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Surprising Commons

*Carol M. Rose**

Let me begin this article on “surprising commons” with a few words about another article that I wrote some years ago, in the mid-1980s. It was called *The Comedy of the Commons*, and in it, I tried to figure out a peculiar and very long-standing legal pattern in which some kinds of terrain systematically resist privatization and instead remain in a state of more or less open access.¹ It is not a large category, but what makes this kind of territory interesting is that it has a legal land use profile that is quite different from the ordinary pattern for land. Land normally can become private property and indeed is generally expected to turn into private property, with some exceptions for property owned by governmental entities—and even the latter category is unlikely to be held in a condition of complete open access.

I suspect that *The Comedy of the Commons* is the reason that I am here today, as a figure something like “The Old Lady of the Commons.” The article did create a minor flurry at the time it came out, though certainly not as much as I would have liked. Of course, academics always would like more fuss about their work than the work actually gets, but with this one in particular, I had hoped for more attention in what was then a voluminous literature about the “public trust” in natural resources. I thought to myself for a while that I should have put the words “public trust” in the title, but then I more or less forgot about the whole thing and went on to other petty grievances about later articles that in my opinion were dreadfully under-cited.

But then, to my amazement, *The Comedy of the Commons* turned out to have a second life fifteen or twenty years later, thanks to some

* Ashby Lohse Professor of Water and Natural Resource Law, University of Arizona Rogers College of Law, and Gordon Bradford Tweedy Professor of Law and Organization (emer.), Yale Law School. I would like to thank the organizers of this symposium for all the work they have done to get us all here and talking to one another, particularly Brigham Daniels, who did so much to bring us all here, as well as Nicole Sofe, who has made all the logistics so smooth.

1. Carol Rose, *The Comedy of the Commons: Custom, Commerce, and Inherently Public Property*, 53 U. CHI. L. REV. 711 (1986).

unknown person who told Larry Lessig to have a look at it. Larry Lessig and Yochai Benkler are among our main gurus of the idea of an open Internet, and the two of them, to my great delight, thought that my *Comedy* was just the ponderous citation they needed to show what is positive and helpful about open access.² Thanks to them, I have gotten a second chance to dine out on that old article, as a friend of mine puts it; and indeed, the dining is even better in the second round.³

And so, what happened to *The Comedy of the Commons* was definitely a pleasant surprise. But that is not actually the surprise that I want to talk about now. What I want to talk about is the more general phenomenon of surprises in real resources that are called “commons” or “commonses.” Hence the title, *Surprising Commons*: the commons can surprise you.

In one sense, one thing that should be a surprise is the fact that we have a phrase like “the commons” at all. For this we have to thank Garrett Hardin, whose famous essay tacked the fateful word “tragedy” onto the commons.⁴ For all the problems in Hardin’s essay, it did usher in an importantly catchy phrase, and it induced many other scholars to think systematically about what happens to resources that are open to all. But Garrett Hardin’s famous *Tragedy of the Commons* did not treat the fate of the commons as at all surprising and neither did other natural resource economists whose work preceded Hardin’s. Before Hardin’s famous essay, Scott Gordon had written an analysis that was quite similar, although more technical, with a dreadful name: *The Economic Theory of a Common-Property Resource: The Fishery*.⁵ You can guess why Hardin, rather than Gordon, became the iconic figure in this line of thinking. But Gordon was like Hardin in thinking that the decimation of open-access resources was to be expected. For both, the whole point was to analyze the reasons why commons tragedies are the way things

2. Yochai Benkler, *Sharing Nicely: On Sharable Goods and the Emergence of Sharing as a Modality of Economic Production*, 114 YALE L.J. 273, 296 n.77 (2004); Lawrence Lessig, *Recrafting a Public Domain*, 18 YALE J.L. & HUMAN. 56, 64 (2006).

3. The latest gratifying citation arrived with JEREMY RIFKIN, *THE ZERO MARGINAL COST SOCIETY: THE INTERNET OF THINGS, THE COLLABORATIVE COMMONS, AND THE ECLIPSE OF CAPITALISM* 157–58 (2014) (making much of this old article).

4. Garrett Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243 (1968).

5. H. Scott Gordon, *The Economic Theory of a Common-Property Resource: The Fishery*, 62 J. POL. ECON. 124 (1954).

are, at least in the absence of consciously chosen constraints, rather than to question whether the commons might come out some other way.

Why did these scholars see commons tragedies as simply the nature of things? One way to look at this is simply as a description. Look around and you will see that people overuse things that are freely available or they free ride on the work of others when it is possible. As a result, at least with respect to physical resources, we decimate grasslands, we overfish open fisheries, we chop down forests, and we pour junk into the air and the water. That is Hardin's description, and it is at least recognizable. With respect to intellectual resources, there is nothing physical to destroy, but we take a free ride on the ideas and efforts of others, and in so doing we undermine creativity by making it harder for originators to capitalize on their own creativity.

The more interesting way to look at these issues is not simply descriptive, but analytic. Commons issues can be analyzed as collective action problems, which themselves are multi-person versions of the "prisoners' dilemma" (PD)⁶—a scenario in which the best collective payoff occurs if the actors cooperate, but in which the actors' individual motivations drive against cooperation. While people do in fact reach cooperative solutions, a point to which I will return later, those solutions ultimately depend on moments of generosity or trust that are out of line with conventional rational actors' behavior—what Jon Elster has called a "magical" belief that others will reciprocate one's cooperative actions.⁷ But there is no reason to expect that magic to occur, either in PDs or in the multi-person commons.

According to these theorists of the commons, then, there is logic behind our rationale of selfish behavior, even if it is ultimately ruinous to the common resource. We behave as we do not because we are evil, but because we have every reason to believe that others behave in this way. Our own behavior is not even simply a matter of playing copycat; it rather derives from a realistic reckoning of the situation, a kind of rational response. If we go lightly and conserve

6. For a discussion of the dominance of the prisoners' dilemma among game theory stories, see Carol Rose, *Game Stories*, 22 *YALE J.L. & HUMAN.* 369, 382–91 (2010).

7. JON ELSTER, *THE CEMENT OF SOCIETY: A STUDY OF SOCIAL ORDER* 5, 195–201 (1989).

resources, will those resources be saved? Will we have teeming fisheries, intact forests, clean air and water? No. All that will happen is that we fall behind those who are *not* conserving resources; they will take what we have not taken, and our abstemiousness will just hurt us and do nothing for the resources that others squander in our stead. The tragic part of the tragedy of the commons is that even people who would like to do better do not think they can change things.

In short, according to this well-known and lugubrious caricature, commons tragedies are built into the nature of collective action. They should not be a surprise to anyone.

