Undermining abundance
(Counter-productive uses of technology and law in nature, agriculture, and the information sector)

by Roberto Verzola

Abstract: Technology and law are increasingly used to undermine processes of abundance intrinsic to nature, agriculture and the information sector. A number of examples are reviewed here. Such counter-productive use of technology and law is traced to corporate profit-seeking. The relationships between the phenomenon of abundance and the related concepts of scarcity and commons are explored. Finally, approaches are proposed that harness abundance for the human good.

A poisoned pill against abundance

After the Second World War, the chemical industries of the West shifted their attention back to civilian applications, including the large-scale production of synthetic urea, organochlorines and other fertilizers and pesticides. These agrochemicals were marketed supposedly to provide additional nutrition for farmers' crops and to kill crop pests. However, farmers and governments did not realize that these products also killed, incapacitated, weakened, or otherwise made life difficult for very important but little-known creatures: soil organisms which turned organic matter into natural plant food, and friendly organisms like predators and parasites which kept pest populations in check. These creatures comprised a vast, largely invisible and unrecognized commons which all farmers unknowingly tapped into, every time they planted seeds and grew crops. In their defense, the chemical industry might claim that they did not know either (which would be an admission of recklessness, if not negligence). But this excuse would be untenable by the 1960s, when the chemical industry viciously attacked Rachel Carson and her book *Silent Spring*,[1] which had called attention to the harmful effects of DDT and other agrochemicals on non-target organisms, including human beings.[2]

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[1] Rachel Carson, *Silent Spring* (Boston: Houghton Mifflin, 1962).

[2] Kira Gould and Lance Hosey, *Women in Green: Voices of Sustainable Design* (Ecotone Publishing, 2007), p.20.

In effect, the chemical industry was selling farmers and governments a deadly technological Trojan Horse, an anti-abundance poisoned pill. Agrochemicals appeared to offer more abundant harvests; in truth, their deployment would gradually weaken and take the life out of the farmers' biological support systems such as natural sources of plant food and pest enemies. As more agrochemicals were used, the diverse soil populations dwindled, the soil became less fertile and farmers' crops starved. To keep the plants from starving, more synthetic fertilizers were added, which caused the living soil populations to dwindle even further. As the predator and parasite populations likewise dwindled, pest populations went up. So farmers had to spray more pesticides, which then killed even more predators and parasites. More recent studies based on the theory of trophobiosis suggest that synthetic fertilizers actually make plants more attractive to pests.[3]

Farmers who took the poisoned pill were caught in the trap and fell into agrochemical addiction, draining life out of the soil and around the crops.

In the 1960s, the International Rice Research Institute (IRRI)[4] introduced IR-8, the first of a series of new "high-yielding varieties" (HYV) of rice, whose high yields partly came from their better responsiveness to chemical treatment. Farmers were wary and few were willing to let go of their traditional varieties. Drawn by aggressive government subsidies and lending programs, however, more and more farmers switched. As they did, they also stopped planting their heirloom varieties, which were soon lost as the old seeds they had saved dried up and died. As the heirloom varieties disappeared and HYV-dependence grew, farmers also lost their selection and breeding skills.

Agrochemicals and the new chemically-responsive varieties would eventually be promoted as the "Green" Revolution.[5] Even today, this technological poisoned pill continues to keep millions of farmers addicted to agrochemicals, mired in poverty and debt.

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[3] Francis Chaboussou, *Healthy Crops: A New Agricultural Revolution* (Charlbury, UK: Jon Carpenter Publishing, 2004).

[4] A Philippine-based Rockefeller-funded research center on rice breeding. See http://www.irri.org. For a comprehensive critique of the IRRI approach, see Nicanor Perlas and Renee Velvee, *Oryza Nirvana?* (Quezon City: Southeast Asian Regional Institute for Community Education, 1997).

[5] For s critique of the Green Revolution, see Andrew Pearse, *Seeds of Plenty, Seeds of Want* (Oxford: Oxford University Press, 1980. See also Vandana Shiva, *The Violence of the Green Revolution: Third World Agriculture, Ecology and Politics* (London: Zed Books, 1991).

Another facet in the technological substitutions of this period was the gradual replacement of work animals by farm machinery. In the Philippines, for instance, carabaos were the farmers' main source of mechanical power. Carabaos also grazed the less fertile areas around the farm, their dung enriching the soil. The animal usually recovered by itself from injury or sickness. Even more – perhaps the most amazing thing of all – the female carabao gave birth to another carabao every two years or so. Yet, through the same poisoned pill strategy, farm machinery suppliers and the government eventually managed to get many farmers to switch to a mechanical power source that was fuelled by costly imported gasoline instead of free grass, gave out noxious pollutants instead of milk and natural fertilizer, required a skilled technician and costly spare parts if it stopped working, and of course never gave birth to its own replacement.

Seed dependence: F1 hybrids

Also in the 1960s, another development would worsen this slippery slide towards seed dependence. U.S. seed companies introduced their commercial version of the F1 corn hybrid developed decades earlier in the public sector.[6] (F1 means the first filial generation after crossing two different parental lines). Unlike heirloom varieties, F1 hybrids did not breed true. When their seeds were replanted, the offsprings' characteristics segregated and the desirable traits were expressed weakly or irregularly in subsequent generations. So, regardless of the benefits the current crop offered, saving seeds became pointless.

Corn farmers had to buy hybrid seeds from the seed suppliers every planting season. Obviously they still had the option to go back to traditional varieties, but government technicians promoted the hybrid varieties aggressively and extended highly subsidized credit to farmers who used them. So the use of F1 hybrids among corn farmers grew.

As more farmers abandoned their traditional corn, these varieties became scarce and gradually disappeared. Commercial hybrid corn varieties eventually dominated the seed corn market, like the HYVs did among rice farmers. But with a difference. If seed

[6] Mark Mikel and John Dudley, "Evolution of North American Dent Corn from Public to Proprietary Germplasm," in *Crop Science* 46:1193-1205 (2006). See http://crop.scijournals.org/cgi/content/full/46/3/1193.

buying had been an occasional purchase in the past when seeds produced their own kind, hybrids led to repeat sales season after season, turning seeds into highly profitable commodities.

