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Introduction: An Overview of the Knowledge Commons

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Two monks were arguing about a flag. One said, "The flag is moving." The other said, "The wind is moving." The sixth patriarch, Zeno, happened to be passing by. He told them, "Not the wind, not the flag; mind is moving."
—Douglas R. Hofstadter, *Gödel, Escher, Bach*

The Purpose of This Book

This book is intended as an introduction to a new way of looking at knowledge as a shared resource, a complex ecosystem that is a *commons*—a resource shared by a group of people that is subject to social dilemmas. The traditional study of knowledge is subdivided into epistemic areas of interests. Law professors argue the legal aspects of knowledge in regard to intellectual property rights. Economists consider efficiency and transaction costs of information. Philosophers grapple with epistemology. Librarians and information scientists deal with the collection, classification, organization, and enduring access of published information. Sociologists examine behaviors of virtual communities. Physical scientists study natural laws. Every discipline, of course, has a claim on knowledge; this is the common output of all academic endeavors. The focus here is to explore the puzzles and issues that all forms of knowledge share, particularly in the digital age. The intention is to illustrate the analytical benefits of applying a multitiered approach that burrows deeply into the knowledge-commons ecosystem, drawing from several different disciplines.

Brief History of the Study of the Knowledge Commons

The exploration of information and knowledge as commons is still in its early infancy. Nevertheless, the connection between "information" in its

various forms and "commons" in its various forms has caught the attention of a wide range of scholars, artists, and activists. The "information-commons" movement emerged with striking suddenness. Before 1995, few thinkers saw the connection. It was around that time that we began to see a new usage of the concept of the "commons." There appears to have been a spontaneous explosion of "ah ha" moments when multiple users on the Internet one day sat up, probably in frustration, and said, "Hey! This is a shared resource!" People started to notice behaviors and conditions on the web—congestion, free riding, conflict, overuse, and "pollution"—that had long been identified with other types of commons. They began to notice that this new conduit of distributing information was neither a private nor strictly a public resource.

An increasing number of scholars found that the concept of the "commons"[1] helped them to conceptualize new dilemmas they were observing with the rise of distributed, digital information. In the mid-1990s, articles suddenly started appearing in various disciplines addressing some aspect of this new knowledge commons. Some information scientists made inroads in new areas of virtual communities and commons (Rheingold 1993; Brin 1995; Hess 1995; Kollock and Smith 1996). Others explored commons dilemmas on the web, such as congestion and free riding (Huberman and Lukose 1997; Gupta et al. 1997). The largest wave of "new-commons" exploration appeared in the legal reviews. *Commons* became a buzzword for digital information, which was being enclosed, commodified, and overpatented.[2] Whether labeled the "digital," "electronic," "information," "virtual," "communication," "intellectual," "Internet," or "technological" commons, all these concepts address the new shared territory of global distributed information.

Study of Traditional Commons

For us, the analysis of knowledge as a commons has its roots in the broad, interdisciplinary study of shared natural resources, such as water resources, forests, fisheries, and wildlife. *Commons* is a general term that refers to a resource shared by a group of people. In a commons, the resource can be small and serve a tiny group (the family refrigerator), it can be community-level (sidewalks, playgrounds, libraries, and so on), or it can extend to international and global levels (deep seas, the atmosphere, the Internet, and scientific knowledge). The commons can be well bounded (a community park or library); transboundary (the Danube

River, migrating wildlife, the Internet); or without clear boundaries (knowledge, the ozone layer).

Commons analysts have often found it necessary to differentiate between a commons as a resource or resource system and a commons as a property-rights regime. Shared resource systems—called *common-pool resources*—are types of economic goods, independent of particular property rights. *Common property* on the other hand is a legal regime—a jointly owned legal set of rights (Bromley 1986; Ciriacy-Wantrup and Bishop 1975). Throughout this book, the more general term *commons* is preferred in order to describe the complexity and variability of knowledge and information as resources. Knowledge commons can consist of multiple types of goods and regimes and still have many characteristics of a commons.

Potential problems in the use, governance, and sustainability of a commons can be caused by some characteristic human behaviors that lead to social dilemmas such as competition for use, free riding, and overharvesting. Typical threats to knowledge commons are commodification or enclosure, pollution and degradation, and nonsustainability.

These issues may not necessarily carry over from the physical environment to the realm of the knowledge commons. There is a continual challenge to identify the similarities between knowledge commons and traditional commons, such as forests or fisheries, all the while exploring the ways knowledge as a resource is fundamentally different from natural-resource commons.