But in fact, commons tragedies *are* a surprise. We have one example after another of how astonished people are by commons problems, including commons problems that degrade physical resources, which one would think we would notice. We are surprised, first, that we have a commons problem at all, and second, that the problem has something to do with open access to resources.

Let me give some examples. In 1883, sportsmen from the eastern United States got themselves outfitted and came out on the new railroads to the western plains, hoping to repeat the grand bison slaughter of the previous years.⁸ After all, they had seen or heard about the bison herds—unimaginably large, an inexhaustible tide of animals. And what did the hunters find? An empty, silent plain. We all know what had happened: the bison had been hunted practically to extinction. The great herds were gone. The newly outfitted hunters had not even realized that there could be a problem about bison because there had been so many.

Fifty-plus years later, in the early 1940s, citizens of Los Angeles found that their valley was filled with an acrid, fummy smog. They thought it must be coming from a wartime synthetic-rubber plant, which they proceeded to shut down.⁹ Then they were surprised to find that, no, it was not the synthetic-rubber plant after all, because nothing changed. The cause was their own cars and trucks. What? Impossible! It cannot be us, with our little-bitty cars and trucks. But it was. They knew they had a problem, but they did not realize that

8. JAMES A. TOBER, WHO OWNS THE WILDLIFE? THE POLITICAL ECONOMY OF CONSERVATION IN NINETEENTH CENTURY AMERICA 100–102 (1981).

9. JAMES E. KRIER & EDMUND URSIN, POLLUTION AND POLICY: A CASE ESSAY ON CALIFORNIA AND FEDERAL EXPERIENCE WITH MOTOR VEHICLE AIR POLLUTION, 1940–1975, 52–54 (1977).

it was a commons problem.

Forty years later, from about 1980 onward, just about everything about climate change has been a surprise. The hole in the ozone layer was the first major atmospheric event that people noticed widely, thanks to satellite observations.¹⁰ Oh my goodness, there is a hole in the ozone layer, and we are all going to fry! Or at least, we are all going to have an elevated risk of skin cancer. As one of my friends said, he was raised to think that the atomic bomb would destroy the earth, but it turns out that the culprit will be aerosol underarm deodorant. Who knew?

A little later, it was, oh my goodness, the polar ice caps are melting.¹¹ Who knew? Now the culprit turns out to be our own coal-fired electricity plants and our own trucks and autos, along with everything else that produces carbon dioxide and other greenhouse gases—and that is a lot of things. And more recently, here is one of the latest surprises: jellyfish are taking over the oceans.¹² There are so many jellyfish that one Japanese fishing vessel capsized when trying to pull up a net that the fishers thought was full of fish. It was not. It was full of jellies, and they were far too heavy for the boat to manage. Unlike other fish, jellies can live in severely de-oxygenated water, so they do not mind pollution, and they don't mind it if the other fish have died off and are not around to eat their larvae either. And speaking of jellies' larvae, those little things just love to breed on the hard plastic surfaces of junk that sticks in the craw of other fish and tangles up waterfowl and drowns them.¹³ Not that the jellies need the plastic in order to breed—they apparently can breed in profusion just about anywhere. They do breed just about everywhere, too, because they get sucked up into the ballast water of ocean-going vessels and then hitch rides all over the watery world. Some of Australia's most deadly and poisonous jellies are starting to show up in the waters off Florida.¹⁴ Presumably some may say that

10. See OZONE HOLE, <http://www.theozonehole.com/ozoneholehistory.htm> (last visited Feb. 12, 2014) (brief history of ozone depletion and its discovery).

11. See Justin Gillis & Kenneth Chang, *Scientists Warn of Rising Ocean from Polar Melt*, N.Y. TIMES, May 13, 2014, at A1 (describing early warnings of sea rise due to ice cap melt).

12. Tim Flannery, *They're Taking Over!*, N.Y. REV. BOOKS (Sept. 26, 2013), <http://www.nybooks.com/articles/archives/2013/sep/26/jellyfish-theyre-taking-over/?pagination=false&printpage=true> (reviewing LISA-ANN GERSHWIN, STUNG!: ON JELLYFISH BLOOMS AND THE FUTURE OF THE OCEAN (2013)).

13. See *id.*

14. See *id.*

the current superabundance of jellies is just a natural variation, but one cannot help but wonder about this, given their prodigious hardiness amidst human overuse of the ocean commons—that is, our taking far too much out in the case of other fish stocks, and in the case of pollutants, putting far too much in.

Anyone could think of more examples, but just for that reason, we should all be expecting the nasty outcomes that we get from uncontrolled commons situations. But instead, those nasty outcomes all too often seem to take us by surprise—even the physical problems, the ones that we ought to be able to see with our eyes.

A parenthesis here: all the items that I have mentioned so far come from what political scientist and Nobel Prize winner Elinor Ostrom called “open access” and not what she considered the true “commons.”¹⁵ What she meant by commons is a more traditional understanding, one that long predates Hardin’s usage: a limited common resource that benefits a particular community of users and that is governed by that same community. For now, I am going to stick with the commons as open access—the Hardin version of the commons rather than the Ostrom version. I will take up the Ostrom version a little later, particularly to show some ways that the Ostrom limited commons can be useful for solving some of the surprises lurking in Hardin’s open-access commons.

With that, I want to turn to the reasons why commons problems surprise us.

I. WHY THE SURPRISE?

Perhaps the most ordinary source of surprise about commons problems is a characteristic that is shared by most commons: each commons problem is an accumulation of small events over time, none of which seems very significant at the time. The smog in the Los Angeles basin is an example: there and elsewhere smog is caused by the combustion of thousands and then millions of autos and trucks, each emitting what are actually quite small amounts of the gases that are transformed into smog by sunlight. No wonder people were surprised. How could such small leakages be responsible for the miserable air quality throughout the huge Los Angeles basin?

Carbon-caused climate issues have a similar pattern. A great

15. ELINOR OSTROM, GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION (1990).

number of things emit carbon dioxide, but so what? It is not poisonous, indeed the plants need it to grow, and we need the plants in order to survive. Besides, the air mantle is huge and the oceans absorb a lot of carbon dioxide, as do all those plants. So, what could be the problem if another new factory starts burning fossil fuels? And those jellyfish blooms and fish die-offs are similar: sure, we dump a lot of junk and gunk into the rivers, and the rivers flow into the oceans, but the oceans are massive. So how could that stuff really have an effect on aquatic life? Who could see all this coming?