As the seed business became more profitable, giant agrochemical firms began buying up the seed companies that had established themselves in the market. A similar corporate trend towards F1 hybrids emerged in the vegetable sector and, later, in the rice sector, a trend that continues today.[7] [8] [9]

F1 hybrids mark the beginning of corporate efforts to gain full control over seeds, especially in major staple crops and vegetables. They also represent the first technology in agriculture explicitly meant to end the farmers' age-old practice of saving part of their harvest to use as seed in the next planting season. This counter-productive technology strikes at the very heart of sustainability and the seed commons.

Commercial seed breeders took care that non-hybrid varieties would remain under their control too. Their demand for exclusive rights over varieties they developed eventually gave rise to the 1961 Convention for the Protection of New Varieties of Plants. This convention defined plant breeders' rights, mandated plant variety protection and established an international union, the UPOV, to work for plant breeders' interests. As countries acceded to UPOV agreements, they moved to adopt counter-productive national seed laws that limited the freedom of farmers to exchange seeds or to sell them. Subsequent UPOV agreements (1972, 1978, 1991) became more and more restrictive of farmers' rights.[10]

It was a two-pronged offensive against seed-saving and exchange: the technology of hybrids and new laws and international agreements restricting farmers' options over seeds.

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7 See for instance: Wayne Wenzel, “Syngenta buys Garst” (May 12, 2004) http://farmindustrynews.com/news/Syngenta-buys-Garst/

8 Matthew Dillon, “Monsanto buys Seminis”, Organic Broadcaster (Mar.-Arp. 2005) http://www.newfarm.org/features/2005/0205/seminisbuy/index.shtml

9 Carrey Gillam, “Monsanto to Buy Vegetable Seed Company” (April 1, 2008) http://www.planetark.com/dailynewsstory.cfm/newsid/47728/story.htm

10 See The Crucible Group, *People, Plants and Patents: The Impact of Intellectual Property on Trade, Plant biodiversity, and Rural Society*, (Ottawa: International Development Research Centre, 1994.)

Patenting engineered seeds

In the early 1980s, seed companies learned to directly modify plant genomes through genetic engineering (GE).[11] Then they patented the modified genes, using the patent system – originally meant for industrial inventions and designs – to claim exclusive rights over seeds and plants with the patented genes.[12]

This new weapon in the growing corporate arsenal of counter-productive practices was even more restrictive than plant variety protection: the novelty of the technology itself now justified excluding by law everyone from using patented seeds unless they paid some kind of royalty or technology fee.

The first commercially successful applications were soya and canola plants that incorporated herbicidal resistance and corn plants that incorporated pesticidal toxins. For the first time, seed companies held the power to sue farmers who saved the seeds of these crops and planted them in a subsequent season, simply on the strength of the patents they held over the genes incorporated in these seeds.

GE corn was also a poisoned pill, engineered to produce a modified version of a pesticidal toxin from the soil bacterium Bacillus thuringiensis (Bt). Organic farmers had used Bt for decades to control corn pests, prudently spraying the cultured bacteria only if pest damage reached significant levels. When the Bt gene was inserted into the corn plant, the resulting Bt corn now expressed the toxin throughout the plant's life, making it more likely for Bt resistance to develop rapidly among the target pests and sabotaging a resource that organic farmers – the nemesis of the agrochemical/GE industry – had used for decades.

Terminating a 350-million-year-old cycle of life

Counter-productive technologies now in the pipeline are taking to higher levels the bizarre goal of attacking natural abundance to create artifical scarcity.

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[11] "Top Awards for Scientist Who Developed the First Transgenic Plant", *Pesticide Outlook* June 2002.

[12] See for instance U.S. patents 4900676, 4970168, 5276268, 5312912, 5382429, 5503999, 5498533, 5633434, 5648249, 6043409, 6130368, 6204436, 6495745, 6646184, 6791009, and 7314973

The precursor of these technologies is the "Terminator Technology", which genetically modifies plants to make their seeds sterile, ending the 350-million-year-old process of reproduction through seeds. Truly, it is the "death of birth."[13] U.S. patents have been granted, though commercial application seemed a long way off. The real question is: will farmers use them? The idea was so outrageous that its promoters backtracked for a while, trying to find a spin that would make their idea more publicly palatable.

They soon found one. Engineered seeds led to a seemingly intractable problem: genetic contamination. Engineered soya and canola, which survived despite herbicide applications, were showing up in places where they were neither expected nor wanted – in farms which had used no engineered seeds, especially organic farms where strict safety standards prohibited such seeds. So, on the strength of their patent claims, Monsanto sued. The farmers insisted that they had used no engineered varieties. Yet, some plants in their farm tested positive for Monsanto's patented genes. Many farmers, intimidated by Monsanto's legal and financial muscle, paid the fines and suffered the conseqences such as losing their organic certification. However, in one celebrated case that dragged on for years, Canadian farmer Percy Schmeiser stood his ground and fought the legal battle to the end. The Canadian Supreme Court issued an ambiguous decision which each side interpreted as its victory.[14]

Terminator Technology promoters now say that their technology can prevent genetic contamination from engineered crops, by further modifying these crops to produce sterile seeds.

New ideas in the pipeline fine-tune the concept further to allow finer-grained control of sterility. Known as genetic use restriction technologies (GURTs), these will enable the seed companies to control seed sterility in the field through external triggers like a chemical (presumably patented too). By spraying this chemical on a GURT-modified plant, the plant can be induced to turn its sterility (or fertility) on or off – scarcity and abundance marketed under full corporate control. A similar technology can also be used for turning genetically-engineered traits themselves on or off.

The common thread in these developments is the counter-productive corporate bid

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[13] This term comes from Paul Hawken, *The Ecology of Commerce (A Declaration of Sustainability)*, (New York: HarperCollins, 1993).

[14] E. Anne Clark, "So, Who Really Won the Schmeiser Decision?" *Crop Choice* 13 June 2004, http://www.mindfully.org/GE/2004/Schmeiser-Who-Won13jun04.htm.

to control abundance in agriculture and create artificial scarcity. This opens a market for substitute products and leads to a supply system completely under corporate control through various technological and legal mechanisms.[15]

The use of hybrids and genetic engineering have been justified in the interest of "feeding the world". Yet, a U.S. Department of Agriculture study in 2006 found that 10% of U.S. adults and 17% of children went occasionally hungry for lack of food.[16] If the U.S. cannot even sufficiently feed all its citizens, how can they presume to feed the world?