With "subtractive" resources such as fisheries, for instance, one person's use reduces the benefits available to another. High subtractability is usually a key characteristic of common-pool resources. Most types of knowledge have, on the other hand, traditionally been relatively nonsubtractive. In fact, the more people who share useful knowledge, the greater the common good. Consideration of knowledge as a commons, therefore, suggests that the unifying thread in all commons resources is that they are jointly used, managed by groups of varying sizes and interests.

Self-organized commons require strong collective-action and self-governing mechanisms, as well as a high degree of social capital on the part of the stakeholders. *Collective action* arises "when the efforts of two or more individuals are needed to accomplish an outcome" (Sandler 1992, 1). Another important aspect of collective action is that it is voluntary on the part of each individual (Meinzen-Dick, Di Gregorio, and

McCarthy 2004). *Self-governance* requires collective action combined with "knowledge and will on the one hand, and supporting and consistent institutional arrangements on the other hand."[3] *Social capital* refers to the aggregate value of social networks (i.e., who people know), and the inclinations that arise from these networks for people to do things for each other (i.e., the norms of reciprocity) (Putnam 2000). Throughout this book we will see these three elements—collective action, self-governance, and social capital—frequently in play.

Since the mid-1980s and the formation of the International Association for the Study of Common Property,[4] a large number of international, interdisciplinary studies have focused on various types of commons resources. More and more researchers began to realize that combining disciplines and pooling knowledge was the only way to arrive at deeper understandings of effective commons management. One well-known fisheries researcher illustrates the urgent need for a multidisciplinary approach in the introduction to her 1989 edited volume:

[The authors] share a belief that we can no longer afford to tackle these intractable problems in isolation from one another. All efforts are needed. All examples add something to our understanding. The making of this book had already stimulated unusual collaboration in research and our hope is that it will further the process of bringing about better communication across disciplines and between theoreticians and practitioners. (Pinkerton 1989)

To be able to understand the complex processes at work in a commons such as a fishery, researchers over the past twenty years[5] have demonstrated the necessity of examining the biological, economic, political, and social elements involved that lead to the success or failure of the resource system.

While the bulk of commons research has been aimed at natural-resource commons, particularly forests and land, fisheries, and water resources, attention to human-made resources has increased dramatically since 1995. Whether the focus is traditional or new, however, the essential questions for any commons analysis are inevitably about equity, efficiency, and sustainability. *Equity* refers to issues of just or equal appropriation from, and contribution to, the maintenance of a resource. *Efficiency* deals with optimal production, management, and use of the resource. *Sustainability* looks at outcomes over the long term. Many studies hone in on issues of property-rights regimes and the various challenges of common property. Indeed, the important distinctions between the terms "common *property*" and "common-*pool resource*" grew out of this scholarship.

One of the truly important findings in the traditional commons research was the identification of design principles of robust, long-enduring, common-pool resource institutions (Ostrom 1990, 90–102). These principles are

• Clearly defined boundaries should be in place.

• Rules in use are well matched to local needs and conditions.

• Individuals affected by these rules can usually participate in modifying the rules.

• The right of community members to devise their own rules is respected by external authorities.

• A system for self-monitoring members' behavior has been established.

• A graduated system of sanctions is available.

• Community members have access to low-cost conflict-resolution mechanisms.

• Nested enterprises—that is, appropriation, provision, monitoring and sanctioning, conflict resolution, and other governance activities—are organized in a nested structure with multiple layers of activities.

These principles were discovered after conducting a large set of empirical studies on common-pool resource governance. One of the central findings was that an extremely rich variety of specific rules were used in systems sustainable over a long time period. No single set of specific rules, on the other hand, had a clear association with success. Only after grappling with this wide diversity of robust systems was it possible to identify general principles that tended to underlie the robust institutions. The eight factors identified were those found to exist in most robust institutions—but they were absent in failed systems. These principles have inspired hundreds of studies. And they are, indeed, helpful as a possible place to start an investigation. But they are in no way prescriptive—nor are they models. Rather, they are insightful findings in the analysis of small, homogeneous systems. Whether they apply to the study of large and complex systems like the knowledge commons is a question for further research.

