

**DNA Rules: Legal Implications  
of Biological “Lock-Out” Systems\***

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*Recent advances in genetic engineering now allow the design of programmable biological artifacts through application of genetic use restriction technologies, or "GURTs." Biological inventions such as transgenic plants are currently protectable under the intellectual property systems of trade secrecy, patent, plant patent, and plant variety protection. But the introduction of GURTs programming may include usage constraints that will alter the balance of ownership and control for biotechnology products. Similar changes have been analyzed in the context of digital content management system, or DRMs; and while this previous work is useful in analyzing issues related to biological programming, the latter technology presents new conceptual problems that require more comprehensive evaluation of the interplay between law and technologically embedded values. In particular, the ability to embed contractual terms in technological artifacts now requires a re-examination of disclosure and consent in licensing transactions involving such artifacts, as well as a re-consideration of commonly employed notions of property and contract.*

INTRODUCTION

The fundamental assumption of the humanities holds that artifacts embody the values of their creators, bearing the indelible stamp of the mind and culture that produced them. This holds true for technology as well as for more palpably cultural objects. Human artifacts, whether technological or artistic, embody certain assumptions as to their proper or intended use. Scholars

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of technology refer to the embedded limitations of artifacts as “prescriptions”<sup>1</sup> or “affordances”<sup>2</sup>: the design constraints that delimit what can or cannot be done with a particular artifact.

More than any other human artifact, information technology embodies within its design rules for its own use. Computer software, for example, comprises a technological artifact that can be programmed or scripted to “behave,” that is, to perform complex functions specified by a programmer. The inscription of software artifacts may include specified constraints on the program’s behavior, such as denial of access to a file without proper authorization. Biotechnology as well has now arrived as true information technology, permitting technological constraints to be purposefully programmed into genetic code. The emerging ability to program genetic code in this fashion blurs the line between law and artifact, and promises to challenge long-held assumptions in the legal regime of ownership and control over such biological artifacts.

I hope in this essay to illuminate these emerging problems by drawing upon some of the insight that has been developed in parallel discussions regarding digital technology, recognizing that those parallel discussions are themselves in their infancy, and may need to be enhanced or extended for my purposes here. In particular, I highlight the problem of distinguishing coded constraints that we might treat as equivalent to law from other types of technologically embedded values. In doing so, I touch upon the broader questions as to whether long-standing discussions of contract law can be effectively applied to technological constraints.

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<sup>1</sup> Bruno Latour (a.k.a. Jim Johnson), *Mixing Humans with Non-Humans: Sociology of a Door Closer*, 35 SOC. PROB. 298, 306 (1988).

<sup>2</sup> See, e.g., Brian Pfaffenberger, *Technological Dramas*, 17 SCI. TECH & HUM. VALUES 282 (1992).

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I shall begin by describing the recent advances in genetic design that allow constraints on the use of plants or other transgenic organisms to be programmed into the organism itself. I then show that this development parallels that in other programmable information technologies, and that current trends in the analysis electronic digital technologies may be properly applied to biological technologies. In particular, the development of programmable biological code implicates a series of difficult policy questions regarding the market power of commodity producers, the autonomous choices of commodity users, and the proper role of the state in regulating programmed constraints.

#### CODED CONSTRAINTS

Gene splicing techniques have enabled the creation of many types of sexually reproducing plants with commercially attractive characteristics: increased nutritional value, resistance to drought and pests, herbicide resistance, and medicinal properties, to name only a few.<sup>3</sup> The economic challenge to development of such plant varieties is that plants reproduce and multiply, as living organisms are wont to do. Even without human intervention, planting a single seed leads to a harvest of many seeds – that is what seeds are designed to do. This reproductive strategy of the plant forms the basis for human agricultural activity; the farmer reaps an excess of seed for food or other uses, typically including the seed needed for the next year's planting.

As a consequence of their natural tendency to proliferate, new varieties of plant may be relatively expensive to create, but are often trivially inexpensive to propagate once they are in

existence –indeed, may propagate even when intended not to do so. This “public goods” problem of distribution at a marginal cost close to zero is common other areas of innovation, even where the subject matter does not reproduce itself.<sup>4</sup> Ideas, books, music, inventions, and other valuable creative or inventive works may be costly to create, but nearly costless to propagate. The conventional wisdom of economics suggests that such items may be underproduced, as the efficient price of distribution for such a good leaves no room for a creator to secure any profit on the investment made to produce the good.<sup>5</sup>

Legal prohibitions have been the typical solution to this problem, although technological solutions have also been employed. Intellectual property law allows the rights holder an exclusive right to the protected good, allowing an artificial inflation of price to recoup the investment made in creating the good. Technological solutions ranging from padlocks and fences to sophisticated encryption algorithms allow potential users to be physically excluded from the good, reintroducing the characteristics of a private good. Both these strategies have now emerged in the case of genetically engineered plants, though with important and unusual aspects not seen in previous incarnations of the problem.

### **Anti-Germination Technology**

Until recently, society has tended to rely upon legal rules to govern the exclusive use of biological inventions. For example, in the United States, at least three distinct regimes of

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<sup>3</sup> United States Congress Office of Technology Assessment. *A New Technological Era for American Agriculture*. U.S. Government Printing Office, Washington D.C., 1992.

<sup>4</sup> William M. Landes and Richard A. Posner, *An Economic Analysis of Copyright Law*. 18 J. LEGAL STUD. 325 (1989).

intellectual property protection govern the use of novel plant varieties. First, a special variation on patent protection, the Plant Patent, covers asexually reproducing plant varieties. Second, since the United States Supreme Court declared in the landmark case of *Diamond v. Chakrabarty* that utility patents cover “anything under the sun made by man,”<sup>6</sup> the statute authorizing utility patents has been interpreted to cover transgenic plant inventions. This interpretation has been explicitly endorsed by the Supreme Court in a more recent decision, *J.E.M. v. Pioneer*<sup>7</sup>, where the court held that overlapping coverage by utility patents and other forms of plant-specific intellectual property protection is permissible.

Finally, a *sui generis* form of intellectual property called Plant Variety Protection encourages development of new varieties of sexually reproducing plants by granting the developer broad control over the growth, use, importation, and sale of a new plant.<sup>8</sup> This American statute implements an international plant variety protection treaty, UPOV. The PVPA statute differs from patent protection in the length and scope of coverage. Unlike patents, but as permitted under UPOV, the Plant Variety Protection Act includes some important exceptions to a seed developer’s control, such as allowing farmers to save seed from a proprietary crop, or permitting agricultural research involving the plant.<sup>9</sup>

Plant variety owners may prefer that their control over the variety were not subject to such exceptions, and so as a condition of access to their seeds, routinely require that farmers

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<sup>6</sup> 447 U.S. 303 (1980).

<sup>7</sup> 534 U.S. 124 (2001).

<sup>8</sup> 7 U.S.C. § 2402

<sup>9</sup> International Convention for the Protection of New Varieties of Plants, Dec. 2, 1961, as revised 33 U.S.T. 2703, 815 U.N.T.S. 89.

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contractually waive their rights to save seed or engage in other legally permissible uses.<sup>10</sup> Often the terms of this contract are printed on or attached to the bag of seed; by using the seed, the contractual “fine print” purports that the farmer has agreed to the terms.<sup>11</sup> However, it is difficult to police the use of seed and to enforce the terms of such “seed-wrap” licenses. To do so, seed developers must send agents out into farmers’ fields to sample crops, looking for unlicensed users of proprietary seed. When such uses are found, costly legal procedures may be necessary to halt the use, force acceptance of a license, or recover unpaid royalties.