A virtual cornucopia of software

In the 1980s and early 1990s, many countries enjoyed a virtual cornucopia of software. For a very affordable fee, one could copy from computer shops almost any Apple or IBM PC software that was also available in the U.S. Students, new graduates and enthusiasts bought cheap IBM clones and practiced basic computer operations, word processing, presentation, spreadsheet, database management, and programming. There was no Internet then, but it did not matter – in the Philippines, a 64 kbps connection ushered the Internet in 1994. A *de-facto* software commons was maintained in computer shops and electronic bulletin board systems which made software quickly and efficiently available to students and computer enthusiasts. Many computer professionals today – who now form the backbone of their country's computer industry or who enjoy well-paying jobs abroad as overseas workers – had regularly dipped into this cornucopia and acquired their computing skills thanks to the software abundance of that period.

Back in the U.S., software developers tried various copy-protection schemes, from non-standard disk formats to hardware dongles[17]. But the best minds of the U.S. software industry were no match to the resourcefulness of hackers and altruists who wanted to keep the abundance coming. Some U.S. companies even specialized in software that duplicated copy-protected software. Other software developers abandoned copy-protection to gain competitive advantage, and consumers responded favorably. Eventually, the U.S. software industry gave in and, except for some niche markets, abandoned

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[15] A thorough discussion can be found in Vandana Shiva, *Protect or Plunder: Understanding Intellectual Property Rights*, (London: Zed Books, 2001).

[16] Food Research and Action Center, "Hunger in the U.S.", http://www.frac.org/html/hunger_in_the_us/hunger_index.html

[17] A small device plugged into a computer that enables an application program to run.

technical copy-protection schemes altogether.

Invoking copyright laws did not help much. Though software were legally protected by copyright laws and international agreements, many countries did not take these seriously, preferring to let their citizens enjoy the abundance. People likewise knew that governments enforced laws selectively anyway, whether they were laws on minimum wage, corruption, pollution, taxes, elections, or copyrights. In the 18th and 19th centuries, the U.S. itself was a center of piracy of British books and publications. Subsequent experiences of Japan, Taiwan, Hongkong and other countries/territories likewise showed that copying was a necessary stage in national development. Furthermore, the countries which complained most loudly about piracy of their intellectual property rights were themselves most guilty in pirating intellectuals such as doctors, nurses and engineers from the Third World. The latter was deemed a more malignant case of piracy because it took away the original and left no copy behind. Finally, how can a government clamp down on its citizens when commercial software was likewise freely copied among government computers?[18]

Turning off the tap: enforcing copyrights

Things began to change after the 1994 formation of the World Trade Organization (WTO). This global system adopted effective mechanisms to enforce its highly protectionist provisions on intellectual property rights (IPR). An international legal infrastructure was gradually built which, combined with strong diplomatic pressures and economic threats, started to turn the tide for copyrights holders.

In the Philippines, a turning point occurred in 1998, when Microsoft chairman Bill Gates visited President Fidel Ramos.[19] Gates offered to recognize as legal copies all Microsoft products installed in government computers. In return, Ramos promised to enforce copyright laws, now that government copies were "legal". The U.S. still needed to direct a whole series of economic, political and diplomatic pressures at the administrations that followed Ramos', but the days of software abundance in the

[18] See a fuller discussion of these arguments in Roberto Verzola, *Towards a Political Economy of Information: Studies on the Information Economy* (Quezon City: Constantino Foundation). See also http://rverzola.files.wordpress.com/2008/01/infoeconomy-verzola.pdf.

[19] See Philippine Greens, "Philippine Greens protest the visit of #1 U.S. cyberlord Bill Gates" March 20, 1998, http://www.hartford-hwp.com/archives/29/048.html.

Philippines appeared to be numbered.

CDs/DVDs flood Asia

As copyright enforcement began in earnest, compact discs (CDs), video CDs (VCDs) and digital video discs (DVDs) were introduced in the 1990s and early 2000s. For a while, the industry managed to prevent copying and to restrict the use of DVDs by geographical region. However, this was eventually thwarted by a combination of dedicated hacking, the technical savvy of rising industrial giant China, and plain consumer freedom of choice.

The Philippine case is probably typical: When illegal CD/VCD/DVD discs began to circulate, rumors spread that these discs could damage the disc player itself. The original U.S.-, Europe- or Japan-made players were so expensive that owners would not risk damage from discs of unknown quality. So those who bought original players stuck to expensive original discs and suffered under the ridiculous geographic restrictions (e.g., DVDs sent home by U.S.- or Middle East-based relatives were unreadable, and players they sent or brought home could not play locally-available DVDs.)

Enters China. Cheap DVD players that could play discs from any geographic region and priced at one-fifth or less of their competitors flood the Asian market, including the Philippines. Another rumor – perhaps apocryphal – circulates: that original DVDs may damage these players. Between China-made machines that played cheap unauthorized discs and branded players that played only high-priced discs that were also geographically-challenged, it was a no-contest. With the further entry of low-cost CD/DVD burners, duplicating these read-only discs became trivial.

So Asia remains a flourishing market of China-made DVD players and unauthorized CD/DVDs, creating a new abundance of cultural fare for Asians. Many of the DVDs are adult material or otherwise of doubtful cultural value. But most regular movies are available too, and, increasingly, movie classics and truly educational collections of documentaries from the Discovery, National Geographic, and similar cable channels; software, too. In some countries, the materials are made more accessible to ordinary people through translations into the local language.

To suppress the new abundance, special government police and private detectives

from the U.S. regularly conduct surprise raids not only against the disc vendors and distributors, but also against businesses, schools, computer shops and Internet cafes that use unauthorized software. These highly disruptive raids have driven CD/DVD and software copying underground, where it flourishes unabated thanks to cheap China-made disc burners.[20]

In the U.S., another round of efforts against unauthorized copying was launched under the banner of digital rights management (DRM), consolidating counter-productive technological and legal measures for finer-grained control of copying and access to materials in digital media and on the Internet. DRM includes content encryption, digital signatures, digital fingerprinting, digital watermarks, digital serial numbers built into CPUs and computer mother boards, and miscellaneous authentication systems. They involve such concepts as conditional access systems, remote revocation of use-rights, and other means to ensure that scarcity and abundance remain under tight corporate control. They may be aptly called digital use restriction technologies (DURTs), after their genetic counterparts for controlling seed reproduction, the GURTs.