This, then, is one major reason why commons problems are surprising: so many of them arise from an accumulation of relatively small-scale events, none of which seems very significant taken alone.¹⁶

Another and closely related source of surprise is what one might call the “unexpected environmental byproduct effect.” The effect emerges when efforts that are taken for one purpose and one set of reasons generate unexpected consequences in some unnoticed or unpredicted environmental realm. Take, for example, roadways that are constructed in rainforest areas. The roads are built in order to help people get in and out of these remote areas, so that they can settle there, get around, and get to market. Settlement obviously has foreseeable effects on the rainforest; settlers are almost certainly going to cut down some trees. But the roads themselves have consequences: they allow sunlight to enter, the sunlight dries out the vegetation, and dried-out vegetation catches fire easily or permits erosion. Meanwhile, the roads provide corridors for invasive plant and animal species, while they block the crossing movements of native species.¹⁷

Another example comes from the early years of the twentieth century: researchers found that lead additives in gasoline could enhance the performance of motor vehicles, particularly by reducing engine knock. But the lead additives vaporized into the air. Then

16. See also Bonnie J. McCay, *Emergence of Institutions for the Commons: Contexts, Situations, and Events*, in *THE DRAMA OF THE COMMONS* 361, 365–69 (Elinor Ostrom et al. eds., 2002) (noting the lack of knowledge of commons depletion and the lack of attribution to human causes).

17. Carol M. Rose, *Big Roads, Big Rights: Varieties of Public Infrastructure and Their Impact on Environmental Resources*, 50 *ARIZ. L. REV.* 409, 420 (2008); Robert L. Fischman, *From Words to Action: The Impact and Legal Status of the 2006 National Wildlife Refuge System Management Policies*, 22 *STAN. ENVTL. L.J.* 77, 84 n.24 (2007).

kids who breathed the vapors in the air got lead into their bloodstreams and suffered from impaired nervous system development.¹⁸ Certainly none of this happened on purpose; it was an unexpected byproduct of an effort made for other purposes entirely. In a similar example, I have read recently that some subscribe to a theory that the active ingredient in some herbicides could cause various ailments, including autism.¹⁹ The theory is that herbicide residues remain on food, and when ingested they kill microbes in the human digestive tract—microbes that normally control other bodily functions, including brain functions. This all sounds rather far-fetched, a kind of biological Rube Goldberg machine, but a pathway of that sort would be akin to other commons byproducts: some unexpected environmental effect that comes from an effort to do something else altogether.

Technology is a major source for commons problems of this sort, that is, the unexpected consequences that emerge in some domain entirely different from the aim of the technology itself. No one invented the automobile in order to pollute Los Angeles's air; the automobile was invented to get around the city more easily. No one was aiming to kill birds when they built gleaming new skyscrapers. Who knew that migrating birds would crash into them by the millions?²⁰

Another generic reason for surprise is also related to technology, but here technological advances reveal information right away—about unanticipated subjects. Technological developments sometimes thrust commons issues into the world's attention, even while the technologists were trying to do something else altogether. All of a sudden, we can see a number of things that we did not notice before at all, and we are surprised. The most obvious example

18. Carol M. Rose, *Scientific Innovation and Environmental Protection: Some Ethical Considerations*, 32 ENVTL. L. 755, 762–63 (2002).

19. See, e.g., David Gumpert, *It's Everywhere: MIT Scientist Presents Dire Portrait of Damage from Monsanto's Roundup*, THE COMPLETE PATIENT (June 8, 2014), <http://thecompletepatient.com/article/2014/june/9/its-everywhere-mit-scientist-presents-dire-portrait-damage-monsantos-roundup> (last visited Jan. 24, 2015) (reporting on lectures by MIT research scientist Stephanie Seneff).

20. The number of bird collisions with glass in buildings of all sorts has been estimated to come close to one billion (2014 estimate), as compared to about 600,000 for wind towers (2013 estimate). See *Birds and Collisions*, AMERICAN BIRD CONSERVANCY, <http://www.abcbirds.org/abcprograms/policy/collisions/index.html> (last visited Jan. 24, 2014).

is satellite technology, which has enabled scientists to see the hole in the ozone layer, and which now permits observers to see the fires in tropical rainforests.²¹ Those issues were not the reasons for satellite technology at all; it was aimed at other things, like military intelligence, telecommunications, and conventional weather forecasting. But satellite technology has allowed us to see other things too, quite unexpectedly.

Another source of surprise about commons problems has to do not with the simple non-observance of commons problems, but rather with the refusal to see them. It is a rare person who wants to believe that her activities might cause bad things, especially when those activities are economically important. Thus, fishers have persistently denied that fish populations are affected by their fishing; they say the scientists are ignoramuses who know nothing about fish.²² Farmers worldwide ignore the effect that pesticides can have on bird populations, not to speak of their own health.²³ Defenders of carbon emitters say that climate change is a fraud, or that it is unrelated to human activities.²⁴ Over time, some of these refusals have given way to contrary facts. At least some fishers have gotten on board with effective conservation measures like no-fishing zones or cap-and-trade in fisheries,²⁵ and farmers have generally adopted less toxic pesticides, although perhaps not as environmentally friendly as

21. See *Ozone Hole over Antarctica*, VISIBLE EARTH, <http://visibleearth.nasa.gov/view.php?id=476> (last visited Mar. 21, 2015) (showing early satellite images of ozone hole); Rebecca Lindsey, *From Forest to Field: How Fire is Transforming the Amazon*, EARTH OBSERVATORY (June 8, 2004), <http://earthobservatory.nasa.gov/Features/AmazonFire/> (showing inter alia satellite images of forest burns).

22. See DAVID DOBBS, *THE GREAT GULF: FISHERMEN, SCIENTISTS, AND THE STRUGGLE TO REVIVE THE WORLD'S GREATEST FISHERY* (2000); James William Merrill, *Trawling for Meaning: A New Standard for "Best Scientific Information Available" in the Magnuson-Stevens Fisheries Conservation Act*, 60 CATH. U. L. REV. 475–79 (2011), and sources cited therein.

23. See, e.g., *Farmers Not Heeding Pesticide Warnings*, IRIN NEWS (Sept. 10, 2012), <http://www.irinnews.org/printreport.aspx?reportid=96223>; Helen Thompson, *Popular Pesticides Linked to Drops in Bird Populations*, SMITHSONIAN.COM (July 10, 2014), <http://www.smithsonianmag.com/science-nature/popular-pesticides-linked-drops-bird-population-180951971/?no-ist>.