The problems of detection and enforcement might be lessened if seed could be designed to be “self-policing,” that is, unsuitable for use without the developer’s permission. Newly available transgenic technologies dubbed “GURTs,” for “Genetic Use Restriction Technologies” allows for the creation of such “self-policing” seed.<sup>12</sup> Genetic elements that produce a toxin late in seed development may be introduced into the plant variety.<sup>13</sup> The toxin kills the seeds after the plant has matured, producing a viable crop for the farmer, but forcing him to return to the seed producer for new seed each year. Even in the absence of a contractual obligation not to save seed, the technology makes saving seed impossible. Thus, the genetically altered seed in essence carries within its own makeup a prohibition on unlicensed use.

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<sup>10</sup> Neil D. Hamilton, *Legal Issues Shaping Society’s Acceptance of Biotechnology and Genetically Modified Organisms*, 6 DRAKE J. A.G. L. 81 (2001).

<sup>11</sup> Mark D. Janis & Jay P. Kesan, *Intellectual Property Protection for Plant Innovation: Unresolved Issues after J.E.M. v. Pioneer*, 20 NAT. BIOTECHNOLOGY 1161 (2002).

<sup>12</sup> Keith Aoki, *Neocolonialism, Anti-Commons Property, and Biopiracy in the (Not-So-Brave) New World Order of International Intellectual Property Protection*, 6 INDIANA J. GLOBAL LEGAL STUD. 11, 54 (1998). The most widely publicized embodiment of this technology has been dubbed the “terminator” gene. I have chosen to avoid this nomenclature, in part because it has assumed certain rhetorical implications that are unhelpful to serious analysis of the technology’s impact, and in part because I wish to avoid confusion: in molecular biology, the term “terminator” refers to a specific type of genetic control sequence that is not employed in GURTs.

<sup>13</sup> See U.S. Patent No. 5,723,765, Control of Plant Gene Expression (Mar. 3, 1998); see also M.L. Crouch. *How the Terminator Terminates: An Explanation for the Non-scientist of a Remarkable Patent for Killing Second Generation Seeds of Crop Plants*, Edmonds Institute, 1998. (<http://www.bio.indiana.edu/people/terminator.html>)

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Indeed, the “terms” of usage embedded in such genetic code may be quite sophisticated. In one embodiment of the technology, it is possible to introduce into the seed a genetic "switch" that will repress, or turn off, the toxin production when the seed is exposed to a particular chemical. This in effect supplies a chemical “password” to seed activate germination, and which can be used to control the terms of seed usage from year to year. Yearly application of the control chemical, obtained from the seed owner for payment, would allow the owner to activate or deactivate seeds in return for prescribed payment. One can easily envision other types of switches, sensitive to temperature, precipitation, soil alkalinity, or other environmental factors, that could be used to limit use of the seed to certain geographical regions or seasonal applications. Indeed, plants could be engineered for various desirable properties - pest resistance, drought resistance, superior yield, and so on - and particular attributes activated or deactivated depending on the price paid by the purchaser.

Although the patent on this technology is directed to control of plant development, similar genetic control elements are known in other organisms, and there is no particular reason that such technology need be confined to plants. Since the advent of genetically engineered animals, beginning with the “Harvard Oncomouse,” the ability of the animal to reproduce has posed a challenge to the owners of proprietary rights in the organism: does the purchase of a patented animal confer the right to breed or use subsequent generations of the animal, and if not, how can the patent holder control subsequent generations?<sup>14</sup> Much as in the case of genetically altered seed, this problem has been largely handled via licenses that either include or exclude the

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<sup>14</sup> Rebecca Dresser, *Ethical and Legal Issues in Patenting New Animal Life* *Jurimetrics Journal* 28 JURIMETRICS J.399 (1988); United States Congress Office of Technology Assessment, *New Developments in Biotechnology: Patenting Life*, 121 (1989).

right to breed the animal.<sup>15</sup> But once again, due to policing and enforcement problems, as well as the opportunity for price discrimination, the availability of a genetic system to activate or deactivate a genetically engineered trait might be highly attractive to the creators of such animals.

The prospect of germ-line alteration of human subjects has been even more controversial although for somewhat different reasons, primarily relating to the ethical controversy of altering traits in future generations who have had no opportunity to consent to such alterations.<sup>16</sup> A full exploration of this issue is impossible within the scope of this essay, but I will note that some of the ethical objections to germ line therapy might be addressed by a control system that could deactivate germ-line therapies in future generations, unless perhaps they requested activation of the trait. A more likely, but no less troublesome application of the technology might be found in somatic cell therapies. Genetic regulatory elements analogous to those in plant applications could equally well be added to the transgenic DNA cassettes contemplated for human gene therapy, placing recombinant genes in human cells under similar proprietary control.

One can easily envision genetic therapies for certain diseases, such as diabetes or hemophilia, which are caused by the failure of a particular gene in the body to produce a particular protein. A recombinant genetic “cassette” containing a healthy copy of the defective gene could be introduced into the patient’s cells in order to supply the missing protein.<sup>17</sup> The cassette could include regulatory elements allowing the gene to be activated or deactivated by administration of a proprietary pharmaceutical; so long as the patient were supplied with the

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<sup>15</sup> Robert P. Merges, *Intellectual Property in Higher Life Forms: The Patent System and Controversial Technologies*, 47 MARYLAND L. REV. 1051 (1988).

<sup>16</sup> LeRoy Walters & Julie Gage Palmer. *The Ethics of Human Gene Therapy*. Oxford University (1997).

pharmaceutical, the gene would continue to prevent the disease. Such a system might perhaps to allow the recipient to pay for the therapy over an extended period of time, rather than all at once. The supplier of the treatment could exercise self-help if payment were not forthcoming. Of course, under the current system, the supplier would presumably have legal recourse for non-payment, but for the reasons described above, self-help might be a more attractive form of recourse. Consequently, it is possible to envision eventual application of GURT's technologies to a wide range of biotechnological products.

### **Content Management Technology**

The description of seed licensing offered above bears an uncanny resemblance to the history of content licensing in digital media.<sup>18</sup> Digital technology offers inexpensive and widespread access to the means of reproducing and distributing copyrighted materials. As PVPA provides legal protection for seeds, copyright law affords the owners of digital content some recourse against many unauthorized uses of their material, but copyright is subject to a host of consumer uses that require no authorization from the copyright holder. Owners of digital content, much like seed owners, have long wished to escape the consumer privileges afforded by copyright law. They have done so through the fiction of the "shrink-wrap" license, which

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<sup>17</sup> P.D. Robbins, *Retroviral Vectors in, Gene Therapy, Principles and Applications* 18 (Thomas Blankenstein, ed. 1999).

<sup>18</sup> Charles R. McManis, *The Privatization (or "Shrink-Wrapping") of American Copyright Law*, 87 CAL. L. REV. 173 (1999).

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purports to restrict a purchaser's use of the accompanying product.<sup>19</sup> The license takes its name from the legal fiction that the purchaser demonstrates agreement to the license terms by breaking the "shrinkwrap" cellophane on the product package. More recently, such "clickwrap" using the mouse to click on a graphic labeled "I agree."<sup>20</sup>

However, courts in the United States have in many cases been reluctant to enforce such agreements because the purchaser may have no opportunity to review the license prior to opening the package.<sup>21</sup> Proponents of mass-market licenses for software have complained that such agreements have long since been accepted in most other areas of commerce.<sup>22</sup> This observation is true, so far as it goes, but of, say, a car rental agreement has at least a nominal opportunity to read the agreement before the rental occurs; in the case of shrinkwrapped licenses, even the fiction of a pre-transaction opportunity to review is absent. "Clickwrap" agreements similarly often involve after-market agreement to use software pre-installed on a computer the consumer has already purchased. The situation has not changed appreciably with the advent of electronic commerce; proposed rules for information licensing would permit a merchant to change the terms of the agreement by posting the new terms somewhere on the Internet, or by sending the purchaser an e-mail message that would be considered effective even if the purchaser never actually receive the message.