The U.S. remains ahead in DURTs and GURTs developments, having the most corporate interests to protect, especially in the information sector. The U.S. Digital Millennium Copyrights Act (DMCA) now mandates and protects DURTs themselves, making it illegal to construct devices that bypass or disable these technologies. Citizens' groups in the U.S. like the Electronic Frontier Foundation and Public Knowledge are concerned about the impact of DRM and the DMCA on privacy, political freedoms, and human rights.[21]

The increasing availability of high-quality free/open source software. however, has pulled the rug under the argument that creativity can only be encouraged by granting creators statutory monopolies through IPRs.

In the information and agriculture sectors, the see-saw between abundance and

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[20] For a fuller discussion, see Alan Story, Colin Darch and Debora Halbert (eds.), *The Copy/South Dossier: Issues in the Economics, Politics and Ideology of Copyright in the Global South (*Kent: University of Kent, 2006), http://www.copysouth.org/. See also Pradip Ninan Thomas and Jan Servaes (eds.), *Intellectual Property Rights and Communications in Asia: Conflicting Traditions (*New Delhi: Sage Publications, 2006).

[21] Adam Thierer and Wayne Crews, eds., *Copy Fights: The Future of Intellectual Property in the Information Age*, (Washington D.C.: Cato Institute, 2002).

scarcity, between markets and commons, continues through skirmishes in the technology front, in the legal arena, and of course in the market.

Creating artificial scarcity elsewhere

Counter-productive efforts to control abundance and scarcity have occurred in other fields as well:

- Drug laws make medically-effective herbal preparations inaccessible to many. Ironically, herbs easily grown in backyards and community gardens, whose preparations would be illegal if prescribed by traditional healers, are often the basis for very expensive drugs manufactured by pharmaceutical firms.[22] It is not a coincidence that many of these firms are owned by the same agrochemical companies which control the seed industry.

- Through misleading advertising and collusion with hospitals and medical professionals, formula milk companies have managed to undermine mothers' confidence in their own breast milk. This had led to a decline in breastfeeding in a number of Asian countries.[23] As mothers try substitutes; their production of milk slows down and eventually stops, creating a vast new market for formula milk.

- A traditional Filipino song about plants around the hut ("Bahay Kubo"[24]), taught to every child in grade school, enumerates 18 food plants that include legumes, greens, root crops, seeds, nuts, and spices. The song omits many more. Filipinos have become so fixated on Western foods and diets that they overlook the great variety of indigenous food sources, many of which simply grow untended like weeds in their backyards. The monoculture mindset treats these food sources as weeds that must be suppressed. Razed by farm mechanization and the use of herbicides, most of them have now disappeared from people's backyards, from their diets, and from their consciousness, creating real food scarcity and malnutrition.

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[22] See for instance Tiahan Xue, "Exploring Chinese Herbal Medicine Can Foster Discovery Of Better Drugs", *The Scientist 10(4):9*, February 19, 1996.

[23] Simon Montlake, "Milk Formula Goes on Trial in Asia", Christian Science Monitor, June 22, 2007. http://www.csmonitor.com/2007/0622/p05s01-woap.html

[24] For an English version, see http://rverzola.wordpress.com/2007/12/27/bahay-kubo-english-translation/.

- Organic products are scarce and expensive because a system biased towards chemicals imposes on organic producers the burden of proof: detailed record-keeping, testing, inspection, certification and labelling. What if producers of chemically-treated crops and foods, not organic producers, were instead required by law, in accordance with the "polluter pays" principle, to keep-detailed records of chemical treatments; get their products regularly inspected and tested by accredited laboratories for minimum residue levels; undergo third-party certification; and follow mandatory labelling requirements to identify which chemicals and by what amounts their food products have been exposed to? If this were so, the price tags of both organic and chemically-treated foods would change dramatically in favor of organics.

- A low-power radio station that can serve a large community or a small town now costs only about as much as laptop. Yet, such stations continue to be a rarity, because most governments make it nearly impossible to meet all the legal requirements to operate one. As communications expert and president of the World Association of Community Radio Broadcasters Steve Buckley writes, "it is the policy, legal and regulatory framework that remains the single most persistent obstacle" to such stations.[25]

- Internet service providers (ISPs) continue to charge exhorbitant rates for static Internet Protocol (IP) numbers, arguing that they are running out of these numbers. Yet, by simply upgrading to IP Version 6 (IPV6), every person on Earth can be assigned hundreds of IP numbers each, with a lot more to spare.

- The sun cannot be hidden, suppressed, illegalized or otherwise made scarce. Instead, this universal source of absolute abundance has been largely ignored -- intentionally, it has been argued[26] -- as energy industries focused on energy sources easier to privatize and to control, like fossil and nuclear fuels.

These examples suggest that the phenomenon of abundance in the natural world and in human societies should not be taken for granted. We need to study it, learn its

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[25] Steve Buckley, "Community Radio and Empowerment", May 1, 2006. http://portal.unesco.org/ci/en/files/22022/11472542151Steve_Buckley.doc/Steve%2BBuckley.doc

[26] See Ray Reece, The Sun Betrayed (Boston: Southend Press, 1979). See also Daniel Berman and John O'Connor, "Who Owns the Sun?" (White River Junction, VT: Chelsea Green Publishing, 1997).

dynamics, and tap it for the human good.

Abundance in the agriculture and information sectors

Creating abundance is a matter of reproducing a good over and over again, until more than enough is available for everyone's need or even for everyone's capacity to consume.

In nature, the tendency towards bountiful abundance is obvious, especially where seasonal variations highlight the contrast between abundance and scarcity. Prehistoric artefacts of fertility goddesses as well as harvest festivals and rituals still practiced today show the extent abundance has been recognized and sought.