24. See STEVE GOREHAM, *THE MAD, MAD, MAD WORLD OF CLIMATISM: MANKIND AND CLIMATE CHANGE MANIA* (2012).

25. See Jonathan H. Adler & Nathaniel Stewart, *Learning How to Fish: Catch Shares and the Future of Fishery Conservation*, 31 UCLA J. ENVT. L. & POL'Y 150, 190 (2013).

had been hoped.²⁶ Even some climate change scoffers have moderated their positions, though not all by any means.²⁷

Outright denial of commons problems is one reason to ignore these issues, but another reason to ignore them is that they may not seem to matter—at least until they turn into surprises. A major factor here is human ingenuity. When things get scarce, human beings are likely to find workarounds: better ways to produce the scarce things, better ways to use less of them, or substitutes that do almost as well (or in some cases better). Decades ago, the economist Julian Simon made a bet with biologist Paul Ehrlich when Ehrlich argued that humans were on the high road to running out of the earth's natural resources. Simon bet that humans would do no such thing, and the proof was to be that a basket of specified resources would not increase in price (adjusted for inflation) over a period of ten years. Simon won the bet hands down.²⁸

However, there is a catch: Simon and Ehrlich made their bet not on common resources, but rather on resources that normally belong to some person or entity—commodities, including tin, nickel, and so on. With resources of that sort, someone owns the mine and someone else owns the refining plant, and they have good reason to pay attention as the resource becomes scarcer. With goods that are owned, increasing scarcity shows up pretty quickly in higher prices of the resource, and higher prices incentivize the human ingenuity that produces the workarounds of conservation and substitutes.

Unfortunately, open-access common resources have a different profile. No one has to pay for the common resource itself, so these resource scarcities produce no price signals.²⁹ The only prices that come into anyone's calculations are the prices of extraction itself—

26. See Thompson, *supra* note 23 (describing move away from DDT to what was thought to be safer pesticide).

27. See, e.g., Anthony Adragna, *Ryan Acknowledges Human Involvement but Says Climate Change Science Unsettled*, 45 ENVTL. REP. 2989 (Oct. 17, 2014) (describing Representative Paul Ryan's shift in position on climate change, conceding human role though little else); Bjorn Lomborg, *Climate Change Misdirection*, WALL ST. J. (Jan. 23, 2013, 7:05 PM), <http://online.wsj.com/articles/SB10001424127887323485704578258172660564886> (same for former skeptic).

28. See PAUL SABIN, *THE BET: PAUL EHRLICH, JULIAN SIMON, AND OUR GAMBLE OVER EARTH'S FUTURE* 181–89 (2013) (describing Simon's victory but also some ambiguities about it).

29. Carol M. Rose, *Property and Emerging Environmental Issues—The Optimists vs. the Pessimists*, 1 BRIGHAM-KANNER PROP. RTS. CONF. J. 405, 408–11 (2012).

things like boats and equipment and the costs in time of chasing increasingly scarce goods—so that no one will stop until the good is so scarce that extraction itself is not worth the expenditure of effort and equipment. By this time, the resource itself is likely to be a mere remnant, and the former extractors, who have never invested in a workaround that conserves the common but now remnant resource, simply turn to some other resource.

And so do consumers. Simon and Ehrlich's erstwhile consumers of tin and nickel are still consuming tin and nickel. Higher resource prices sent a signal about those commodities and made it worthwhile to figure out conservation and substitutes early on, so that nickel and tin are still available. But consumers of wild fish are not consuming Orange Roughy anymore, because that stock is close to extinction.³⁰ Instead, they are eating some other species of wild fish, and they do not feel in their pocketbooks the cost of the new fish stock's depletion either. No one does, because the new species is up for grabs—just like Orange Roughy once was.

I have exaggerated here, because in fact, the very serious depletion of wild fish stocks has induced some governments to institute a number of conservation efforts, nowhere more than in New Zealand, to whose fishermen the Orange Roughy's depletion was once a surprise. But it is not a surprise anymore, and New Zealand now has an extremely active fisheries management system.³¹ On the other hand, many wild fish stocks continue to be overfished because they are still in a condition of open access, where the tragedy of the commons plays out to its doleful finish.³² The crashes of these stocks may not seem to matter as long as fishers can turn to some other species. One can only hope that fishers figure out a way to make jellyfish into an attractive kind of seafood.

These, then, are some of the sources of surprise about commons tragedies: the reasons why we ignore what is happening to some common resource until its crash surprises us—or, if we are lucky, some new information source, prior to a crash, reveals the problem we were

30. See John Charles Kunich, *Losing Nemo: The Mass Extinction Now Facing the World's Ocean Hotspots*, 30 COLUM. J. ENVTL. L. 1, 13 n.32, 31–32, 32 n.125 (2005).

31. See Kirsten M. Batkin, *New Zealand's Quota Management System: A Solution to the United States' Federal Fisheries Management Crisis?*, 36 NAT. RES. J. 855, 866–70 (1996).

32. See, e.g., Eric A. Bilsky, *Conserving Marine Wildlife Through World Trade Law*, 30 MICH. J. INT'L L. 599, 601–604 (2009) (attributing worldwide “peril” in wild fish stocks to overfishing).

blithely ignoring. There is a sort of generic reason behind all these reasons for ignoring commons problems, and this generic reason sets the background for our surprise when things go awry or the well runs dry unexpectedly.

Open access means that no one has the right to exclude—that is, there are no property rights in the common resource that vest in any particular person, entity, or group. But if that is the case, there also is no way to make much money or to take other gains from conserving or investing in the open-access resource. But there is a further consequence for information: if there is no way to make gains from something, we tend not to bother to find out much about it.³³

The possibility for economic gain is a huge driver of information collection and investigation. But where that possibility is missing, investigation is much less intense. And so, we get lots of information about the ways to catch fish, including the technology for catching them, but not so much (until relatively recently) about the larger stocks from which individual fish come. To be sure, sheer curiosity and perhaps affection can lead people to invest in information about some unowned things, for example birds, which fascinate many people.

But in the meantime, a great deal of information gathering goes into activities that do make gains, even if, or maybe especially if, those activities can use open-access resources without paying for them. I mentioned lead additives earlier; these are an example of the information aspect of commons problems. Back in the 1920s, there was considerable research and development to make lead additives that would enhance automobile engine performance. There was even some research about the direct effects of lead on those who worked with lead additives, especially when the workers started to behave oddly. But there was very little research about the damage that vaporized lead in air might do, especially to children's mental acuity.³⁴ Generally speaking, these lapses are not anyone's fault. The problem is just that open access in physical resources—like ambient air—not only tends to leave the resource open to dissipation; open

33. See Rose, *supra* note 18, at 758–66 (discussing the relationship between property and information); cf. Jason Scott Johnston, *The Rule of Capture and the Economic Dynamics of Natural Resource Use and Survival Under Open Access Management Regimes*, 35 ENVTL. L. 855, 876 (2005) (noting that information about open-access resources is a public good, whose provision depends on politics).

34. See Rose, *supra* note 18, at 762–63, and sources cited therein.

access also dissipates the investment in *getting information* about the resource.

The absence of property rights, then, is a kind of generic reason for surprise about the decimation of commons resources. No property means no chances for gain—a scenario that sets the stage for simply ignoring open-access resources, and then, of course, being surprised at their degradation.