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<sup>19</sup> David W. Maher, *The Shrink-Wrap License: Old Problems in a New Wrapper*, 34 J. COPYRIGHT SOC'Y. 292 (1987); Deborah Kemp, *Mass Marketed Software: The Legality of the Form License Agreement*, 48 LA. L. REV. 87 (1987).

<sup>20</sup> Mark Lemley, *Shrinkwraps in Cyberspace*, 35 JURIMETRICS J. 311 (1995).

<sup>21</sup> Mark Lemley, *Beyond Preemption: The Law and Policy of Intellectual Property Licensing*, 87 CAL. L. REV. 111 (1999); Mark Lemley, *Intellectual Property and Shrinkwrap Licenses*, 68 S. CAL. L. REV. 1239 (1995).

<sup>22</sup> Robert W. Gomulkiewicz & Mary L. Williamson, *A Brief Defense of Mass Market Software License Agreements*, 22 RUTGERS COMP & TECH. L.J. 335 (1996).

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In some circumstances, such licenses may be limited by contract doctrines of unconscionability, or preempted by federal policy governing the rights the contract seeks to allocate. This may occur, for example, where the contract would frustrate the movement of intellectual property into the public domain as intended by Congress, or mandated by the Constitution. Some commentators have suggested that overreaching attempts to limit access to uncopyrighted portions of a work governed by the contract, or to limit fair use of the work, could run afoul of federal copyright or patent policy. This is in part due to the mass-market nature of such provisions; proponents of such licenses protest that, unlike property rights which are good against the world, contracts bind only the parties to the agreement. But when every user of a product is required to acquiesce in the same agreement, the contract begins to resemble an effective property right, one which has different and potentially conflicting bounds from those set by Congress. To the extent that such a blanket contract provision frustrates federal policy, the Supremacy clause dictates that the state law contract must give way.

In the face of uncertain enforcement by the courts, software vendors have sought to legitimate such practices by promulgation of the Uniform Computer Information Transaction Act, or UCITA, which has been adopted in two states, although rejected in several others.<sup>23</sup> UCITA purports to be neutral on the question of preemption<sup>24</sup>, as well as on the question of unconscionability,<sup>25</sup> but is clearly intended to legitimate formation of standardized, non-negotiated information licenses.

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<sup>23</sup> Niva Elkin Koren, *A Public-Regarding Approach to Contracting Over Copyrights* in EXPANDING THE BOUNDARIES OF INTELLECTUAL PROPERTY: INNOVATION POLICY FOR THE KNOWLEDGE SOCIETY 191 (Rochelle Cooper Dreyfuss, Diane Leenheer Zimmerman, & Harry First, eds., 2001).

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Several recent cases seem to indicate a trend toward legitimization of such licenses through adaptation of general contract law. Legitimation may also come via promulgation of licenses containing choice of law-provisions that contemplate the laws of Maryland or Virginia, where versions of UCITA have been enacted. Yet even if such licenses become more frequently enforceable, it is still extremely difficult for copyright holders to police such agreements. Consequently, copyright owners have begun deploying sophisticated software "lock-out" systems that prevent access to digitized content except on the terms dictated by the owner.<sup>26</sup> Such content management software, sometimes called "digital rights management" or "DRM" systems, may govern a wide range of user behaviors, such as the number of times a work may be accessed, or the duration of access, the ability to reproduce or transmit the work, or the payment schedule for additional uses access.<sup>27</sup>

For example, the management system might be programmed to permit only one playback of a work, or allow only one copy of a work to be printed. Users may be able to pay for different levels of access and use if they wish to make additional copies or engage in additional playback of the work. Technological protection may also be combined with legal mechanisms; for example, access to technologically controlled content may be provisioned on agreement to a clickwrap-type license that purports to restrict the permissible uses of the work.<sup>28</sup> Similarly, the content management system may permit the owner to shut off the software remotely if the user

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<sup>26</sup> Julie E. Cohen, *Reverse Engineering and the Rise of Electronic Vigilantism: Intellectual Property Implications of "Lock-Out" Programs*, 68 S. CAL. L. REV. 1091 (1995); Julie E. Cohen, *Some Reflections on Copyright Management Systems and Laws Designed to Protect Them*, 12 BERKELEY TECH. L.J. 161 (1997).

<sup>27</sup> Mark Stefik, *Shifting the Possible: How Trusted Systems and Digital Property Rights Challenge Us to Rethink Digital Publishing*, 12 BERKELEY TECH. L.J. 137 (1997).

<sup>28</sup> Michael J. Madison, *Legal-Ware: Contract and Copyright in the Digital Age*, *Fordham Law Review*, 67 FORDHAM L. REV. 1025 (1998).

fails to make the required payment in a timely manner; a controversial provision of the UCITA statute makes agreement to such “self-help” a valid term of computer information licenses.<sup>29</sup>

In this environment where technology provides the first line of defense against unauthorized uses of content, the legal protection preferred by content owners may be not so much a deterrent against violation of copyright or similar proprietary rights, but legal deterrents against circumvention of technological protections.<sup>30</sup> In the United States, they have gained such protection in the form of the Digital Millennium Copyright Act, or DMCA, which prohibits circumvention of technical protection measures, and trafficking in technology that would facilitate such circumvention.<sup>31</sup> This statute effectively provides content owners a new right of technological access, independent of any intellectual property right. Language promulgating similar legal measures has appeared in a recent European Union Copyright directive.<sup>32</sup>

The implications of this development are striking: By implementing technical constraints on access to and use of digital information, a copyright owner can effectively supersede the rules of intellectual property law. For example, as described above, the copyright owner may decide that the technological controls will not permit any copying of the controlled content, whether or not the copying would otherwise constitute fair use. If the integrity of the controls is backed by the state, as it is under the DMCA’s anti-circumvention provisions, the result is to shift enforcement of the rights-holder’s interest from penalties for unauthorized infringement to penalties for unauthorized access. When combined with UCITA provisions favoring the

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<sup>29</sup> Eric Schlachter, *The Intellectual Property Renaissance in Cyberspace: Why Copyright Law Could Be Unimportant on the Internet*, *Berkeley Technology Law Journal* 12 BERKELEY TECH. L.J. 15 (1997).

<sup>30</sup> Kenneth W. Dam, *Self-Help in the Digital Jungle*, 28 J. LEGAL STUD. 393(1999).

<sup>31</sup> Digital Millennium Copyright Act, Pub. L. No. 105-304, 112 Stat. 2860 (1998).

<sup>32</sup> Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the harmonization of certain aspects of copyright and related rights in the information society, 2001 Q.J. (L. 167) 10.

licensing terms promulgated by information producers, these developments dramatically alter the balance of ownership and control of new technologies.<sup>33</sup>

#### PROGRAMMING BIOLOGICAL “CODE”

The design of genetic products may equally dramatically alter the balance of ownership and control in biological technologies due to the constraints or values embedded in those designs, and the ability of consumers to exercise choice regarding the use of those products. Where either biological or digital technological constraints substitute for legal constraints, control over the design of information rights is shifted into the hands of private parties, who may or may not honor the public policies that animate public access doctrines such as copyright fair use or a PVPA “farmer’s exemption.” Rights-holders can effectively write their own intellectual property statute in either software or DNA. This shift in control challenges the traditional role of the state in determining the limits of property and contract, as well as the accepted philosophical assumptions underlying these legal institutions.

#### **Lex Informatica**

The development of digital content management systems has been recognized as a graphic demonstration of the power of technology to regulate behavior. As both Larry Lessig<sup>34</sup>

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<sup>33</sup> Niva Elkin Koren, *A Public-Regarding Approach to Contracting Over Copyrights*, *supra* note \_\_\_\_.