Abundance is inherent in the reproductive processes of life. Natural abundance is simply Life reasserting itself through the endless cycle of reproduction by every life form of their own kind. This is the engine of abundance in nature and in agriculture. The process is self-limiting too. As every available ecological niche is filled up, species gradually form a food web and settle into a dynamic balance, with closed material cycles ensuring that the balance is maintained. This enables the processes of abundance to continue indefinitely.

Sharing information does not diminish or deplete but rather multiplies and enriches it. Shared information begets more information. The engine of information abundance is the inherent human desire to communicate, to seek information and knowledge, and to share them, an urge that gets more fully expressed as the cost of sharing goes down.[27] The cost of reproducing electronic signals is now approaching zero. With digital technology, books, artworks, music and video can now be stored in the same format as software and databases: as a long string of binary values. From these ones and zeroes, with the right equipment and algorithm, an exact copy of the digital original or a faithful copy of the analog original, can be reconstructed. Once stored digitally and made available in easily searchable form on a global network, an unlimited number of users may now get any number of exact copies of the work. Who cannot recognize the

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[27] For a full discussion, see James Boyle, *Shamans, Software and Spleens: Law and the Construction of the Information Society*, (Cambridge, Massachusetts: Harvard University Press, 1996.

abundance of human knowledge, experience and creative work made possible by the Internet? As more and more people discover its possibilities for sharing freely, the whole range of human skills, thought and feeling is now being made available through this medium.

From an information perspective, abundance in nature and in agriculture is, in a way, driven by the inherent program within genetic information to reproduce itself. This abundance, however, must eventually express itself in terms of biomass and is therefore constrained by material limits. Information abundance, on the other hand, is of the non-material variety. Thus information goods offer the promise of practically unlimited abundance, constrained mainly by the limits of human creativity, the storage capacity of media, and the availability of electricity to power servers on the Internet twenty-four hours a day.

Using technology and law to restrict abundance and create artificial scarcity

It is clear from the preceding examples that technology and law, separately or in various combinations, are being intentionally used counter-productively by businesses and governments to undermine abundance and create artificial scarcity. These counter-productive approaches may be summarized as follows:

The technological approach. A good example are the copy-protection measures taken by software developers to make it difficult for users to copy disks and similar media. These technological approaches include not only copy-protection but also copy-restriction, copy-identification, and user-restriction. An example in agriculture is the Terminator Technology. This approach is often combined with a legal approach.

Incentives and disincentives. Another approach similarly uses digital/genetic use restriction technologies (DURTs/GURTs) to prevent copying and reproduction, but goes further. These technologies are also actively promoted by the government through incentives while low-cost credit, subsidies and other forms of support are withdrawn from competing technologies. This is the case in the promotion of HYVs, hybrids and engineered seeds at the expense of traditional and heirloom varieties, and the replacement of work animals with mechanized equipment.

Technology protection. Still another combination approach uses laws to protect technological copy-protection from being bypassed or to mandate its use. The former is the case with DRM technologies, which U.S. law now protects from being bypassed or disabled.

The purely legal approach. Outright bans illustrate a purely legalistic approach. The enforcement of patents, copyrights and plant variety protection bans simple copying, seed sales and seed exchange. Other bans: uncertified seeds; low-power broadcasting; unlicensed practitioners of healing. Bans may not be so benign: in the Middle Ages, women healers were burned at the stake.

The poisoned pill. The most devastating approach of all has been the poisoned pill strategy of introducing an anti-abundance technology that appears to deliver a good or service but in fact destroys a resource that it intends to replace. For example: agrochemical industry destroyed the natural fertility of the soil and devastated populations of natural pest control organisms; the genetic engineering industry is undermining organic farming through genetic contamination; engineered corn is hastening Bt resistance that will make the natural Bt biopesticide useless; formula milk slows down and eventually stops the mothers' production of breast milk for their babies.

Ignore or suppress. If it cannot be controlled like the sun, then the abundant resource and related knowhow are simply ignored or suppressed as much as possible.

Who wants abundance restricted and why

The driving forces behind abundance in the agriculture and information sectors have been identified. In agriculture, it is the inherent urge in every life form to reproduce its own kind, fuelled by the practically limitless energy from the sun. In the information sector, it is the inherent urge in every human being to communicate with others, share knowledge and information with them, and produce knowledge together, given full expression by the near-zero cost of sharing made possible with digital electronic technology.

Abundance helps to meet human needs and wants and should therefore be welcomed. What is the driving force behind anti-abundance?

The answer should be clear by now. Attacks against abundance have been mostly initiated by business firms or by governments. Where governments undertook these measures, they have done so at the instance of some business firms, which in the final analysis reaped the benefits of the government measures.

Looking more closely at the logic of business firms, it is obvious that the immediate effect of restricting abundance is to reduce supply and increase overall demand. These in turn raise prices or keep their levels high. If the costs of production change little or not at all and prices go up, then profits go up. This is the logic behind corporate efforts to develop technologies and influence State policies that give them closer control over the abundance and scarcity of goods: to create the best conditions for maximizing profits. Indeed, they may maximize profits, but may not necessarily be the best way to encourage creativity. Free/open source software and farmer-bred varieties show that creativity can continue to flourish even without the attraction of monopoly earnings.

Shouldn't this selfish end give way to higher societal goals? The economist's answer is that society's higher goals are indeed served when everyone pursues their own self-interest in free competition with others. In fact, economists argue, the competitive pursuit of individual gain accomplishes overall social goals *better* – even if this "was no part of his intention" -- than when individuals consciously try to advance society's higher goals. This idea that individual pursuit of self-interest not only leads to but is actually the *best* path towards overall social good became the moral basis for capitalist society. This was then programmed into business firms as an "urge" to maximize gain, and they do so by controlling abundance and scarcity in their favor. This is the driving force behind anti-abundance.

Because human beings were a complex bundle of urges, emotions and motivations who often acted irrationally (i.e., regardless of self-interest) from an economist's perpective, corporations became the ideal economic agents, pursuing nothing but maximum gain for themselves based on the economic theory of *laissez faire* capitalism.[28] They are therefore driven to undermine abundance and create artificial scarcity as an unintended but logical consequence of their internal programming, creating a modern class of rentiers who accumulate wealth by charging fees for access to the resources they

[28] See David Korten, *When Corporations Rule the World (*West Hartford: Kumarian Press, 1996).

control.[29]

Constructing a theory of abundance

Economics has always assumed a condition of scarcity and defined its role as the efficient allocation of scarce resources relative to unlimited human wants. Nowhere does abundance figure in the definition or goals of economics.

