted this role in the very strong belief that this initiative can transform our region into an economic power house.

Kiribati's President Anote Tong added his endorsement:

The Pacific Bridge to Noble Wealth advocated under the Pangea World Project provides the economic rationale for protecting the

natural heritage of future generations and is an innovative concept which offers options available at a time when climate change has highlighted human abuse of this planet. (Embassy of the Republic of Fiji, 2010, p. 1)

Legacy Investments as Cradles of Earth-Nurturing Economic Partnerships

A symposium cohosted by the West Coast Headquarters of the National Academies and UC Irvine on February 7, 2014, reinforced the academic credentials of the PBNW investment strategy and showcased the prospective multiplier of benefits from just one staging area.

The event's agenda placed an emphasis on the mutually reinforcing relationship that intertwines Pangea World's legacy-investment business model and the science-guided sustainable-development strategy, and on this relationship's relevance and expected contribution to *sustainability science*.

Michael Clegg, the Donald Bren Professor of Biological Sciences at UC Irvine and foreign secretary of the U.S. National Academy of Sciences, underscored the importance of the Pangea World concept as a model for sustainability. "In order to improve the quality of human life in the face of increasing demands on our earth's resources, we must develop scientific approaches to problems of sustainability," Clegg said. "Pangea World's vision embodies strategic synergies linking the creation and utilization of scientific knowledge to a business model firmly grounded in legacy investment opportunities." (UC Irvine, 2014)

Each legacy investment—and the resort or private *legacy estate* driving this investment—will engage and yield benefits across a transnational geographical unit that defies political borders. The symposium introduced Panama's Las Perlas Archipelago, off the country's Pacific coast, as a model setting of immense biological, ecological, and geological interest and transnational connectivity—across the Central American isthmus and the larger Pacific—as a laboratory of evolution. An investment in harnessing this setting's formidable capacity to offer science-fueled insights into a monumental ecosystem complex would acquire limitless potential to appreciate in stature and legacy rewards. It could help transform from donations dependent to investment worthy such vital conservation projects as the Pacific-Asia Biodiversity Transect (PABITRA), which seeks to interlink the naturally fragmented Pacific-wide biomes into a comprehensive network for a regional approach to biodiversity research and conservation management. It could engender an unprecedented economic and conservation partnership between countries spanned by PABITRA and the Central American nations linked via PABITRA's analog, the Mesoamerican Biological Corridor, and stimulate an expansion of this novel sustainable-development alliance across other countries along the ocean-linked biological networks of the larger Indo-Pacific Region.

In many Pacific island nations—which are among the world's top biodiversity hotspots threatened by climate change—the Pangea World transnational model for the global knowledge economy can offer a lifeline for their peoples' future. "Pangea World's strategy of interlinking and valuing multiple pools of knowledge-rich natural capital with a legacy investment in the Panama islands can provide a new economic geography for the future benefit of our people," said Winston Thompson, Fiji's ambassador to the United States. "We remain strongly committed to this vision." (UC Irvine, 2014)

Redefining the Global Transformative Role of the Pacific

Leon Panetta, then the U.S. Secretary of Defense, stated in a speech he delivered in Singapore in June 2012: "While the U.S. will remain a global force for security and stability, we will of necessity rebalance toward the Asia-Pacific region" (Himmelman, 2013, p. 29). He referred to the United States as a "Pacific Nation" (p. 29). On October 5, 2015, the U.S. Trade Representative Michael Froman announced successful conclusion of the Trans-Pacific Partnership negotiations, aimed at easing trading between the United States and 11 other Pacific Rim nations—Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, and Vietnam (Chappell, 2015). My assessment of the Pacific as a region of vital importance to the United States has a complementary but very different premise, focused on the island-dotted ocean region circled by the Rim. This premise links this Pacific nation, whose world-class academic resources, business foresight, and investment power make it an icon of the existing definition of knowledge economy, with a horizon line beyond which, hidden to the eye, lies a vast, priceless pool of knowledge-mineral veins upon which the future of national, regional, and global economies will be founded. It invites economically savvy science and conservation collaborations among nations, corporations, and institutions not yet perceived as strategic partners in the current scenarios of international trade.

Turning a Vision Into a Sustainability Partnership

According to a United Nations press release, Pangea World's multinational approach represents "an unprecedented opportunity to fortify a knowledge bank with incalculable value to strengthen and sustain the emerging global knowledge economy, one that could elevate the conservation of the planet's most exquisite and vulnerable places into an economic imperative" (United Nations Department of Public Information, 2010, p. 2).

It became a foremost priority for me to endow this opportunity with the propensity to grow in vigor and endurance as it materializes, starting in the Pacific context. It became an equally important priority for me to ensure that Pangea

World's endeavor to assist, complement, and accelerate the existing efforts of international government to protect and sustain common pool resources does and will perpetually adhere to the highest standards of ethics and integrity. The earlier mentioned symposium held at the West Coast Headquarters of the National Academies and cohosted by UC Irvine on February 7, 2014, served as a catalyst for the pursuit of these priorities.

The vision and transnational effort spearheaded by Pangea World will, inevitably, continue evolving, because they will follow and engage the advancing frontiers and capabilities of scientific exploration across a dynamic world. Their essential capacity for change is synergistic with the imperative of excellence-nurturing creativity and receptivity to new opportunities that defines top-caliber academic environments, embodied by UC Irvine and its sister UC campuses. It was on the premise of this synergy that I used the event's stage to announce formally my desire to bond the future of Pangea World's mission with the UC and to anchor its headquarters in the distinguished context of UC Irvine's academic preeminence—and that of its neighbor, the National Academies' West Coast Headquarters—and in the pledge of this mission's and headquarters' eventual passage to this university.

I have been honored by the reception that greeted my desire and aspiration (Drake, 2014). The event “revealed a nascent strategic partnership that could place UC Irvine at the forefront of high-level science diplomacy for global sustainability” (UC Irvine, 2014). It also underscored that the time had come to appreciate—at national, regional, and global levels—the existing and planned protected areas as knowledge banks whose consolidation will unfold along very different paths from those defining the expansions and mergers of their financial counterparts: paths paved by geological, evolutionary, and other forces that have molded the natural capital across geographies.

Novel designs of conservation networks that double in value and function as research networks are pivotal to this perspective. This is where California holds a great asset in the UC Natural Reserve System—the world's largest university-administered network of protected areas (Fiedler, Gee Rumsey, & Wong, 2013). Born from a visionary idea to encompass the spectacular ecological diversity of California in a network of undisturbed environments for research, education, and public service, this collection of reserves has been leveraged for such prominent research projects as the study of the effects of climate change on California ecosystems by the UC-wide Institute for the Study of Ecological and Evolutionary Climate Impacts. However, this asset is yet to be awakened in its value as a unique competitive edge and assurance of the sustainability of California's economic might in this century of biology. Aiding this awakening while inviting the UC expertise into transnational laboratories for heritage-nurtured knowledge economies is a prospect I embrace.

It will be highly symbolic to navigate the geographies-bridging trajectory of the Pangea World journey from California: a Pacific state *assembled*, over the last 100 million years, via a series of seafloor eruptions and island arcs' collisions, and linked through plate tectonics to various parts of the present-day Indo-Pacific (McPhee, 1993). This trans-Pacific geological identity makes California a most fitting portal into the Pacific- and, eventually, the globe-spanning effort to release knowledge woven into the earth's evolutionary and ecological fabric as a source of wealth that could profoundly augment the global strength and sustainability of the knowledge economy, foster a culture of peace (Mayor, 2014), and bolster conservation measures to mitigate rising temperatures around the world.

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