Knowledge as a Resource

Knowledge in this book refers to all intelligible ideas, information, and data in whatever form in which it is expressed or obtained. Our

thinking is in line with that of Davenport and Prusak (1998, 6), who write that "knowledge derives from information as information derives from data." Machlup (1983, 641) introduced this division of data-information-knowledge, with data being raw bits of information, information being organized data in context, and knowledge being the assimilation of the information and understanding of how to use it. *Knowledge* as employed in this book refers to all types of understanding gained through experience or study,[6] whether indigenous, scientific, scholarly, or otherwise nonacademic. It also includes creative works, such as music and the visual and theatrical arts. Some view knowledge as polemical, in that it has "dual functions"—as a commodity and as a constitutive force of society (Reichman and Franklin 1999; Braman 1989). This dual functionality as a human need and an economic good immediately suggests the complex nature of this resource. Acquiring and discovering knowledge is both a social process and a deeply personal process (Polanyi 1958).

Further, knowledge is cumulative. With ideas the cumulative effect is a public good, so long as people have access to the vast storehouse, but access and preservation were serious problems long before the advent of digital technologies. An infinite amount of knowledge is waiting to be unearthed. The discovery of future knowledge is a common good and a treasure we owe to future generations. The challenge of today's generation is to keep the pathways to discovery open.

Ensuring access to knowledge is made easier by examining the nature of knowledge and identifying the ways in which it is a commons. This approach is in contrast to the standard economics literature. In that literature, knowledge has often been used as the classic example of a pure public good—a good available to all and where one person's use does not subtract from another's use. In the classic treatment of public goods, Paul A. Samuelson (1954, 387–389) classified all of the goods that might be used by humans as either pure private or pure public. Samuelson and others, including Musgrave (1959), placed all the emphasis on *exclusion*. Goods where individuals could be excluded from use were considered private goods. When economists first dealt with these issues, they focused on the impossibility of exclusion, but they later moved toward a classification based on the high cost of exclusion. Goods were then treated as if there were only one dimension. It was not until scholars developed a twofold classification of goods (V. Ostrom and E. Ostrom 1977) that a second attribute of goods was fully acknowledged. The new schema

introduced *subtractability* (sometimes referred to as *rivalry*), where one person's use subtracted from the available goods for others, as an equally important determinant of the nature of a good. This led to a two-dimensional classification of goods (see figure 1.1).

Knowledge, in its intangible form, fell into the category of a public good since it was difficult to exclude people from knowledge once someone had made a discovery. One person's use of knowledge (such as Einstein's theory of relativity) did not subtract from another person's capacity to use it. This example refers to the ideas, thoughts, and wisdom found in the reading of a book—not to the book itself, which would be classified as a private good.

Throughout this book, we use the terms *knowledge commons* and *information commons* interchangeably. While some chapters focus specifically on scholarly and scientific communication, the issues discussed have crucial relevance that extend far beyond the ivory tower. Some aspect of knowledge in digital form is the primary focus of all the chapters, primarily because the technologies that allow global, interoperable distribution of information have most dramatically changed the structure of knowledge as a resource. One of the critical factors of digital knowledge is the "hyperchange"[7] of technologies and social networks that affects every aspect of how knowledge is managed and governed, including how it is generated, stored, and preserved.

The growing number of studies regarding various approaches to the knowledge commons indicates the complexity and interdisciplinary nature of these resources. Some knowledge commons reside at the local level, others at the global level or somewhere in between. There are

		SUBTRACTABILITY	
		Low	*High*
EXCLUSION	*Difficult*	**Public goods** Useful knowledge Sunsets	**Common-pool resources** Libraries Irrigation systems
	Easy	**Toll or club goods** Journal subscriptions Day-care centers	**Private goods** Personal computers Doughnuts

Figure 1.1
Types of goods. *Source:* Adapted from V. Ostrom and E. Ostrom 1977

clearly multiple uses and competing interests in these commons. Corporations have supported increased patents and copyright terms, while many scientists, scholars, and practitioners take actions to ensure free access to information. Universities find themselves on both sides of the commons fence, increasing their number of patents and relying more and more on corporate funding of research, while at the same time encouraging open access and establishing digital repositories for their faculty's research products.

Most of the problems and dilemmas discussed in this book have arisen since the invention of new digital technologies. The introduction of new technologies can play a huge role in the robustness or vulnerability of a commons. New technologies can enable the capture of what were once free and open public goods. This has been the case with the development of most "global commons," such as the deep seas, the atmosphere, the electromagnetic spectrum, and space, for example. This ability to capture the previously uncapturable creates a fundamental change in the nature of the resource, with the resource being converted from a nonrivalrous, nonexclusionary public good into a common-pool resource that needs to be managed, monitored, and protected, to ensure sustainability and preservation.