I do not want to leave the topic of sources of surprise about the commons—the Hardin variety, that is—without mentioning what Dan Farber has called probabilities behaving badly.³⁵ Farber is interested in the kinds of nonlinear sequences of interactions that one sees in fractal geometry. These ill-behaved probabilities occur when some combination of seemingly minor events lead to major follow-on events and sometimes disaster scenarios. The classic hypothetical is something like the butterfly that flaps its wings somewhere in the tropics and sets in motion a train of events that ends up with a hurricane that strikes Cape Cod. As of now, we cannot foresee these events except in broad generalities on the one hand, or very short-term predictions on the other. In the broad generality category, we know that we are very likely to have hurricanes in certain seasons in certain general locations; we know too that earthquakes are bound to happen at some time in some locations. Alternatively, in the very short term, we know that a tornado is forming this afternoon near a mid-sized city in Kansas. We just do not know much in the middle ground between the long-term generality and the very short-term actuality.

But we do see the aftermaths, such as the results of wildly disproportionate weather events in the news. In November 2013, it was the terrible photographs of dazed people walking in the wreckage of the Philippine city of Tacloban after Typhoon Haiyan. Several years back, it was the equally terrible pictures of people thrown together in the Superdome in New Orleans after Hurricane Katrina. These exceedingly unpleasant surprises are different from the other commons surprises, where we ourselves have been blithely re-enacting the tragedy of the commons without paying attention, and then we suddenly realize we have a problem. With probabilities behaving badly, we are the ones who are suddenly thrust into a commons, a kind of commons of nature where all kinds of events

35. Daniel A. Farber, *Probabilities Behaving Badly: Complexity Theory and Environmental Uncertainty*, 37 U.C. DAVIS L. REV. 145 (2003).

enter and build on one another without restraint. The surprise is not that we have devastated a commons, but that this commons has devastated us.

But to finish this section on a cheerier note, in a very limited class of physical resources, surprises from open access are not unpleasant and difficult, but rather fortuitous and happy. This was the topic of my old article, *The Comedy of the Commons*. Roads, waterways, other transportation and communication lanes and areas, possibly even recreational areas and pleasure grounds—all can create pleasant surprises in a state of open access. At least within the limits of capacity and overcrowding, *more is better*: more trade, more commerce, more network effects, more scale economies, more conversations, more fellow feeling, more people at the party.³⁶ As I said at the outset, this article about a “comic” commons began with the locations needed for travel and communication, but it enjoyed a second life in connection with intellectual resources, so at this point I would like to turn to those.

II. INTELLECTUAL RESOURCES AND THE SURPRISES FROM THE COMMONS

In the realm of physical resources, the surprises of open access are very likely to be unpleasant, with the important but limited exceptions of communication lanes and common gathering spaces. All of us can recall the arguments for property rights in physical resources. As opposed to open access, propertization is said to avoid the destruction of resources in wasteful practices and conflicts. Instead, property encourages investment and curtails free riding, allowing owners to reap what they sow;³⁷ moreover, by identifying owners, property encourages trade and the movement of resources to those who most value them. These arguments for property are, in effect, warnings about the dangerous surprises that come from leaving physical resources in open access.

But with intellectual resources, surprises from open access are more ambiguous: some are unpleasant, but many more can be positive, and some are a mixture. For intellectual resources, unlike physical resources, there is no depletion or scarcity caused by

36. Rose, *supra* note 1.

37. 2 WILLIAM BLACKSTONE, COMMENTARIES ON THE LAWS OF ENGLAND 4-9 (1766).

multiple uses. Here, the whole case for property rests on the second part of the property argument: encouraging investment—particularly creative investment—by shutting off free riding and permitting trade toward the highest-value users. But even with this thinner rationale for property in intellectual matters, the case is ambiguous, because open access in intellectual resources also creates surprises.

At least some of these surprises are positive rather than tragic. Although I will have to limit my examples, because I am something of an amateur in intellectual property (IP), there are some obvious ones. As with physical resources, technology plays a major role in creating access to intellectual resources. Everyone knows some examples of the ways that technology has made knowledge more accessible: one can start with the printing press, then add the typewriter, then the copy machine, and then digital technology, to mention just a few of the new technologies along the way. Medieval musicians and troubadours depended on brain technology, i.e., memory, while the medieval learned professions depended on the technology of handwriting. But when movable type printing arrived, songs and poems and books became vastly more available, and this new access encouraged education and then more technology as well.

That is the good part of the open access story. The bad part of intellectual open access, at least arguably, was the invisible discouragement that came from free riding—a discouragement that may have undermined investment in creating the songs and poems and pictures and machines in the first place, because others could copy them and take some of the credit and the proceeds.³⁸ The industrial revolution of the later eighteenth and nineteenth centuries exemplified this dilemma. England was a major source of new technology, particularly the technology that assisted in the manufacture of textiles. With their new inventions, English mills could create vastly more textile products, at lower costs than the non-mechanized technologies. Along the way, inventors got more ideas for further improvements to machines for spinning, weaving, and other manufactures, as innovation built on innovation.³⁹

38. See Martha Woodmansee, *The Genius and the Copyright: Economic and Legal Conditions of the Emergence of the "Author"*, 17 EIGHTEENTH-CENTURY STUDS. 425 (1984) (discussing eighteenth-century German writers' efforts to establish ownership via a cult of "genius").

39. DORON S. BEN-ATAR, TRADE SECRETS: INTELLECTUAL PIRACY AND THE ORIGINS OF AMERICAN INDUSTRIAL POWER 10–12, 83–84 (2004).

But free riding was a constant threat to this burst of technological inventiveness. I recently caught up with Doron Ben-Atar's book about national industrial policy in that era, roughly the turn of the eighteenth to the nineteenth century. Most nations' basic policy was simple: to get access to information about new inventions coming from other countries while preventing similar information from leaking out of their own borders.⁴⁰ The methods were crude. We here in the United States had policies much like those of other countries; we encouraged craftsmen and machinists to come here with their technological knowledge, but at the same time we, like others, did not permit the export of technological inventions originating inside the country.⁴¹

We have all seen the replication of this sequence in digital technology. On the one hand, new copying technology has opened up unprecedented access to intellectual products, along with an explosion of new mixes and matches of ideas. But on the other hand, arguments and legislation have followed, taking the position that copying undermines creativity and investment in creative work. By this time, though, it is not actually much of a surprise that this two-step has appeared.