Practically all economic textbooks are premised on scarcity. Check their index: "scarcity" would be found in the early pages – the first chapter, probably; "abundance" would be missing, creating a blind spot among economists. Samuelson and Nordhaus write in page 2 of their textbook: "At the core, [economics] is devoted to understanding how society allocates its scarce resources. Along the way to studying the implications of scarcity, economics tries to figure out the 1001 puzzles of everyday life."[30] Some books might refer to "overproduction", suggesting an anomaly to be avoided or corrected. Misunderstanding abundance as overproduction logically leads to counter-productive measures restricting abundance, a misapplication of concepts developed under assumptions of scarcity.

Yet, once we open our minds, we should see abundance all around us. Solar energy has been with us from the beginning. So have clean air and water, plants and animals, soil life, forests, and the astounding variety of life on Earth, now threatened. Since the Internet emerged, we have also seen an extraordinary abundance of information and knowledge and no lack of people willing to share them freely. Just look at the Web, Yahoo!, Google, Wikipedia, YouTube and all the lesser known but incredibly useful efforts to make information and knowledge freely available on the Internet. New technologies promise even more abundance: in bandwidth through fiber optics, in air time through spread spectrum technology, and in storage through new media.

Clearly, abundance is as much a feature of the real world as scarcity. To understand this blind spot of economics and harness it fully for the human good, we need

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[29] How this happens in the information economy is discussed in Peter Drahos and John Braithwaite, *Information Feudalism: Who Owns the Knowledge Economy?* New York: The New Press, 2002.) See also Verzola, "Cyberlords: rentier class of the information sector" in Towards a Political Economy, p. 145-161.

[30] Paul Samuelson and William Nordhaus, *Economics 14th ed.* (New York: McGraw Hill, Inc., 1992), p.2.

to construct theories of abundance to complement the theories of scarcity that dominate economics today. In fact, economists who talk of "relative scarcity" only need a minor leap of logic to recognize "relative abundance". After all, a glass that is half-empty is also half-full.

Consider the variations in abundance. It can be precarious (collapse imminent), temporary (lasting less than a lifetime), short-term (a few lifetimes), medium-term (many lifetimes) or long-term (longer than human existence). It can be relative (enjoyed by a limited number), local (confined to a specific area) or absolute (accessible to all). The abundance of solar energy and other energy forms associated with it, such as hydro, wind and wave energy, is obviously long-term. Solar energy is universal, while hydro, wind and wave energy are more local. Coal's abundance is medium-term, if the estimates are correct that the world's reserves may last for several hundred years more (i.e., many human generations). Oil, which is perhaps good for another generation or two at current extraction rates, is short-term. In addition, fossil fuel abundance is relative because it is not accessible to all, but only to large firms with enough financial, technical and human resources. While absolute, universal abundance can have free/open access, others may need some form of management. Local resources may need to restrict or even exclude outsiders. Extraction rates may need to be regulated. Moratoriums may even have to be imposed on threatened resources.

The ultimate goal of any management regime should be to ensure against any failure of abundance. The following specific goals are suggested:

1. **Make the resource accessible to a greater number of people – ideally, to all**. This is merely a restatement of the goal of social justice. Potable water, for instance, is so important to human survival that this goal should be paramount for this resource, abundant or not. For water – and for land, as well – Gandhi's observation rings true: "There is enough in the world for everyone's need, but not for everyone's greed." These resources can become abundant for all or scarce for many, depending on how they are managed. In a country like the Philippines, land seems scarce to the millions who do not own a home lot because the ownership structure allows a few to own thousands of hectares of land. Agrarian reform is, in effect, an effort to keep land abundant for every rural household that is willing to farm land. Some have also argued that family-size farms can be as productive and efficient, if not more, than huge, corporate-held tracts.[31]

[31] Peter Rosset, *Multiple Functions and Benefits of Small Farm Agriculture*. Food First/The Institute for Food and Development Policy. September 1999. For a comprehensive discussion of the sustainable

2. **Make sure the resource will last for generations, preferably indefinitely.** This means turning limited, temporary or short-term abundance into long-term abundance. This is also a restatement of the goal of sustainability. Rain forests, for instance, have been providing countless generations of indigenous tribes everything they needed for survival. At current rates of depletion, however, our generation has turned rain forests into a short-term or temporary resource that will be gone in a few generations, if not within our generation. Economists should be familiar with the difference between income and capital, natural resource stocks and flows. In the rain forest case, ensuring long-term abundance means limiting the consumption of forest products to the natural income we get out of the forest, and refraining from eating into the capital stock. Strategies for managing non-renewable resources, or information resources, would of course be different.

3. **Build a cascade of abundance.** Abundance in one sector (or of one good) can help create abundance in another sector (or of another good). The food chain is a good example of abundance at one level (solar energy) supporting abundance at the next level (plants) which supports abundance at a higher level (herbivores), etc. By building linkages among farm components, permaculture[32] teaches how one type of abundance can be made to support another through conscious design. A similar cascade occurs on the Internet, which supports the Web, which in turn supports search engines and new applications like wikis and blogs, one abundance building on another. The sun is a flexible energy source that can provide, through collectors and concentrators, a wide range of temperatures to match various end-uses. By tapping it more, industry can harness potentially huge amounts of energy for various productive activities, opening up possibilities for creating abundance in many other sectors. Photovoltaic (PV) cells made from silica, also an abundant resource, can transform sunlight into cheap electricity for industrial, commercial and home use. This can make viable the electrolytic extraction from water, another abundant resource, of hydrogen and oxygen. These can be stored and later used in fuel cells, holding the promise of a pollution-free hydrogen-based economy.

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agriculture approach for small farms, see P.G. Fernandez, A.L. Aquino, LE.P. de Guzman and M.F.O. Mercado (eds.), *Local Seed Systems for Genetic Conservation and Sustainable Agriculture Handbook* (Los Banos, Laguna: University of the Philippines College of Agriculture, 2002).