<sup>34</sup> LAWRENCE LESSIG, *CODE AND OTHER LAWS OF CYBERSPACE* (1999).

and Joel Reidenberg<sup>35</sup> have pointed out, technical standards are within the control of the designer, and so confer upon the designer the power to govern behavior with regard to that system. Once constraints on behavior are built into the technical standards governing a technology, the technical standards effectively become a new method for governing use of that technology – in essence, the technical standards become a type of law. Such technical rule sets may supplement or even supplant the legal rule sets designed to govern the same behavior.

Consider, for example, an example suggested by Latour,<sup>36</sup> in which the state wishes to enforce safety standards by requiring all automobile drivers to use seat belts.<sup>37</sup> One method to produce the desired behavior is to pass laws penalizing the failure to use such harnesses. However, an alternative method to produce the desired behavior is to fit automobiles with seatbelt interlocks that prevent the car's ignition from functioning unless the seatbelt is fastened to complete an electronic circuit. Either method controls the behavior of drivers, penalizing the failure to buckle up, in the first instance by means of a fine, and in the second by disabling the operation of the automobile. Thus, government may choose to employ or enforce technical standards to achieve goals that might otherwise be achieved by legal rulemaking. Such use of technological rules to govern behavior has been dubbed by Joel Reidenberg as "lex informatica."<sup>38</sup>

Reidenberg in particular has examined in detail the complex set of interactions through which governmental action can shape technological standards into a substitute for legal controls.

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<sup>35</sup> Joel Reidenberg, *Lex Informatica: The Formulation of Information Policy Rules Through Technology*, 76 TEXAS L. REV. 553 (1998).

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<sup>37</sup> Bruno Latour, *Where are the Missing Masses? The Sociology of a Few Mundane Artifacts in SHAPING TECHNOLOGY/BUILDING SOCIETY: STUDIES IN SOCIOTECHNICAL CHANGE* 225 (Weibe E. Bijker & John Law, eds., 1992).

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For example, the state may implement the technological alternative through a variety of regulatory mechanisms, from a variety of sources. Most directly, the state might simply require automobile manufacturers to install seatbelt interlocks on all cars produced.<sup>39</sup> Alternatively, courts, or legislatures acting through courts, could impose liability for deaths or injuries on manufacturers who fail to install seatbelt interlocks, creating an incentive to include the feature in cars. Similar liability could be imposed on car drivers or owners, creating a consumer demand for manufacturers to install the devices. Ancillary social actors, such as insurers, may also be mobilized to ensure installation of the technological feature, as for example will occur if liability is imposed on drivers who fail to adopt the technology, and insurance payments for such drivers increase. Insurers will presumably decrease premiums for drivers who lessen their liability by adopting the technology, partially subsidizing the cost of adoption.

*Private Lawmaking*

The design of technological rule sets, however, is not the sole provenance of the state; indeed, it is more often left to private parties. In the case of digital content management systems, copyright owners determine the rules that are embedded into the technological controls. These embedded rules effectively supplant statutory copyright rules, as choices that might be permitted under the statute become physically impossible. Moreover, to the extent that the DMCA appears to legitimate technological controls over copyrighted works, without regard to their effect on

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<sup>38</sup> See Reidenberg, *supra* note \_\_\_\_.

<sup>39</sup> Jerry L. Mashaw & David L. Harfst, *THE STRUGGLE FOR AUTO SAFETY* (1990).

public policy, the statute effectively grants rubber-stamp approval to such private legislation.<sup>40</sup> Although there exists at present no similar anti-circumvention statute for genotechnology, other private property statutes might be impressed into service to produce the same result. For example, prior to passage of the DMCA, attempts were made to characterize circumvention of digital rights management technologies as violations of copyright or patent in the protective software.<sup>41</sup> Similarly, the anti-germination technology described here is patented, so that attempts to tamper with it or reverse engineer it could constitute patent infringement. When so employed, the patent in the anti-germination technology essentially becomes a form of anti-circumvention law.

The development of such technological use controls, whether in either software or transgenic corn, has raised concern because it substitutes private technological rules for the public statutory rules declared by Congress in respectively in the Copyright Act or Plant Variety Protection Act. Producers who employ such lock-out technology may in essence become private legislatures, imposing rules of usage without regard to the broader public interest that informs democratic rule-making.<sup>42</sup> This problem has been well explored with regard to digital technology; the instantiation of a proprietary rule in genetic code, which following Reidenberg we might call “lex genetica,” is the first example of regulation through genetic code, but is unlikely to be the last.

Of course, the promulgation of technologically embedded rule sets is not the first situation in which private allocation of rights in information has been encouraged and enforced

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<sup>40</sup> Niva Elkin-Koren, *The Privatization of Information Policy, Ethics and Information Technology*, 2 ETHICS & INFO. TECH. 201 (2000).

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by public institutions. Most notably, the coercive power of the state is routinely brought to bear in the case of contractual agreements, such confidentiality agreements and intellectual property licenses. Since technical controls can impose conditions that formerly might have been the subject of a detailed license agreement, such controls might be viewed as equivalent to a sort of licensing regime. Then, extending the analogy, penalties for circumvention of the technological constraints simply stand in for the private law of contract, which penalizes breach of license.

But such a comparison to contract law by no means justifies employment of technical controls that contravene established public policy. Where traditional contracts are at issue, carte blanche enforcement of private agreements has never been the rule in Anglo-American law. When such agreements are found illegal, unconscionable, or simply in violation of public policy, they are held unenforceable.<sup>43</sup> Because contract law is state law, a similar result also may be reached on grounds of federalism: where enforcement of a state law contract would violate the public policy inherent in the federal intellectual property scheme, or that embedded in the Constitution itself, such contractual provisions are preempted. An attempt to leverage the federal statutory right beyond the limits set by federal policy constitutes grounds for voiding the contract.

To the extent that “code” confronts us with behavioral constraints that are somehow analogous to legally enforceable contractual provisions, we presumably face much the same dilemma with regard to hardwired constraints that we have previously faced with regard to contractual constraints. This point has perhaps been argued most forcefully by Julie Cohen,

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<sup>42</sup> J.H. Reichman & Jonathan Franklin, *Privately Legislated Intellectual Property Rights: Reconciling Freedom of Contract With Public Good Uses of Information*, 147 U. PENN. L. REV. 875 (1999).

<sup>43</sup> Restatement (Second) of Contracts, § 178.

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although not in precisely these terms, when she opines on the potential for constitutional preemption of certain technological content management constraints.<sup>44</sup> Cohen suggests that the coercive power of the state should be extended in support of technological constraints no farther than it may be to enforce statutory or contractual constraints. This conjecture, which Lessig has dubbed the “Cohen Theorem,” might be applied in either private or public law settings to restrain the implementation of technological constraints by, respectively, individuals or the state.

Under the “Cohen theorem” analysis, there is no reason to suppose that technological analogs to contracts should be privileged over the legal instruments themselves. Where rights management systems attempt to impose restrictions on access to or use of informational content that would be improper in a contractual agreement, the restrictions should be viewed as equally repugnant to public policy and equally void. Stated differently, where the Constitution imposes limits on the government’s creation and recognition of property rights in intellectual goods, those limits apply equally to both legally and technologically delineated property. In some instances of overreaching via technological controls, the Constitution may even demand a limited self-help right, or “right to hack,” to surmount privately erected technological barriers to information that the Constitution requires be publicly accessible.

One would expect a similar result with regard to parallel provisions in “seed-wrap” licenses. For example, federal policy granting a research exemption or farmer’s exemption under PVPA might abrogate seed-wrap terms that would frustrate the intent of such provisions. The Supreme Court *J.E.M.* decision indicates that utility patents may also be the basis for some

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<sup>44</sup> Julie E. Cohen, *Copyright and the Jurisprudence of Self-Help*, 13 BERKELEY TECH. L.J. 1090 (1998).