Are there any surprises, then, in what might be thought to lead a tragedy of the commons in intellectual resources? One such surprise might be the lengths to which inventors and creators (or rather their investors) will go to block open access to their creations. The most recent major copyright legislation extends copyright protection to what amounts to three generations, and it applies not only to new works but to those that were already in existence at the time of the act, and that would have come out of copyright earlier under the laws in effect at the time of their creation. This of course makes something of a mockery of the incentivizing rationale for the new statute.⁴² And then there is the technology that secures what is called digital rights management (DRM), i.e., the technology that, among other things, might make your electronic book disappear or that might prevent you from copying it and passing it on. Technology of this sort was obviously a challenge and a magnet for hackers, but further technological defenses against hackers could be costly for the

40. *Id.* at 8–15.

41. *Id.* at 78–141.

42. *Eldred v. Ashcroft*, 537 U.S. 186, 248–49 (2003) (Breyer, J., dissenting).

manufacturers. And so, after DRM technology was invented, legislation followed to make it illegal to circumvent DRM—legislation that coincidentally may extend protection further than copyright itself, for example, preventing people from “cheating” at digital games.⁴³

There is certainly opposition to the privatization of intellectual products through IP, but opposition to these privatization efforts has typically been slow to develop and rather ineffective in a legislative process historically dominated by insiders.⁴⁴ But then, another major surprise is that proponents of open access have actually emerged and have started to make themselves visible and audible.⁴⁵ Those proponents include Larry Lessig and Yochai Benkler, who were mentioned earlier, but also many others as well, including academics like Mark Lemley, Amy Kapczynski, Jamie Boyle, and the whole group around the Creative Commons alternative to conventional copyright.⁴⁶

A third surprise has been the explosion of open-access activities in the realm of intellectual efforts, ostensibly with no real payoff to the players aside from interest and fun. Here we see the wild proliferation of YouTube creations; the artists who now compose new works made up of other peoples’ posted photos; the flash mobs who organize through social media to sing Handel’s *Messiah* in food courts—or to protest against dictatorial regimes the world over; and of course the happy surprises of Wikipedia and Linux. The upshot of all this is that open access in intellectual resources has created surprises too. Some are unhappy, mimicking the free-riding problems familiar in physical resources. But a number have been happy, in a higher proportion than is the case with physical resources.

43. Joseph P. Liu, *Paracopyright—A Peculiar Right to Control Access*, in *INTELLECTUAL PROPERTY AT THE EDGE: THE CONTESTED CONTOURS OF IP* 227, 229, 242–44 (Rochelle Cooper Dreyfuss & Jane C. Ginsburg eds., 2014).

44. JESSICA LITMAN, *DIGITAL COPYRIGHT* 23, 70 (2006).

45. *See, e.g.*, Brief of George A. Akerlof et al. as Amici Curiae Supporting Petitioners, *Eldred v. Ashcroft*, 537 U.S. 186 (2003) (arguing that extension of copyright act violated incentivizing purpose).

46. Works by all these authors, except Amy Kapczynski, are cited in Anupam Chander & Madhavi Sunder, *The Romance of the Public Domain*, 92 CALIF. L. REV. 1331 *passim* (2004); for Kapczynski, see *The Cost of Price: Why and How to Get Beyond Intellectual Property Internalism*, 59 UCLA L. REV. 970 (2012). Chander and Sunder have some criticism of the open-access idea, however, particularly as applied to less-developed areas and indigenous issues.

III. THE PROSPECTS

At this point I would like to turn to the question of what comes next. How can we avoid the unpleasant surprises of open-access resources and keep the happy ones? Here I especially want to turn to the late Elinor Ostrom's version of the commons, the limited commons, as a potential antidote to the "tragedy of the commons" in Hardin's account.

Ostrom famously complained that Hardin and his followers took too narrow an approach to solving the problems of open access. She complained that Hardin et al. proposed either individual property or statist intervention as the only potential solutions to the problems of open access.⁴⁷ Ostrom's idea was that there is a third way, exemplified in the practices of some communities. These communities have continued for many years, even centuries, to hold a set of critical resources—such as pastures, fisheries, or forests—in common for insiders, while closing them to outsiders. In this way, these communities have continued to enjoy the advantages of common access, particularly the economies of scale that may accompany multiple-participation; but they also incorporate the manageability, conservation, and investment that accompany exclusive property.

Meanwhile, there are a couple of surprises about limited commons too. One surprise is the fact that we have limited commons regimes at all. This is in itself a kind of pleasant development, but it is an unexpected one.

Community-based regimes for governing common pool resources are reenacting a kind of property too—it is just a group-based property. And that is the surprise. James Krier long ago made the point that if people fail to solve the commons problem at the resource level, say, overgrazing or overfishing or polluting, then it is a mystery how they solve it at the level of organizing a management regime.⁴⁸ Just as commons issues at the resource level are problems of collective action, organizing a management regime is another collective-action problem. This would be the case whether the management regime is based on public intervention, group-based property, as in the case of limited commons, or even individual

47. OSTROM, *supra* note 15, at 12–14.

48. James E. Krier, *The Tragedy of the Commons, Part Two*, 15 HARV. J.L. & PUB. POL'Y 325, 338 (1992).

property. Issues of structure, membership, contribution, payoffs, monitoring, and enforcement must all be addressed, and anyone who has run a committee can attest to the hard work involved—and to the temptation to shirk and free ride on the organizing efforts of others. And so it is a surprise to find that we do in fact have limited common property regimes, just as it is a surprise that we have any other kinds of resource-management regimes, including private property.

Some have been literally surprised to find such community-based regimes. I heard Ostrom herself say many times that when Nepal's central government began a program of state-sponsored irrigation works in the mid-twentieth century, the plans ignored the existing irrigation works. But irrigation works were there. They were just not the type that centralizing officials noticed. They were numerous, small, do-it-yourself irrigation systems created and managed by local farmers, and as it turned out, they generally out-performed the state-sponsored works.⁴⁹

Ostrom's *Governing the Commons* compiled information on many regimes of this sort from all over the world, not only irrigation systems, but also community-managed grazing areas, fisheries, and forests. So did many other writings of the 1980s and 1990s. James Acheson described Maine's "lobster gangs" and their collective management practices for lobster fisheries;⁵⁰ Acheson, together with Bonnie McCay, collected articles about a variety of common property regimes from all corners of the globe for fishing, grazing, and agriculture;⁵¹ my Yale colleague Bob Ellickson wrote his famous *Order Without Law*,⁵² describing the very subtle norms and social controls among ranchers of rural Shasta County,

49. Ostrom, writing with some other authors, mentioned this incident and its aftermath in PAUL BENJAMIN ET AL., INSTITUTIONS, INCENTIVES, AND IRRIGATION IN NEPAL 29–30, 41 (1994), available at http://pdf.usaid.gov/pdf_docs/pnabt150.pdf; see also Elinor Ostrom et al., *Revisiting the Commons: Local Lessons, Global Challenges*, 284 SCIENCE 278, 280 (1999) (citing the Nepal example to argue that because the norms that make local farmer-operated irrigation systems function are "not visible" to "well-meaning donors," the latter advocate the replacement of "primitive" systems with governmentally directed technical projects that reduce productivity).