The Tragicomedy of the Commons

The analysis of any type of commons must involve the rules, decisions, and behaviors people make in groups in relation to their shared resource. Economist Mancur Olson's influential *The Logic of Collective Action* (1965) is still being read by students today as a basic introduction to the challenges of human organization. Collective action, voluntary groups working to achieve a shared goal, is a key ingredient in understanding commons. Olson laid the groundwork for the study of *incentives* for people to contribute to a joint endeavor and outlined the basic problem of *free riding*, where one reaps benefits from the commons without contributing to its maintenance.

The impetus for countless studies has been the model of "The Tragedy of the Commons" (Hardin 1968). Biologist Garrett Hardin created a memorable metaphor for overpopulation, where herdsmen sharing a common pasture put as many cattle as possible out to graze, acting in their own self-interest. The tragedy is expressed in Hardin's (1968, 1244) famous lines: "Ruin is the destination toward which all men rush, each

pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all." This is one of the most often cited and influential articles in the social sciences and is still taught in large numbers of university courses worldwide.

Hardin's vivid narrative contains a number of contentions that commons scholars have repeatedly found to be mistaken: (1) he was actually discussing open access rather than managed commons; (2) he assumed little or no communication; (3) he postulated that people act only in their immediate self-interest (rather than assuming that some individuals take joint benefits into account, at least to some extent); (4) he offered only two solutions to correct the tragedy—privatization or government intervention. Whether studying California groundwater basins, North Atlantic fisheries, African community forests, or Nepalese irrigation systems, scientific case studies frequently seem to answer: *Au contraire, Monsieur Hardin*! There may be situations where this model can be applied, but many groups *can* effectively manage and sustain common resources if they have suitable conditions, such as appropriate rules, good conflict-resolution mechanisms, and well-defined group boundaries.[8]

A knowledge-commons variation of the tragedy of the commons that has become quite popular in the law literature is the concept of the *anticommons*. The term was originally applied to extreme regulatory regimes in real property.[9] Adapted by Michael Heller in 1998,[10] the tragedy of the anticommons in the knowledge arena lies in the potential underuse of scarce scientific resources caused by excessive intellectual property rights and overpatenting in biomedical research.

Another frequently used model in commons analysis is the prisoner's dilemma (PD), developed in the early days of game theory in 1950 by mathematician A. W. Tucker at Stanford (Cunningham 1967, 11). The original narrative of the two-person, noncooperative, non-zero-sum game concerns two criminals who are interviewed separately about a crime. Each is given a strong incentive by the prosecutor to inform against the other. The prisoner's dilemma has remained popular perhaps because it is one of the simplest formal games to understand and can quickly illustrate the problems of collective action and irrational group behavior when trust and reciprocity have little opportunity to develop and be expressed.

All of these models—collective *in*action, tragedy of the commons, and the PD game—can be useful in helping to conceptualize some of the

incentives in simple situations involving various forms of knowledge commons. The problem with them is that they have been overused as realistic models of much more complex and dynamic situations. They are frequently put forth as explaining why participants are "trapped" in perverse incentives and cannot themselves find ways of increasing trust, developing norms of reciprocity, or crafting new rules. Yet they are certainly not predictive of all situations involving a commons dilemma or any of the specific pet solutions offered to solve these problems. As study after study demonstrates, there is no one solution to all commons dilemmas.

Two Intellectual Histories

Curiously, most of the interdisciplinary work on the knowledge commons to date is not an outgrowth of the natural-resource commons literature (although the tragedy of the commons still "plays" at all the knowledge-commons theaters). Rather, it is rooted in two distinct intellectual histories: the history of enclosure and the history of openness and inclusiveness—that is, democracy and freedom.

Historically in Europe, "commons" were shared agricultural fields, grazing lands, and forests that were, over a period of 500 years, enclosed, with communal rights being withdrawn, by landowners and the state. The narrative of enclosure is one of privatization, the haves versus the have-nots, the elite versus the masses. This is the story of Boyle's (2003) "Second Enclosure Movement," featuring the enclosure of the "intangible commons of the mind," through rapidly expanding intellectual property rights. The occurrence of enclosure is an important rallying cry on the part of legal scholars, librarians, scientists, and, really, anyone who is alert to the increasing occurrence of privatization, commodification, and withdrawal of information that used to be accessible, or that will never be available in our lifetimes.