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seed licensing.<sup>45</sup> Although such patents lack meaningful research or farmer's exemptions, overreaching patent licensing might constitute misuse of the patent or an anti-trust violation in excess of the rights intended by the statutory grant. In cases where such misconduct occurs, courts have declined to enforce the license, and overreaching seed-wrap based on patent rights might be void on such grounds.

Yet, even assuming the preemption of some "seed-wrap" terms, it is less clear what rights might form the jurisprudential basis for a "right to hack" equivalent technological lock-out measures outside the context of digital technology. The tension between free speech and copyright is well-defined and well-documented, and the limits upon Congressional power have been the subject of long scrutiny. Technological controls over creative works are only the most recent chapter in that policy discussion. Biological controls appear to lack any similar policy precedent. Unlike content management systems, anti-germination systems do not implicate a fundamental human right to receive information. No court has ever recognized a constitutional right to save seed, or to engage in agricultural research. Some commentators have argued in favor of a general First Amendment right to engage in scientific research,<sup>46</sup> but the legitimacy of such arguments is unsettled, and their application to proprietary organisms uncertain.<sup>47</sup>

Internationally, a variety of commentators, particularly those in the developing world or concerned with the development of poorer nations, have raised objections to GURTs as a threat to adequate food supplies. The concentration of seed technology in a very few firms, when

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<sup>46</sup> Harold P. Green, *Constitutional Implications of Federal Restrictions on Scientific Research and Communicatio*, 60 UMKC L. REV. 619- (1992); Richard Delgado & David R. Millen., *God, Galileo, and Government: Toward Constitutional Protection for Government*, *Washington Law Review*, 53 WASH. L. REV. 349 (1978); John A. Robertson, *The Scientist's Right to Research*. *California Law Review*, 51 CAL. L REV. 203 (1977).

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accompanied by legal or technological exclusivity, could make needed agricultural technology inaccessible to poorer nations. The production of adequate food implicates a human right that in many quarters would be viewed as more fundamental, or at any rate more pressing, than the right to free expression. International human rights conventions list adequate food as a fundamental right,<sup>48</sup> although it is unclear what this might mean in the context of U.S. law. No serious jurisprudence has developed in the U.S. concerning this right, and the incorporation of international obligations into American law is a topic beyond the scope of this paper.<sup>49</sup> Nonetheless, this illustrates the possibility of looking beyond the U.S. constitution for a compelling public policy interest that may in some ways parallel the speech interest in analyses of digital content.

In some instances, a “right to hack” anti-germination technology might be inferred from the constitutional jurisprudence of supremacy. To the extent that anti-germination technology interferes with federal policy embodied in the PVPA, such as a federally promulgated right to save seed, or a right to conduct research, it might be treated as equivalent the state law contract that it supplants: both the contract and the technological lock-out system must give way before federal policy. This argument has less force where the contract or its technological equivalent sound in patent rights that do not provide for such user privileges; patents that overlap PVPA rights appear under the *J.E.M.* analysis to eradicate the exemptions in the latter. Contract or technology arising from such patents might be seen to do the same. But the technology equivalent to patent license might be seen overreach in the same manner as a patent license, such as misuse, giving rise to a user right to circumvent the technological control. It is important to

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note that no explicit anti-circumvention statute currently prohibits the “hacking” of GURTs biological controls. However, because the technology is patented, direct and contributory patent infringement may preclude circumvention of GURTs; thus, enforcement of the patent that precludes GURTs “hacking” might be denied under the “Cohen theorem” analysis.

However, the right to hack GURTs presents certain practical problems; even if a sound legal basis for overriding legal protections can be found, the practical implementation of a “right to hack” may be problematic outside the context of digital technology. There appears to be no comparable community of biological “hackers” who might either personally have the skill to circumvent biological lock-out coding, or to supply users with the tools to circumvent such code. Unless such tools are available, it is unclear how efficacious a right to circumvent GURTs would be.

### **Technological Scripts**

Technical controls on digital or biological system therefore challenge the existing order of control and ownership for technology, moving product usage discretion away from users and toward producers, and concomitantly moving control decisions away *ex post* enforcement and toward *ex ante* design decisions. However, the application of technological controls as substitutes for legal controls may in some senses be viewed as a subset of a more general phenomenon. The use of technological constraints to channel behavior predates programmable artifacts, and the idea that technology embodies rules is not new. Bruno Latour identified the

“scripted” nature of different artifacts, pointing out for example that out automobile seatbelts with ignition interlocks embody type of “script” requiring a driver to take the particular action of fastening the seatbelt before driving.<sup>50</sup> Similarly, a locked door effectively embodies a rule against unauthorized entry. These artifacts are not programmable in the sense that software or DNA may be programmed with a wide range of attributes, but nonetheless the physical construction of the door enforces its particular prohibition, just as the electro-mechanical “script” of the ignition interlock enforces its particular prohibition.

In digital media, a similar physical design “script” might be illustrated by the recent production of DVDs that, much like the anonymous directive audio tapes in the old *Mission: Impossible* television show, self-destruct after use. The DVDs are formed of a substance that degrades after the packaging is opened, limiting the life of the product after purchase.<sup>51</sup> The discs are composed of a polymer that begins to darken when exposed to air; when the reaction reaches a certain degree of opacity, the data on the disc can no longer be read by the laser in a playback machine. The polymer can be formulated so that the darkening process takes 24, 48, or some other specified number of hours, so that the consumer essentially pays for a set period of access to the content. The process can reportedly be slowed by refrigeration, but irreversible characteristic of the product’s physical structure.

The composition of such DVDs provides a relatively simple design script DRM and GURTs systems may embody more complex scripts. Thus, although programmability certainly increases the range and complexity of artifactual “scripts,” this may represent a difference of

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<sup>50</sup> See Latour, *supra* note \_\_\_\_.

<sup>51</sup> Eric A. Taub, *DVDs Meant for Buying but Not for Keeping*, The New York Times, July 21, 2003, at C1.

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degree, rather than a difference of kind. Myriad user constraints are built routinely built into all kinds of artifacts, and all of them will entail some set of values: the hinge design causes the door to swing in a particular direction, the doorknob is set at a particular height and requires a certain degree of manipulation to open, and so on. Many of these constraints go unnoticed as part of the artifactual backdrop of society, while other constraints implicate important social values, either supporting or frustrating such values. Such effects may be intentional or unintentional; the door may be unintentionally difficult for physically disabled persons to open, or may be intentionally difficult for small children to open, or may even unintentionally frustrate use by the physically disabled precisely because it was designed to retard use by small children.

The creation of such artifactual “scripts” may be influenced by state action. As suggested by the seatbelt example above, technological design may be either directly or indirectly determined by a range of regulatory interventions.<sup>52</sup> But in market-based economies, such intervention is typically limited to design features that have a noticeable effect on public health or safety, or to extraordinary regulation, such as removal of architectural barriers to the disabled.<sup>53</sup> The vast majority of technological choices go largely unregulated, as we primarily entrust to market forces the task of weeding out over time the most inefficient or unusable designs. Although it is understood that such markets may be subject to network effects, incomplete information, and a wide range of market failures that could in fact hamper the efficient development of such designs, the market approach is assumed on the whole to operate more ably than command and control intervention by the state. At the same time, this market approach itself undoubtedly imbues the resulting artifacts with particular embedded values

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<sup>52</sup> MASHAW & HARFST, *supra* note \_\_ .