50. JAMES M. ACHESON, THE LOBSTER GANGS OF MAINE (1988).

51. THE QUESTION OF THE COMMONS: THE CULTURE AND ECOLOGY OF COMMUNAL RESOURCES (Bonnie J. McCay & James M. Acheson eds., 1987).

52. ROBERT C. ELICKSON, ORDER WITHOUT LAW: HOW NEIGHBORS SETTLE DISPUTES (1991).

California; Lisa Bernstein described the close community of diamond merchants and their intricate practices governing trade and dispute resolution.⁵³

These community-based property arrangements have had some common characteristics. The first is that they limit access; not everyone can have access, but generally only the community of people contributing to maintenance. Second, transfer and movement in and out of the regime are not easy, so that group membership—and thus group know-how—is relatively stable. A third characteristic is related: the rules and conventions of the group are likely to be very complex, creating what scholars have called an anti-commons that actually protects the commons by preventing easy entrance and exit. A fourth characteristic is the reward system: aside from access to the commonly managed resource, other rewards and punishments are likely to be indirect, taking the form of prestige in the case of reward, and neighborhood disapproval and even shunning in the case of punishment.

For an example, take community-based irrigation systems: their benefits are for the exclusive use of the community of contributors to the ditch system, and not for outsiders. As to the insiders, the contributing farmers keep an eye on one another; they complain and gossip about those who take too much water or shirk on maintenance of the ditches; they may select a particularly trusted and respected person as the water master who decides allocation and responsibilities; they may add another internal dispute resolution system, as in the case of medieval Spanish irrigators.⁵⁴

Moreover, arrangements of this kind are not just about physical resources; analogous patterns sometimes emerge in intellectual property. Rob Merges has described groups of scientists who organize themselves in similar ways,⁵⁵ as has Katherine Strandburg for surgeons' organizations.⁵⁶ In these cases of intellectual resources, the members

53. Lisa Bernstein, *Opting Out of the Legal System: Extralegal Contractual Relations in the Diamond Industry*, 21 J. LEGAL STUD. 115 (1992).

54. OSTROM, *supra* note 15, at 69–81; *see also* Bernstein, *supra* note 53, at 123–27 (describing dispute resolution in the diamond industry).

55. *See* Robert P. Merges, *Property Rights Theory and the Commons: The Case of Scientific Research*, 13 SOC. PHIL. & POL'Y 145 (1996).

56. *See* Katherine J. Strandburg, *Legal But Unacceptable: Pallin v. Singer and Physician Patenting Norms*, in *INTELLECTUAL PROPERTY AT THE EDGE: THE CONTESTED CONTOURS OF IP* 321 (Rochelle Cooper Dreyfuss & Jane C. Ginsburg eds., 2014).

of the group share information among themselves; they reserve special prestige for major contributors; they reject outsiders who are not in the know; and they decry and shun insiders who want to take their achievements outside the system. All these practices encourage contribution to the maintenance of what Strandburg calls groups of “user-innovators.”⁵⁷

One might ask why members of these community-based property regimes do not take the next step to individual property. That is, why not have individual farms instead of common grazing; patents and copyrights instead of professional exchanges? That this step may not be taken is something of a surprise in itself, given the volume of literature about the way that property rights supposedly evolve from open access, through limited common property, to an end-point of individual property.⁵⁸ But a number of limited common property regimes have been quite stable over long periods of time. Perhaps the classic examples are the irrigation systems of eastern Spain mentioned above, which have been in continuous existence since Muslim times.⁵⁹

Why do limited common property regimes resist individualization? Some answers are now quite well known, and they revolve around the advantages of limited commons regimes. By comparison to completely individualized property, limited commons permit the enjoyment of scale economies in all or part of a set of economic activities, as in community irrigation systems, or, as Henry Smith has illustrated, in the mixture of individual and common elements in the very long-lasting medieval common fields regimes of England.⁶⁰ Similarly, in the case of information-sharing innovator groups, limited common organization permits network effects to fertilize individual creativity.⁶¹

Community-based property arrangements notoriously limit

57. *Id.* at 322.

58. See, e.g., Terry L. Anderson & P.J. Hill, *The Evolution of Property Rights: A Study of the American West*, 18 J.L. & ECON. 163 (1975) (describing property as evolving toward individual property rights).

59. OSTRUM, *supra* note 15, at 72–76, 95.

60. See Henry E. Smith, *Semicommon Property Rights and Scattering in the Open Fields*, 29 J. LEGAL STUD. 131 (2000).

61. See Strandburg, *supra* note 56; Merges, *supra* note 55; see also Amy Kapczynski, *Order Without Intellectual Property Law? A Case Study in Open Science* (Nov. 11, 2014) (unpublished paper) (on file with author) (describing an international network of influenza scientists).

entrance by outsiders, but limitations on outsider entry can be an advantage for maintaining insider trust and group stability. Stability in turn makes it possible to maintain complex resources without excessive transaction costs. Thus, a stable user group can maintain a complicated turn-taking system for fishing in a particular location, while a stable theater troupe can manage all the aspects of setup and performance with a minimum of re-education.

Another point is that group-based economic relationships may spill over into other relationships. Community management can act as a risk-sharing or insurance institution, as members help one another out in times of uneven fortune.⁶² Recreation and fun are also often built into limited commons. All those spring festivals in the country and conversations at the clubhouse create opportunities for sociability and fun, while building solidarity in the group.⁶³

Those are the good parts of limited common property or community management regimes. However, there are some deficits as well. Limited common property regimes miss out on certain aspects of modernist individual property, with its distinct boundaries and easy transfer. Movement of goods to higher value users can be impeded when insiders cannot sell to outsiders. The insiders, meanwhile, can settle into patterns of hierarchical rigidity and innovative sclerosis.⁶⁴ Hanoch Dagan and Michael Heller, in their article on the “liberal commons,” complained of a democratic deficit in what Ostrom considered successful commons,⁶⁵ and Brigham Daniels suggested that these kinds of limited commons regimes might have a creativity deficit as well.⁶⁶

Moreover, it is not clear that either the democracy deficit or the innovation deficit is curable in limited common property regimes. The very patterns that hold these regimes together can stifle political change, and they can stifle major innovation too; outsiders are not welcome, and new ideas may not be welcome either. For example,

62. Robert C. Ellickson, *Property in Land*, 102 YALE L.J. 1315, 1341–44 (1993).

63. See Rose, *supra* note 1, at 740–41, 758–59 (describing traditional protection of recreational uses in customary law of the commons).