This trend of enclosure is based on the ability of new technologies to "capture" resources that were previously unowned, unmanaged, and thus, unprotected. This is the case with outer space, with the electromagnetic spectrum, and with knowledge and information. The case of distributed digital technologies is particularly complex and problematic, as many stakeholders seek to renegotiate their interests in the new digital environment. Currently there are a vast array of enclosure threats to

information and knowledge—including computer code as law (Lessig 1999) and new intellectual property legislation (DMCA, TRIPS, the Copyright Term Extension Act, the Patriot Act, and so on)—that undermine free access to public, scientific, and government information.[11]

Historically in the United States, *commons* has most often referred to shared spaces that allow for free speech and the democratic process, most notably the New England town commons. This is the focus of Benkler's (2004) "commons-based production."[12] It is the narrative of digital interoperability, open science, collaboratories and scholarly networks, voluntary associations, and collective action. The U.S.-type commons underscores the importance of shared spaces and shared knowledge in fostering viable democratic societies. Libraries, as Kranich (2004) has pointed out, have been the quintessential strongholds of democracy. Traditionally, libraries have been the "protected areas" of the knowledge commons and librarians are the stewards. This narrative calls forth the urgency for all information users and providers to become stewards of the global digital commons.

Clarifying Confusion Surrounding the Knowledge Commons

Two common sources of confusion in the knowledge-commons literature require clarification. First, open access to information is a horse of a much different color than open access to land or water. In the latter case, open access can mean a free-for-all, as in Hardin's grazing lands, leading to overconsumption and depletion. With distributed knowledge and information the resource is usually nonrivalrous. As Suber points out in this book, open access in the information ecosystem means free and unfettered access, without costs or permissions. Authors who choose to make their works available for free may still retain their copyrights. In this instance, instead of having negative effects, open access of information provides a universal public good: the more quality information, the greater the public good.

Second, the knowledge commons is not synonymous with open access, although the content and the community network of the open-access movement, as Suber and Ghosh discuss in their chapters, are types of commons. Forgive us for repeating that a commons is a shared resource that is vulnerable to social dilemmas. Outcomes of the interactions of people and resources can be positive or negative or somewhere in

between. Frequently, within the intellectual arena, the concept of the commons is a battle cry for free speech, universal open access, and self-governance, as a 2004 conference session illustrated:

With the Internet nurturing the sharing spirit inherent in man, commons has taken on a new meaning. Free software proved spectacularly that the commons is a viable alternative to commodification. The term Digital Commons is widely used but only loosely defined, ranging from jointly owned intellectual property to public property and the public domain. Still, it has an obvious evocative power, and the potential to reconceptualize our knowledge environment and to unite those fighting for its freedom. (Program abstract for "The Future of the Digital Commons," at the 2004 WOS3 Conference, http://wizards-of-os .org/index.php?id=1551)

This use of the word *commons* is not infrequent. It can be constructive and often provides the impetus to collective action around the commons. But a commons is not value laden—its outcome can be good or bad, sustainable or not—which is why we need understanding and clarity, skilled decision-making abilities, and cooperative management strategies in order to ensure durable, robust systems.

The Knowledge Ecosystem, Collective Action, and Self-Governance: An Overview of the Chapters in This Book

The rapidly expanding world of distributed digital information has infinite possibilities as well as incalculable threats and pitfalls. The parallel, yet contradictory trends, where, on the one hand, there is unprecedented access to information through the Internet but where, on the other, there are ever-greater restrictions on access through intellectual property legislation, overpatenting, licensing, overpricing, withdrawal, and lack of preservation, indicate the deep and perplexing characteristics of this resource.

Knowledge, which can seem so ubiquitous in digital form, is, in reality, more vulnerable than ever before. When hard-copy journals, for instance, were sold to libraries and individuals, the decentralization of multiple copies made the works robust. When journals are in digital form and licensed to libraries or individuals, the works are centralized and vulnerable to the whims or happenstance of the publisher. Users who rely on certain journals being indexed in LexisNexis or other large indexing services, are frustrated to find one day that those journals were dropped and will no longer be indexed. A vast amount of government

information that used to be freely available online was withdrawn after 9/11 and not replaced. Or, cyberterrorists are too often able to infect or damage a system or steal confidential information.

On the other hand, collective-action initiatives, such as open access, and Free/Libre and Open Source Software development, are ensuring much greater accessibility and robustness of digital resources. Many questions exist as to how to develop future initiatives that will increase the security of digital knowledge while not blocking access to those who would benefit greatly from its use. Several of these issues are addressed in the chapters to follow in this book.