[32] Permaculture (permanent agriculture) is a system of designing farms that minimizes non-renewable energy requirements, ensures the continuous cycling of biomass, fills as many ecological niches as possible with food and cash crops, and provides for a wilderness area within the farm. See Bill Mollison, *Permaculture: A Designer's Manual* (Hyderabad: The Deccan Development Society, 1990).

Most computer equipment, which are silicon-based like PV cells, have either been halving in price or doubling in capacity every few years or so. LCD projectors now sell for a fifth of their price ten years ago. If PV prices follow suit, perhaps due again to China's entry, we can look forward to a cascade of solar-based abundance in the future.

Eventually we should be able to recognize conditions that lead to abundance and then learn how to create more abundance. We alrady have a rough idea how abundance happens in nature, in agriculture and in the information sector. We simply need to nurture the forces that generate such abundance. One challenge is how to emulate ecological processes such as the cyclic loops of nature to create a similar material abundance in the industrial sector, without disrupting natural cycles

4. **Develop an ethic that nurtures abundance**. To manage abundance well, its community of beneficiaries must adopt a behavioral ruleset and the corresponding enforcement mechanisms. It is desirable to eventually turn this ruleset into a mindset, similar to Leopold's land ethic[33] and Postel's water ethic[34], that makes the other goals of social justice, sustainability, cascading abundance, and dynamic balance second nature to all.

5. **Attain dynamic balance**. In a finite world, material abundance cannot grow indefinitely. Nature shows us how abundance can occur indefinitely through a dynamic balance (i.e., harmony) of abundant elements connected in closed material cycles. Citing permaculture again as example, a similar balance can be attained in a farm by modelling it after long-lived self-regenerating ecological systems to design what are, in effect, forests or ponds of food and cash crops. After we learn to design similar closed loops in industry, we can bring this sector back into harmony with the rest of the living world.

At least four major sources of imbalance threaten our world today:

1. ***The current reliance on a non-renewable energy base***. Although the size of the world's fossil fuel stock may be debatable, its rate of exploitation will sooner or later

[33] Briefly, “A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.” See also Aldo Leopold, *A Sand County Almanac*. New York: Ballantine Books, 1966).

[34] An ethic to “make the protection of water ecosystems a central goal in all that we do.” See Sandra Postel, *Last Oasis: Facing Water Scarcity* (New York: W.W. Norton, 1997).

surely fail to keep up with rising demand, causing major economic disruptions.

2. ***The linear production processes of the industrial sector***. The industrial sector uses raw materials from nature and agriculture and turns them into finished products. Whether these goods are durable, reusable or disposable, they are eventually thrown away as waste. Unlike the closed cycles of nature, this is a linear process that consumes biomass, dead matter and energy at the input end and produces synthetic, often non-biodegradable and even toxic goods and wastes at the output end. This one-way transformation constantly disrupts the dynamic balance and closed loops of the natural world. Eventually, the finished goods reach the end of their useful life – quickly, if they are disposable or one-time use goods – and become wastes too. If these wastes enter the body of any living organism, including humans, they can seriously disrupt its health. In effect, fuelled by an ideology of accumulation – industry is turning the natural world into a synthetic – and ultimately, unliveable – one. The solution, as Barry Commoner proposed[35], is to turn linear industrial processes into closed material loops and recycle all industrial wastes as well as goods that have reached the end of their useful life back into the production process.

3. ***The unchecked growth of human population***. For every biological form on Earth except the human, at least one more life form exists – feeder, predator or parasite – that limits the former's population and keeps it in balance with the rest of the living world. This food chain creates an energy pyramid that is wide at its base, where plants directly tap solar energy, and becomes narrower towards the top, as we go from herbivores and to predators. There is one exception. the human population at the apex of this biological food chain has grown disproportionately larger than the rest of the pyramid, appropriating for itself much of the Earth's livable habitat as well as production of energy and biomass. With no natural enemies to effectively limit our population, we have to discover other means to do so. (Perhaps the global drop in sperm counts is nature's own response?) Because it involves the fundamental biological urge to reproduce one's kind, the issues are complex and the debates rage on. But solutions we must find.

4. ***The unlimited corporate drive for profit***. The business firm is programmed to maximize its return on investment, no more, no less. This simplistic programming as a profit-seeker driven purely by self-interest has made it better adapted than the human to the world of markets, competition and capital accumulation which economists have

[35] Barry Commoner, *The Closing Circle: Nature, Man and Technology* (New York: Bantam Books, 1971). See also Barry Commoner, *Making Peace with the Planet.* (New York: Pantheon Books, 1990).

defined the world to be. Being better adapted, corporations have become the dominant economic player in our world. Because, under our legal systems, corporations are legal persons distinct from their board of directors and shareholders, corporations have now acquired a life of their own. They can feed themselves, regenerate, reproduce, make plans in pursuit of their internal urge, and hire people to execute these plans. Using their superior economic power, they have also acquired political power and taken over media and education. They have become so well-entrenched and their accumulated economic, political and cultural powers so extensive that if they were counted as a distinct man-made species, they would now be considered the dominant species on this planet, having managed to domesticate the great *Homo sapiens* itself. As corporations relentlessly pursue their internal programming, seeking profits without limit, they are causing huge global imbalances that threaten the survival not only of human societies but of many other species as well. Displacing these runaway automatons from their dominant status and reprogramming them with more benign goals (Asimov's laws of robotics[36], for instance) has become the greatest challenge of our era.

Reliability and the precautionary principle

Corporations maximize their gain (i.e., profits) through efficiency and scale. Another concept, however, could be more important than efficiency. This is the concept of reliability, the quality of "being available when needed", of "lasting for a long time". This common concept may further clarify how the two goals of social justice and sustainability can be met.

When abundance fails and becomes unavailable to some sectors of society, or to subsequent generations, this failure is a loss of reliability. Reliability is measured in terms of "mean time before failure" (or "mean time between failures"). Improving reliability means reducing the risk of failure. A more familiar formulation is the "precautionary principle".