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At the same time, users of any given technology will for the most part be unaware of the values embedded in a given technological system. Indeed, this is one of Reidenberg's key objections to a wholly "free market" approach to information technology development: that all unknown to the general populace, it cedes to technologists choices that may later dictate the freedom or constraints upon users.<sup>54</sup> Reidenberg's preferred solution appears to be one of governmental oversight or involvement, at least in democratic states. Governmental bodies may exercise such oversight through a variety of channels, including direct regulation, standard-setting, procurement, criminal or civil penalties, and so on. Reidenberg reasons that involvement by elected officials, or at least by bureaucrats answering to elected officials, better reflects and implements the will of the majority than does independent design by unelected technocrats.

But as detailed above, explicit legal or regulatory intervention into technological design is relatively rare, and for good reason. Unless we are willing to countenance wholesale state oversight of every routine design decision, we must somehow separate out those design constraints that implicate public policy from those that we have previously treated as innocuous, or at least as routine. This separation has long been taken for granted; in a conventional transaction involving the use or exchange of an artifact, we have typically separated the values embedded in the artifact from the disembodied values instantiated in the law governing the transaction. For example, when a consumer purchases an automobile featuring seat belt interlocks, we could conceptualize as a term of the transaction, embedded in the artifact, "the purchaser will be required to fasten her seatbelt prior to driving." We have not done so, however, and in fact tend to separate even a public legal requirement to use seatbelts from the

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terms of the private transaction; no promise to use seatbelts is written into automobile sales contract or leases, despite laws requiring seatbelt use.

To be sure, some regulatory intervention may occur at the point of legal transaction if the nexus between the two seems sufficiently close. The licensing of the vehicle, or transfer of the license, may be incorporated into the transaction, if for no other reason than it provides a convenient control point for the state to ensure that such licensing occurs. But conceptual nexus for such incorporation has been relatively rare. Returning to the case of the automobile, other regulatory interventions, such as the requirement that the driver be licensed, or carry proper accident insurance, appear to have an insufficient nexus with the sale of the vehicle.

In much the same way, explicit legal or regulatory intervention into “private lawmaking” via contract is relatively rare. If our past experience with law in fact maps onto the territory of technological constraints, we would expect only a subset of such constraints to trigger legal safeguards, such as the Cohen Theorem – the vast majority of both private and public lawmaking goes relatively unremarked, routinely functioning without the application of extraordinary judicial or constitutional remedies. Only a small number of contracts are struck down as unconscionable or void for public policy, just as few statutes are struck down as unconstitutional. Yet the current literature analyzing technological constraints gives no clear guidance on where routine or garden variety design choices may begin to shade over into legally cognizable constraints, or which legally cognizable constraints should be the abrogated as contrary to existing public policy.

## TAKING CODE SERIOUSLY

Summing up to this point: I have argued that the advent of programmable technical constraints creates two intertwined difficulties: first, determining where legally cognizable technology choices leave off and where routine, if sometimes troubling technological design choices begin; and second, once legally relevant technology choices have been identified, determining how social policy choices that have been implemented in law will be implemented in its technological analogs. The lines drawn in each case may differ according to the technology involved, as biological “lock-out” systems arise in a different milieu than analogous digital control mechanisms. These conclusions have disturbing theoretical and practical ramifications regarding the justification of substantive contract law, as well as in the theory of contract and property.

### **Code and Contract**

The development of technological protections has been closely tied to the development of standardized mass-market contracts for licensing intellectual property. Whether shrink-wrap associated with software, or “seedwrap” associated with transgenic plants, such contracts may serve as an adjunct to technological protections, setting the terms for authorized access or use. In other cases, the contracts and the technological protections serve to some degree as substitutes, although the latter form of protection is as a practical matter more stringent, lacking not only the monitoring and enforcement costs, but also the flexibility of its legal counterpart.

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But if the emergence of technological protections provides a source of controversy, so too has the emergence of the form contract. As I have briefly indicated above, the development of the standardized form contract has challenged the traditional notion of contract as an informed exchange of legally binding promises. Despite their proliferation in many areas of commerce, such contracts certainly are not read or understood by the majority of those they purport to bind, and so they cannot be enforced – as they quite routinely are – on the basis of conscious agreement. As Rakoff famously observed, the terms of such standardized agreements tend to become “invisible” to consumers, who will remain rationally ignorant to their provisions unless and until they are surprised by some term to which they have supposedly agreed.<sup>55</sup> Agreement to such contracts’ terms, as agreement is generally understood, cannot credibly even rise to the level of a legal fiction.

Noting this problem, commentators have sought to rehabilitate the mass market contracts as agreement premised on a different kind of consensus between buyer and seller.<sup>56</sup> This view shifts the agreement to bargains on the basis of consent – a type of generalized, rationally ignorant, blanket consent to be bound by a legal obligation of some sort, even if the party is quite unaware of what sort of obligation she is undertaking. Unfortunately, this rationalization for such contracts proves equally unsatisfactory, as blanket enforcement of terms under such a theory could only prompt the drafter to attempt the most outrageous terms possible, and the consumer surely cannot seriously be regarded as acquiescing to such terms. Admittedly, a court may after the fact declare void or unconscionable the most outrageous terms, but this leaves the

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<sup>55</sup> Todd D. Rakoff, *Contracts of Adhesion: An Essay in Reconstruction*, 96 Harv. L. Rev. 1174 (1983).

<sup>56</sup> See Randy E. Barnett, *Consenting to Form Contracts*, 71 Fordham L. Rev. 627 (2002).

consumer alternately at the mercy of the vendor or the mercy of the judge – an odd form of “consent.”

Given the difficulty of explaining these agreements as any sort of “agreement,” whether actual or implied, the explanation of standardized contracts has increasingly shifted to a theory of contract as product.<sup>57</sup> Under this view, the contract itself is the product being purchased, or at a minimum, becomes a feature of the product being purchased. From the consumer’s perspective, purchasing a movie disc that self-destructs after 48 hours is economically equivalent to purchasing a movie disc that she is contractually obligated to cease viewing after 48 hours – the consumer receives two day’s worth of value in either case. Setting aside the opportunity for contractual breach, the farmer views seeds that will not reproduce and seeds accompanied by a contract forbidding re-use in the same fashion. The provisions of the mass-market contract become “take it or leave it” terms, just like the characteristics of any other off-the-shelf mass market product.

It is this last conceptual shift that presages the introduction of technological protections into seeds or into software, and provides the framework for considering the substitution of technology for contract.<sup>58</sup> Scripted or programmable artifacts take this rationale to its ultimate conclusion, by which the contract becomes in fact not merely an economic feature of the product, but an embedded physical feature as well. The contract need no longer be considered a conceptual feature adjunct to the product, but rather an actual feature of the product. Rakoff’s

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<sup>57</sup> See Margaret Jane Radin, *Humans, Computers, and Binding Commitment*, 75 *Ind L.J.* 1125 (2000).

<sup>58</sup> See Radin, *supra* note \_\_; Margaret Jane Radin, *Online Standardization and the Integration of Text and Machine*, 70 *Fordham L. Rev.* (2002).

classic distinction between visible and invisible terms thus becomes quite literal; the terms disappear into the structure of the object.

But the actual integration of contract into product poses both practical and theoretical problems for the functionality of private bargaining. Each of the successive conceptions of contract depends to a greater or lesser extent upon the informed choice of the consumer. Even the model of contract as product does not avoid consent, as it assumes a knowing purchase by the consumer for a smooth functioning market. According to some commentators, particularly in the bargain or assent camp, the justification of contract rests fundamentally upon promotion of individual choice or autonomy.<sup>59</sup> According to others, particularly under an economic analysis, individual choice plays a central role in implementing the decentralized allocation of resources; by encouraging self-interested activity with minimal outside interference, resources to their optimal use. Thus, in this second set of theories, choice functions within an economic framework as a means to an end, rather than as an end in itself. At the same time, some apologists for an economic approach have melded the two theories, turning the relationship between autonomy and efficiency around to argue that a market-based approach to contract is desirable because it promotes autonomy.<sup>60</sup>

Under any of these approaches, excessive governmental intervention into the bargain may be decried as “paternalism” or interference with the autonomy of the contracting parties. But the focus on autonomy in private bargaining creates a potential paradox regarding state intervention, or paternalism. State intervention into the transaction may be decried as an imposition on the

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<sup>59</sup> Randy E. Barnett, *A Consent Theory of Contract*, 86 COLUM. L. REV. 269 (1986).