The book is divided into three parts. Part I, "Studying the Knowledge Commons," focuses on new ways to conceptualize and analyze knowledge as a complex, global, shared resource. In chapter 2, David Bollier reflects on the evolution of the meaning of the commons from a concept describing some historical developments to its current applications to the realm of knowledge. Although Garrett Hardin's essay brought new attention to the idea of the commons, its misconceptions tended to discredit the commons as an effective instrument of community governance. After all, if a "tragedy" of the commons is inevitable, why study it? However, in the mid-1980s, the flaws in this analysis were explored and scholarly interest in the commons began to take root. Interest in the commons grew further in the mid-1990s as the Internet engendered new types of social communities and communication in an entirely new public sphere, cyberspace. Yet even with these developments, the concept of the commons remains novel and alien to many people. Mindful of this history, Bollier helps readers develop new cognitive maps that enable them to visualize the knowledge commons in a new light. He points out the massive shift in our daily life that has resulted from being online, and how the radical changes in social and economic aspects of knowledge production have generated new problems unforeseen only a few decades ago. Now, instead of being worried about the absence of clearly defined property rights, serious thinkers are equally concerned with the imposition of private control over knowledge that many argue should be in the public domain. The challenge is how to blend systems of rules and norms related to this new commons to guarantee general access to the knowledge that empowers humans while ensuring recognition and support for those who create knowledge in its various forms.

In the third chapter, Elinor Ostrom and Charlotte Hess present the Institutional Analysis and Development (IAD) framework that has been

developed over several decades by colleagues at the Workshop in Political Theory and Policy Analysis at Indiana University. The IAD framework originally emerged from our extensive research on urban public goods, including policing and education (see McGinnis 1999 for an overview, and Ostrom 2005 for an extensive exposition). It was most fully developed as we and our colleagues struggled with an understanding of complex linked social-ecological systems; we were trying to understand how diverse rules affect the likelihood of sustaining or destroying common-pool resources, including groundwater basins, irrigation systems, grazing systems, and forests. We think the framework will now be of value in understanding knowledge as a commons—in regard to both the public-good aspects of this commons and the common-pool resource aspects. Our goal is to make the framework as accessible as possible in order to heighten interest and facilitate further applications. As an illustration, the framework is loosely applied to the action arena of building a university repository, a locally produced, globally harvested complex commons.

Part II of the book, "Protecting the Knowledge Commons," contains contributions from several well-known authors concerning the problem of safeguarding the knowledge commons. These chapters draw from the tradition of guarding against enclosure of the commons. In chapter 4, Nancy Kranich looks at different types of enclosures of knowledge commons. She gives a broad review of the role of research libraries in protecting knowledge, as well as making it available to citizens, as cornerstones of democracy in the contemporary world. Kranich provides historical background to the current enclosures facing research libraries, including those caused by the skyrocketing costs of journals. To a large extent, the current budget crises are an inadvertent consequence of scholarly societies turning the publishing of their journals over to private firms in the 1980s in order to gain high-quality printed journals at a lower cost to the academic editors and universities involved. The cost of journals has risen more than three times the increase in the consumer price index since 1986! This has had further ramifications for the publication of books and the availability of printed scholarly communications, especially those located in universities facing stringent budgetary pressures. These developments, as well as amendments to copyright laws, increased government secrecy, and other enclosures, contextualize Kranich's reviews of contemporary efforts to utilize new technologies and new legal concepts to reclaim scientific and intellectual assets through diverse open-

access initiatives. She also suggests ways to advance the theory and practice of sustainable knowledge commons.

James Boyle is a well-known and articulate spokesperson for the protection of the intellectual public domain. In chapter 5, he brings together two seemingly disparate thoughts. Drawing from the work of sociologist Robert Merton, he discusses the possible impact of fencing off scholarship from the general public. He postulates that greater access to cultural and scientific materials by individuals and groups outside the academy might have a remarkable impact on scholarship, culture, and possibly even science. He urges that the knowledge commons not be restricted to the scholarly community. Boyle also writes about the fencing off of ideas through copyright and licensing restrictions. He poses some interesting questions. Would the original author of a very successful series of books—he uses J. K. Rowling's Harry Potter books as an example—really be concerned that copyright protected her work for seventy years after her death rather than merely fifty years? Yes, if a corporation held the rights, they would be concerned to gain protection for as long as a government was willing to assign it. Those extra years, however, have nothing to do with creating an incentive to put in the hours of work needed to produce good books, pathbreaking research, or enticing music. At a substantial cost to the public, those extra years of protection generate profit to those who did not make the original investment in producing creative work. The chapter illustrates that knowledge is the domain of the public and that as much of it as possible needs to be freely available.