To prevent abundance from turning into scarcity, maximizing gain (efficiency)

[36] Asimov's Three Laws of Robotics: 1) A robot may not injure a human being or, through inaction, allow a human being to come to harm; 2) A robot must obey orders given to it by human beings, except where such orders would conflict with the First Law; 3) A robot must protect its own existence as long as such protection does not conflict with the First or Second Law. Programming corporations with these robotic laws would have made them easier to control.

should give way to minimizing risks (reliability) from threats to the sources of abundance. This suggests a "risk-averse" strategy, which precisely is a strategy common among ancient tribes and traditional societies. Perhaps, they instinctively recognized that their goal was to preserve the natural abundance which sustained them and to minimize any risk that may cause such abundance to end.[37]

Under conditions of abundance, the ideal economic agent is not the gain-maximizer competing for self-interest and incidentally making markets efficient, but the risk-minimizer cooperating with others to intentionally make their common resources more reliable.

Often, a resource that a community considers optimally used because the risk of failure has been minimized will appear under-utilized to a corporation because gain is not being maximized. This is probably the cause of resource conflicts in many areas, especially where corporations intrude into community resources.

To get optimum yield, gain-maximizers keep increasing production towards the "carrying capacity" of the resource. However, imperfect knowledge, uncertainties and lags inherent in natural systems can lead to oscillatory behavior and overshoots. Exceeding carrying capacity, even temporarily, can trigger a major mindset shift that can lead to a race that ends up in a breakdown of the commons.

Guided by the precautionary principle, risk-minimizers focus not on carrying capacity but on the impact of extraction on the resource. Individuals evaluate the negative impact as risk to their perpetual source of abundance – risk being the probability of failure times the present value of their income stream that would be lost – and weigh this against their own need. This self-regulating mechanism, where individuals limit their gain as they minimize the risk of losing a perpetual source of abundance, can keep the system in equilibrium. Even pure self-interest should drive them to cooperate with others to make sure the rate of extraction stayed well below the carrying capacity, which represents a near-100% risk of failure. Should dire need push one to extract beyond acceptable risk, he will have to contend with the wrath of others whose perpetual income stream he is putting at risk. Or perhaps they will cooperatively chip in to help meet a member's dire need, given their common interest to protect the resource that gives each of them a perpetual income stream.

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[37] For a fuller discussion, see Verzola, *Towards a Political...*, p. 170-190.

Abundance creates commons

If we review history, and perhaps prehistory as well, we would see that abundance has often led to the creation of commons. In communities that respond to abundance by treating it as a common pool resource, community members tend to act cooperatively to manage the commons so that the goals of social justice and sustainability are met and the risk of failure in abundance is minimized.

Commons management involves not only economic rules but also cultural and political factors such as conscious community decisions, appeals to the common good, and the values of sharing, cooperation, altruism and community spirit. It often relies not only on prices but also on restrictions, prohibitions and taboos. Ancient tribes and other traditional societies have evolved complex social norms of behavior and hierarchies of communal use and access rights that have served them well in managing abundance and the commons for many generations. Similar norms have likewise evolved among successful modern commons such as free/open source software and the Wikipedia.

Their institutions and methods for governing the commons have proved even more useful for threatened resources as well as resources that have actually become scarce, by helping meet goals of social justice and sustainability. In a number of instances, fishing grounds and forest reserves have been nursed back to abundance, thanks to the proper management of these commons.

A modern political economy of abundance and scarcity

Thus, a rich heritage of theory and practice in managing abundance and coping with scarcity exists and may be found in the literature of the commons. This heritage was overlooked by many for several decades after Hardin observed in 1968 that a "tragedy of the commons" ensued when rational gain-maximizers exploited the commons in pure pursuit of self-interest.[38] This has led governments to take over these commons as State property or turn them over to corporate interests through privatization, oftentimes creating worse tragedies. What can be worse than the tragedy which befell Russia, when the common wealth of its people – literally the product of their sweat, tears and blood –

[38] Garrett Hardin, "The Tragedy of the Commons". *Science 162 (*1968).

became private property overnight of Party bureaucrats-turned-capitalists? Subsequent studies have since shown that Hardin's "tragedy" was by no means universal, and that successful practices in managing the commons continue to serve many communities today.[39]

Hardin's analysis of his herders and pasture example was also too simplistic. Hardin argued that a rational herder would gain for himself +1 unit per additional head, and split with other herders the -1 unit damage to the pasture. He concluded that the positive net gain will drive every herder to keep adding heads to the pasture until the commons collapses. Hardin's risk-blind herder does not take into account the risk to his own perpetual income stream created by each additional head he puts to pasture. A risk-wise herder, weighing the gain from each additional head against the increasing risk of losing his perpetual income stream, will stop adding heads before the probability of losing that income stream reaches 100%, which occurs as carrying capacity is exceeded.

Every herder should get a clear signal as the risk increases, because he will be getting less gain per unit effort as the pasture deteriorates. Here is a potentially self-regulating system that requires no unrealistic assumptions like perfect knowledge or perfect competition.

A foolhardy herder who needs the +1 gain badly enough may still risk not only his own but also everyone else's perpetual income stream. Since each one could, one day, face a similar situation of urgent need, they may eventually realize that it would be better for each herder to contribute a small amount to raise the +1. This suggests, as a long-term solution, a system of insurance or social security, a type of commons that reduces individual risk by pooling resources.

Conclusion

The following table shows how a focus on abundance creates a mindset that is orthogonal to one that focuses on scarcity:

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[39] Elinor Ostrom, Thomas Dietz, Nives Dolšak, Paul Stern, Susan Stonich and Elke Weber (eds.), *The Drama of the Commons* (Washington, DC: National Academy Press, 2002). See also Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge: Cambridge University, 1990).

Abundance	Scarcity
Commons	**Markets**
Community	**Corporation**
Common good	**Self-interest**
Cooperation	**Competition**
Culture	**Commerce**
Balance	**Growth**
Stewardship	**Exploitation**
Minimizing risk	**Maximizing gain**
Reliability	**Efficiency**

The three major sectors of the economy – the agriculture, industrial and information sectors – present us with a complex mix of markets and commons of scarce and abundant goods. We need to tap into the vast pool of historical as well as current insight, knowledge and experience to develop a modern theory of political economy that can cope with both abundance and scarcity.

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