64. Carol M. Rose, *Ostrom and the Lawyers: The Impact of Governing the Commons on the American Legal Academy*, 5 INT’L. J. COMMONS 28, 33–34 (2011).

65. Hanoch Dagan & Michael A. Heller, *The Liberal Commons*, 110 YALE L.J. 549, 565–66 (2001).

66. Brigham Daniels, *Emerging Commons and Tragic Institutions*, 37 ENVTL. L. 515, 522 (2007) (arguing that commons institutions may favor stability over emerging values, blocking change).

there is a good deal of user innovation within the sphere of normal science—and it is very valuable too, perhaps the chief source of scientific advance. But major new ideas, outside the normal box, may have to occur outside the ordinary group context. Dava Sobel's wonderful book, *Longitude*, gives an example: the cozy norms of eighteenth century scientists rejected the clockmaker as a mere tinker, but he was the one who solved the problem of longitude.⁶⁷

IV. CAN HARDIN AND OSTROM COMBINE?

Here it might be worthwhile to pause to consider whether there are any new ways in which the Ostrom commons might get us through some of the difficulties of the Hardin commons—that is, new applications of the limited commons in the world of open-access tragedies.

The short answer is a cautious “maybe”—and a very cautious one with respect to physical resources. In recent years, there has been a good deal of talk about ecosystem-based approaches, particularly in watershed management. Watersheds of any significance are likely to be too big for individual ownership, but too local to be managed by a distant central government. Then too, watersheds are complicated resource clusters. And finally, the goal of watershed management is generally conservationist rather than development-oriented. Limited commons approaches thus seem attractive, given their association with multi-party, stable management of complex resources.

However, some problems loom, because it is not entirely clear how we might deploy the Ostrom commons in ecosystem management. Taking the central case of watersheds, the first problem is the heterogeneity of what are called “stakeholders” in these endeavors. In the modern watershed, unlike the medieval common fields or the ancient irrigators of eastern Spain, residents may include more urbanites along with rural types, and all are not involved in a set of common economic enterprises; few may be managing stock, and none taking part in a joint effort to cut turfs, as they did in medieval times. In fact, in most modern watersheds, some uses are likely to conflict with other uses. Rafters and fishers conflict with each other, and both conflict with irrigators. A related problem is that of devising a reward system for participation. The

67. DAVA SOBEL, *LONGITUDE: THE TRUE STORY OF A LONE GENIUS WHO SOLVED THE GREATEST SCIENTIFIC PROBLEM OF HIS TIME* (1995).

very heterogeneity of the group makes prestige a doubtful form of payoff; farmers are unlikely to care much about high esteem from rafters, and vice versa.

It may be, then, that with respect to heterogeneous physical resources like ecosystems, management will often require something more than the traditional characteristics of limited common property regimes—perhaps something more akin to what Dagan and Heller call the liberal commons, with opportunities for mutual education, voting, horse trades, overt disagreement, and even exit, along with a certain degree of external prodding from governmental entities.

With respect to intellectual ecosystems, the limited common property model may adapt more readily, although it is unlikely to look very traditional. Indeed, it is here that the limited version of the commons can mix more easily with the open-access version. I have become increasingly interested in volunteer systems of economic organization, and in the current era, information gathering turns out to generate quite a number of such systems. In various citizen science projects, one can glimpse something like a mixture of Hardin's open-access commons and Ostrom's community-managed commons. In these projects, amateurs volunteer to measure rainwater, count birds, keep calendars of flowering plants, and map parts of the night sky, among many other things. One can discern the mixture of Hardin and Ostrom in other domains too, as in the crowd funding of small enterprises, and of course in the Linux operating system and Wikipedia Online Encyclopedia.

What makes these mixed commons organizational models work? Take rainwater measurement. First, *modularity*: the tasks are well defined and doable in small portions, and the information to be gathered is quite single-minded; it is just rain. Second, *norms*: the participants are supposed to perform certain tasks, but these are relatively focused and painless: just write it down every day, and fill in this or that form on a computer screen. Third, *fun*: participants like to do the work, and they are interested in seeing the compiled results that come from the information provided by the whole group of volunteers. Fourth, *leadership*: someone has to put all this together and keep it running. It seems that many people are more willing to follow than to lead; initiative is in much demand.

Fifth, and perhaps most interesting, is the factor of *relaxed boundaries*. Participation in citizen science and other volunteer enterprises is not confined to insiders, as with traditional irrigation

systems, or diamond merchant groups, or even surgeons' networks, but rather is open to new members. Still, even with these porous boundaries, some are participants and some are not. One interesting comparison for participation might be with churches or other religious organizations, where membership means something but is also open to outsiders. Here too, Ostrom's commons organization meets Hardin's open access commons.

On reflection, the same might be said of the features of Dagan and Heller's liberal commons, which have considerably more porous boundaries and opportunities for movement than the traditional limited commons. While the analysis of physical resources has traditionally preceded the analysis of intellectual resources, for the very good reason that physical resources can be perceived and monitored more easily, one more surprise might be that modern crowdsourcing enterprises can reverse the pattern. Intellectual enterprises, rather than physical resources, might become the location where we learn how to combine Hardin's commons with Ostrom's.

V. ONE LAST SURPRISE—OR IS IT THE FIRST?

I would like to mention one other surprising element in dealing with open-access resources, one that brings us back to the mysterious aspects of commons solutions. This is a phenomenon that occurs in the worst of all these surprises, the probabilities behaving badly, when the disasters that we knew might come sometime do indeed come and turn our world upside down.

Rebecca Solnit, in a book entitled *A Paradise Built in Hell*, describes the temporary euphoria of people caught in these surprises.⁶⁸ She elaborates on acts of astonishing generosity in disasters like the San Francisco earthquake of 1906—of people opening doors to houses and stores, giving away everything, working day and night on rescue efforts. If people can remember these terrible times later, they remember them as the most blissful days of their lives.

It is not at all clear where this psychological state comes from. It does not sound at all like the behavior of the classic rational actor. In fact, it seems just the reverse: a temporary euphoria that entails

68. REBECCA SOLNIT, *A PARADISE BUILT IN HELL: THE EXTRAORDINARY COMMUNITIES THAT ARISE IN DISASTER* (2009).

forgetting rational calculation and immediate gains and losses as well as long-term discount rates, and instead giving away everything right now, right here.

But then, one may have to suppress the rational actor to break through any kind of miserably unsolvable commons issue, to come out to a happy surprise on the other side. What Solnit describes may be an exaggerated and particularly intense version of the moment of trust and risk-taking that enables human beings to break through any kind of collective action issue, whether it is the small-scale prisoner's dilemma or the larger tragedy of the commons. We may not understand this mysterious turn of mind at the foundation of cooperative behavior, but we know that it happens, and much of our social and political life depends on it—and our economic and environmental life as well.