In chapter 6, Donald Waters takes on the difficult problem of safeguarding and preserving the knowledge commons by focusing in on the links that are preserved versus the links that disappear. In traditional publication, scholars use footnotes to link their statements to the authoritative source for their statement. As more and more scholars link their work to the web pages of other scholars, the problem of preserving the digital information becomes ever-more critical, especially when the average life expectancy of a web page is only a few months! Preserving electronic scholarly journals becomes a key challenge for the scientific community, given the number of citations that are currently made to what might become an ephemeral source in the future. While books and journals were never published in huge quantities in prior eras, libraries looked upon their role as one of preserving these precious resources for future ages. Waters points to the problem of free riding in creating and

managing archival records. Without good archives, the scientific communication of today may be lost to the scholars of tomorrow. Waters lays out the key features that are needed to achieve the preservation of electronic knowledge in regard to legal protection, business models, and incentives to achieve this.

Part III, "Building New Knowledge Commons," draws from the intellectual history of collective action, the free exchange of ideas, and collaboration in the interest of the common good. In chapter 7, Peter Suber makes an eloquent and convincing argument for the advantages of making research and publications available online through open access. Every author has the ability to participate in building one of the richest knowledge commons by contributing peer-reviewed journal articles and their preprints, the primary literature of science. Suber concretely lays out the steps needed to understand and to participate in the open-access (OA) movement. He discusses the peculiarities of royalty-free literature, the conditions and incentives that lead authors to consent to OA, and some obstacles to an OA commons that have the flavor of a tragedy of the commons. Importantly, he discusses different funding models, since, while the user has free access, the producer faces the costs of peer review, manuscript preparation, and online dissemination, and sometimes also the costs of digitizing, copyediting, and long-term preservation. He points out the difference between open-access repositories that do not attempt to provide peer review and open-access journals that continue the important task of peer review of scholarly communication. The long-term existence of broadcast television and radio, which provide free access to users, makes Suber confident that long-term digital publishing in an open-access forum is financially feasible. It does, however, require considerable entrepreneurship in today's transition from entirely printed materials to a combination of print and electronic publication. Suber then provides a good analysis of the various categories of intellectual property. He concludes by outlining the variety of tragedies of the open-access commons that universities, publishers, scholars, and the public will need to overcome.

In chapter 8, Shubha Ghosh weaves a compelling case for understanding the role of intellectual property rights in building the knowledge commons. Focusing specifically on patents and copyrights, he examines a number of pat concepts or solutions and shows that they are not so pat. We are led through the arguments of intellectual property as constrictive, as facilitative, and as irrelevant and shown that there is a

logic to all three of these positions. Ghosh then refocuses the argument from one about intellectual property as an *end* to one of intellectual property as a *means* in which it can be used as a tool in constructing the information commons. He proposes three guiding principles that can be utilized to inform intellectual property policy and to effectively design the commons: imitation, exchange, and governance. Ghosh explores important puzzles involving the separation of the market and the state, showing that these are not reasonably separated.

In chapter 9, Peter Levine demonstrates how a knowledge commons can be used effectively to stimulate students and citizens more generally to engage in research of public value, using as well as contributing to the knowledge commons. He draws on his own experience with the Prince George's Information Commons in Maryland near the University of Maryland. Levine makes a useful distinction between a libertarian commons and an associational commons. A libertarian commons is one that anyone can access if they choose. Associational commons are open to their own members but may be not be open to the public at large. Before the digital age, paper libraries were shared by associations of individuals living in communities. Levine argues that commons need protection by groups interested in their production, care, and maintenance. Thus, he argues that associational commons will be an important part of the democratic use of knowledge commons in the future. He describes the effort by the University of Maryland to develop an effective associational commons for students and citizens living in Prince George's County. By producing knowledge for the commons, students learn about public issues in a way they would not do otherwise. Levine then urges other scholars to develop associational commons of this type as a way of producing important contemporary knowledge, and as a way of training students about their own communities as well as how to produce and evaluate knowledge about communities.

In chapter 10, Charles Schweik argues that the collaborative principles around Free/Libre and Open Source Software (FOSS) development projects could potentially be applied to develop new knowledge commons in science. To make this point, Schweik first applies the institutional analysis and development framework summarized in chapter 3 to analyze the various action situations involved in the open-source software commons. He then links the various action situations faced by participants in the biophysical world, the relevant communities, and the rules-in-use affecting the action situations involved in producing and

protecting software. Schweik provides a good historical overview of the effort to develop open-source software licensing agreements and of how these kinds of information-protection and information-production arrangements have blossomed. He then extends the analysis to include a broader array of artifacts beyond that of software to discuss the general problem of licensing scientific digital content. Readers who are unfamiliar with the development of open-source software will find this chapter a particularly useful history and summary of developments.