<sup>60</sup> Richard Posner, *The Ethical and Political Basis of the Efficiency Norm in Common Law Adjudication*, 8 HOFSTRA L. REV. 487 (1980); Richard Posner, *Utilitarianism, Economics, and Legal Theory*, 8 J. LEGAL STUD. 103 (1979).

autonomy or contractual freedom of the parties. At the same time, state intervention may be necessary to preserve the autonomy or contractual freedom of certain parties, particularly where one party stands in a position of overwhelming power or influence. Typically such asymmetrical bargaining positions are perceived to occur where one party has far more information than the other, or where one party's range of choices are highly constrained due to lack of competitive alternatives. In such situations, the terms of the agreement may be perceived as imposed by the stronger party, without the free consent of the other. The classic case for such asymmetrical bargains are consumer transactions, where a large corporate entity may have access to far more information about a product than the typical consumer, or where the consumer's bargaining choices may be limited to few or even one vendor. Either situation may be conceived in an economic framework as a form of market failure; were the market to operate perfectly, market forces would act to discipline contractual overreaching.

Such situations may in fact be very common, but where the social system puts its faith in markets, the law assumes that they will be rare. The tradition in Anglo-American law has been that for the most part, the state avoids intervention into particular terms of the contract. Courts classically refuse to inquire, for example, into the adequacy of consideration.<sup>61</sup> The state may withhold its coercive power in those rare cases where a party falls into a category clearly classified as lacking legally cognizable autonomy, such as that of minors or the mentally incompetent.<sup>62</sup> Equally rarely, a court may invoke a doctrine such as unconscionability to protect otherwise competent parties, and most especially individual consumers, from exploitation

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<sup>61</sup> Restatement (Second) of Contracts, § 79; E. Allen Farnsworth. Farnsworth on Contracts § 2.11, 2000.

<sup>62</sup> Restatement (Second) of Contracts, § 12.

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by more powerful or better informed parties.<sup>63</sup> Autonomy may also be husbanded in unusual situations by other doctrines, such as rescission,<sup>64</sup> misrepresentation,<sup>65</sup> or mistake,<sup>66</sup> that might be viewed as designed to nullify agreements a party has entered into without full information, which may be to say without full autonomy.

However, such doctrines are invoked rarely and with some reluctance because of their potential to supersede “freedom of contract.” Judges are reluctant to override terms that may have been the preference of the contracting parties. Libertarian analysts denounce the doctrines for introducing the heavy hand of the state into private bargaining. Economic analysts decry the potential for inefficiency. Even analysts outside the free-market economics tradition may be wary of such doctrines because they are highly interventionist – assuming, for example that certain classes of individuals cannot understand contractual terms or cannot formulate a legally recognizable desire to be bound by contractual terms. The historical inclusion of women together with children and mentally handicapped individuals as legal incompetents amply illustrates the objection that imposition of judicial preferences may be dangerous not merely to the success of a particular bargain, but to individual autonomy.

Consequently, although the state may forbid or invalidate certain contractual terms, it will more often mandate disclosure of terms. For example, certain key terms to a mass-market contract must be “conspicuous,” which typically means printed in a larger, bolder, or more prominent typeface than terms considered less important or less potentially troublesome.<sup>67</sup> Such “paternalism light” is intended to secure autonomous decision making by ensuring that

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<sup>63</sup> E. Allen Farnsworth. *Farnsworth on Contracts*. §4.28, 2000.

<sup>64</sup> Restatement (Second) of Contracts § 283.

<sup>65</sup> Restatement (Second) of Contracts § 164.

<sup>66</sup> Restatement (Second) of Contracts § 153.

information deemed important to a decision is available, without dictating the decision itself. This approach is, of course, laden with important underlying assumption that the recipient of the information has the circumstantial latitude to act freely on the information provided, but the more interventionist doctrines may be invoked in those unusual occasions where the law may believe such latitude is lacking.

But where contract becomes product, the potential arises for a persistent asymmetry of information. Although some features of the product may be apparent upon inspection, many features – especially those implementing contract-like terms – will not be. In the analogous mass-market cases, courts have shown some reluctance to enforce written shrinkwrap licenses where information material to the transaction is disclosed subsequent to the transaction. Adherence to “freedom of contract” in such situations may be little more than a sham, and the resistance to state intervention little more than an excuse to give the more powerful party in the transaction the maximum latitude to impose unrestrained oppressive or overreaching terms. The potential for abuse is far greater when the information material to the transaction is never disclosed, but remains embedded in the artifact.

Some movement toward disclosure of product characteristics has become evident in the case of copy-protected CDs, where one consumer has sued the manufacturer on grounds of products liability and deceptive practices, arguing that the product was defective or misleading to consumers as it would not perform as expected.<sup>68</sup> The suit was resolved by notices on the outside of the product, warning consumers that the disc would not play on CD-ROM drives or

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<sup>68</sup> See Jim Hu, *Lawsuit Targets Copy Protection*, CNet News.com, Sept. 7, 2001 <[http://news.com.com/2100-1023\\_3-272784.html?tag=nrn](http://news.com.com/2100-1023_3-272784.html?tag=nrn)>.

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permit downloads to MP3 players.<sup>69</sup> Similar issues of consumer confusion or displeasure have led to objections by the owners of compact disc technology that music discs outfitted with technical protections are not properly labeled “CD.”<sup>70</sup> As a result, publishers of copy-protected discs have treated them as a different product, not called or labeled “CDs.”<sup>71</sup>

Such notice problems will likely be presented by technologically protected seeds. If present, the “seed-wrap” license itself could serve as some notice of the product characteristics. But as technical protections replace written contracts, that form of notice may become diminished. Moreover, although the purchaser of seed may have the opportunity to read the agreement on the side of the bag, he has no ability to examine the programming of a seed, and cannot determine its constraints by examining the product, any more than a pharmaceutical purchaser has the opportunity to run chemical analysis on a drug before purchase. This is of course a primarily a problem with initial encounters; as the farmer knows what to expect from certain types or brands of seed, GURT constraints may appear more and more a normal feature of the product. But as the types of GURT constraints proliferate, the possibility for surprise from hidden characteristics, much like surprise from unexpected contractual terms, multiplies as well.

This suggests in general a need to equalize the informational disparity regarding “scripted” products, but if the traditional solution of disclosure is to be the mechanism for equalization, the precise contours of the needed disclosure remain problematic. In the contractual setting, disclosure requirements have typically been limited to terms considered

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<sup>69</sup> See Lisa M. Bowman, *Consumer Claims Victory in CD Lawsuit*, CNet News.com, Feb. 2, 2002 <<http://news.com.com/2100-1023-843114.html>>.

<sup>70</sup> See Evan Hansen, *Dion Disc Could Bring PCs to a Standstill*, CNet News.com, April 4, 2002 <http://news.com.com/2100-1023-876055.html>.

<sup>71</sup> *Id.*

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“material” to the transaction – terms such as warranties, disclaimers, and remedies.<sup>72</sup> Design choices or embedded technological values have simply not been part of that constellation of terms. The rare instances where design choices are the subject of disclosure tend to arise in the area of products liability, where an industrial product is found to have dangerous characteristics not apparent upon consumer examination.<sup>73</sup> Disclosure of the potential danger allows the manufacturer of the product to avoid liability for injury by virtue of the consumer’s voluntary acceptance of the danger. But non-dangerous design choices are typically mandated by neither contract nor tort theories. Courts do not require that an automobile seller reveal, for example, that a car was designed on the assumption that exhaust manifolds would need replacement every 10 years, or that gasoline prices would remain at \$1.35 per gallon, or that automobile factory worker’s wages would remain stable, or that state law on “plug-molds” would continue to provide a cheap source of replacement automobile body parts, or that Americans in the next decade would value mobility over ecology.

Indeed, the law has been somewhat hostile to mandating disclosure when technologies render products that are not materially different, but morally different. In those rare instances where consumers have displayed an interest in knowing, for example, where particular meats originated, or whether recombinant gene products were used in the production of milk or vegetable produce, both courts and legislatures have been resistant to imposing a legal disclosure requirement.<sup>74</sup> In some of these cases, market demand has prompted producers to provide

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<sup>73</sup> Restatement (Third) of Torts: Products Liability §2(c)

<sup>74</sup> Dan L. Burk, *The Milk-Free Zone: Federal and Local Interests in Regulating Recombinant BST*, 22 COLUMBIA ENV. L. REV. 227 (1997).

products carrying the desired disclosures, obviating the need for legal or political intervention.<sup>75</sup> But where a market for the information has not developed, there has to date been little state intervention to solve the market failure, or to force disclosure for the sake of informed consent.

### **Product and Property**

The problem of contract as product leads to a second, related theoretical problem with long-term practical impact. The merger of contract into product is conceptually intertwined with recent debates over the definitional separation between legal notions of property and contract. Much of this dialog centers on recent scholarship by Thomas Merrill and Henry Smith, addressing the “*numerus clausus*” problem, or constraints upon the number of legally recognized forms of property.<sup>76</sup> Merrill and Smith adopt as definitional the standard maxim that “property” constitutes a legal regime functioning *in rem*, or “against the world,” whereas “contract” constitutes a legal regime functioning *in personam*, or as between particular parties. They derive from these axioms the conclusion that the forms of property should be limited, and new forms of property discouraged, because of the costs the public at large will bear in keeping track of myriad public entitlements. By contrast, they view contract as properly infinitely malleable, since only the parties in agreement need remember the variant entitlements of the agreement.

In reply to Merrill and Smith, Hansmann and Kraakman have argued that property takes a limited number of forms in order to facilitate verification of ownership when rights transfers are

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<sup>75</sup> This has occurred, for example in the case of milk from cows treated with recombinant bovine somatotropin (rBST), to which some consumers may have social or moral objections, in response to which the producers have supplied milk from untreated herds at a higher price.

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transacted.<sup>77</sup> This model emphasizes the continuity between property rights and their associated assets; property “runs with the asset” as they put it. Subsequent purchasers must be notified of the rights conveyed with the asset, and the law disfavors fragmented or partial property interests because of the difficulty in notifying subsequent purchasers of the partial interests conveyed. This bias naturally limits the number of partial or fragmented property formats. Since contract affects only those parties in privity, the costs of alerting those parties to fragmented or partial conveyances are confined to the immediate contracting parties.

Neither of these models is necessarily exclusive of the other, and both may be at work in the operation of property as distinct from contract. But neither fits well with the modern development of contract into property, nor with the technological instantiation of contract *as* property. For example, the Merrill and Smith framework assumes the model of contract as consensus, rather than contract as product. But this assumption runs contrary to the development of contract into mass-market licenses, and to the scholarship examining this development. It is precisely in the creation of standardized form contracts that the public is unable to keep track of the myriad variations of possible rights structures. Mass market licenses bear little resemblance to arms length negotiated contracts; they are essentially rights as against the world – at least, as against any portion of the world that will use the covered product. The cost of remaining cognizant of the mass market licensing terms is not born by only two parties, it is born by the host of consumers who may purchase the product. The terms are not negotiated, so there is no process of bargaining to alert the purchaser to the variation in terms.

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<sup>76</sup> Thomas W. Merrill & Henry E. Smith, Optimal Standardization in the Law of Property: The Numerus Clausus Principle, 110 Yale L. J. 1 (2000); Thomas W. Merrill & Henry E. Smith, The Property/Contract Interface, 101 Colum. L. Rev. 773 (2001).

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The inability of the general public to track all the myriad permutations of mass market license is well illustrated by the frequent appearance of outrageous terms in such contracts. Any number of bizarre and unreasonable terms may creep into the agreement, including provisions that forbid criticism of the product, or that “reach through” the initial product license to confer upon the seller rights in second-generation products produced by normal and intended use of the purchased product – conferring, for example, upon the publisher of web page design software a right in the web pages designed using the software purchased. Users of Internet applications purportedly “agree” to tracking of their web contacts, or insinuation of advertisements into their computer display, where agreement is based upon acquiescence to a mass market license that they have never read and would be unlikely to understand. Consequently, while the cost analysis of Merrill and Smith seems borne out by such examples, they appear under the rubric of “contract” rather than that of property.

Neither does the Hansmann and Kraakman definitional separation deal well with contract as product. Their theory rests upon the cumulative costs of notice, which are anticipated to be greater for rights that “run with the asset.” But many form contracts, including the famous “copyleft” licenses accompanying open source software, effectively “run with the product,” effectively making them indistinguishable from property on this theory. Such contracts would incur the same kind of notification costs as property; indeed, considered on the Hansmann and Kraakman analysis, mass market licenses combine the worst aspects of property and contract: high notification costs due to the many partial conveyances of the contract, coupled with high notification costs due to the persistent partial conveyance to subsequent purchasers.

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<sup>77</sup> See Henry Hansmann & Erinier Kraakman, Property, Contract, & Verification: The Numerus Clausus Problem

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As contractual terms are subsumed into the design of programmable artifacts, but the costs of consumer confusion and the costs of ownership notification. Qualities of the product, such as germination suppression or darkening polymers unquestionably “run with the asset,” are not necessarily apparent upon inspection of the product, and can take myriad, often unexpected, forms. Partial conveyances here occur as contingent properties of the product, such as second-generation seed germination upon payment for activating treatment, or copying privileges upon payment for duplication access. The forms of such partial conveyances are constrained only by the ingenuity of the product designers. In some cases, it will be to the advantage of the producer to inform users that additional rights are available for purchase; in other cases, where the producer prefers to restrict certain uses, the parameters of the restraint may be discovered by the user only after purchase. Anti-circumvention or anti-reverse engineering provisions impose upon these physical features an additional layer of property rights by preventing alteration of the product, reinforcing the reification of the contractual terms. We may choose in some cases to leave consumer dissatisfaction to discipline producers in the marketplace for such design choices; or we may choose in others to require disclosure of the product features. But it seems unlikely that meaningful distinctions between contract and property, as well as between contract and product, can be part of the discourse in deciding which approach to adopt.

## CONCLUSION

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and the Divisibility of Rights, 31 J. Legal Stud. 373 (2002).

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Genetic use restriction technologies present a new instance of programmable technological artifacts. Even more than their cousins, the digital rights management systems, GURTs allow embedding of physical control mechanisms into products that were formerly controlled by law. The deployment of such technologies exacerbates the movement away from publicly scrutinized, ex post producer controls toward privately predetermined controls. Indeed, the creation of programmable artifacts moves private rule-making out of the realm of commercial agreements and related areas that have been traditional subject of legal scrutiny, and into the area of product design, which has largely been immune from legal scrutiny in market economies. All technological artifacts involve some degree of design “scripting,” including physically embedded constraints on their use. Many or most of these constraints may be equivalent to a legal prohibition on their use, but it is not conceivable that we would require regulation or even disclosure for all such constraints. Embedded constraints that violate a sufficiently important social policy might be subjected to such regulation, but even more so than in the case improper agreements, it will be difficult to identify those products sufficiently unconscionable to merit a legal response, without prompting wholesale intervention in the marketplace.