Wendy Pradt Lougee focuses chapter 11 on the profound changes occurring in the world of scholarly communication. Her discussion of the commons explores the increasingly collaborative communities within academia. Whereas university libraries used to be a separate domain from the rest of the academy, the boundaries for producing and disseminating scholarly information, as well as those surrounding the stakeholders involved in the process, have become quite blurred. In the scholarly-communication realm, the focus today is on process rather than product. Lougee looks at the traditional methods of scholarly communication and demonstrates the diversity of norms among academic disciplines. Those differences are evidenced in how particular disciplines have adapted to the digital environment, as well as in how libraries have evolved from being archives or stewards of information goods to being collaborators and potentially catalysts within interest-based communities.

Chapter 12 provides a perfect example of the blurring of the boundaries and stakeholders in the knowledge commons. Economists James C. Cox and J. Todd Swarthout describe a digital library that they, as a teaching facility, built independently of the university's library. At center stage is EconPort, an open-access, open-source digital library for students and researchers in experimental microeconomics—in essence, a new knowledge commons. Cox and Swarthout describe the content of EconPort and the educational philosophy that underlies its creation. From an economist's perspective, they present a marvelous case study of the incentives, risks, and possible negative externalities of creating and maintaining a locally based, discipline-focused digital library and experimental laboratory. They also discuss issues of preservation of such an individualized resource.

Where This Book Leads Us

In this book we are plowing a new field and, perhaps, sowing some seeds. Our hope is that the chapters herein will serve as guideposts for further

research. The book brings together scholars from diverse disciplines, outlines some critical issues within the new types of commons, and presents an analytical tool that helps elucidate the complexities of the rapidly changing environments in the world of knowledge and information.

We hope the readers of this book take away a strong sense that there are indeed analytical commonalities underlying many problems of deep concern today. How do we build effective forms of collective action and self-organizing, self-governing initiatives? How do we break free from path-dependent and limiting systems and creatively design new systems that tap into the limitless capabilities of digital information technologies? How do we effectively safeguard all that is of value in the maintenance and preservation of the cultural and scientific record? Given such a new cornucopia of digital information, how do we assess priorities? How do we evaluate how we are doing? How do we monitor our progress? Who should govern the Internet? How are equity and fairness achieved? How do we protect the interests and creative freedom of authors while also ensuring wide access to new knowledge and information? How are universities going to cover the costs of purchasing journals that are skyrocketing in price? How will the rise of digital repositories affect academic publishers? How are scholarly products that are reproduced digitally going to be preserved for the centuries to come? What are appropriate and effective business models for knowledge preservation?

All of the questions above relate to ongoing challenges in organizing effective institutional arrangements to enhance the production, access, use, and preservation of diverse knowledge commons. This is a fascinating era in which to participate in these interesting questions and to develop better analytical and empirical tools with which to craft answers.

Notes

1. *Commons* is an awkward word in the English language. The same word is used for both the singular and plural forms.

2. For example, see Reese 1995; Aoki 1998; Cohen 1998; Benkler 1998; also Hess and Ostrom 2003.

3. See Wagner 2005, 176, referring to Vincent Ostrom's concept of self-governance.

4. See http://www.iascp.org. This association changed its name to the International Association for the Study of the Commons in June 2006.

5. For a history of modern commons research, see Hess 2000, 2003.

6. Adapted from the *American Heritage Dictionary of the English Language* (1969).

7. Barrett (1998, 288) defines *hyperchange* as "a combination of linear, exponential, discontinuous, and chaotic change."

8. Feeny et al. 1990; Andelson 1991; Hanna, Folke, and Mäler 1996; Bromley et al. 1992. See also *The Comprehensive Bibliography of the Commons* at http://dlc.dlib.indiana.edu/cpr/index.php.

9. The original concept was developed by Frank Michelman in "Ethics, Economics, and the Law of Property" (1982).

10. Heller 1998; see also Heller and Eisenberg 1998.

11. A great deal has been written on various types of information enclosures (see Benkler 1999; Boyle 2003; Bollier 2004; Lange 2003; Lessig 2001; Shiva 2002; David 2000).

12. Benkler (2004, 1110) writes that "production is 'commons-based' when no one uses exclusive rights to organize effort or capture its value, and when cooperation is achieved through social mechanisms other than price signals or managerial directions."

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