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SPACE RESOURCES, COMMON PROPERTY, AND THE COLLECTIVE ACTION PROBLEM

ROBERT P. MERGES & GLENN H. REYNOLDS*

INTRODUCTION

Concerns about property rights are inherent in human nature. Recent experience suggests that the allocation of property rights may have important environmental consequences, especially in the context of space exploration and development. Such consequences, which in the context of common property regimes tend to be negative, can be ameliorated under a sufficiently potent centralized regulatory regime. Such regimes themselves, however, tend to become victims of collective action problems. In this Article, we analyze these collective action problems and centralization issues and suggest a scheme for regulating space resources that is likely to achieve important goals at far lower cost while minimizing intrusiveness.

I

THE COLLECTIVE ACTION PROBLEM

A large and important literature has extensively documented the difficulties involved in organizing any large group to cooperate.¹ This is known as the collective action problem—a problem that is ubiquitous in social and economic life. Consider, for example, legislation that subsidizes only one small group, such as a group of sheep farmers whose sheep produce a certain rare type of wool. While the subsidy is expensive in general, its

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¹ See, e.g., Eyal Benvenisti, *Collective Action in the Utilization of Shared Freshwater: The Challenges of International Water Resources Law*, 90 AM. J. INT'L LAW 384, 388 (1996); Bernard Black & Reinier Kraakman, *A Self Enforcing Model of Corporate Law*, 109 HARV. L. REV. 1911 (1996).

high cost is spread over a broad group of taxpayers. It is easy for the sheep farmers to identify each other, form a lobbying group, and articulate a clear goal—maximizing the subsidy for this type of wool. In contrast, taxpayers in general each suffer only a slight economic harm due to the special wool-protecting legislation. As a consequence, although it is rational for taxpayers to oppose the legislation in principle, as not cost-justified, they almost surely will fail to do so because it is simply not worth the cost of organizing such opposition. The taxpayers, in other words, are likely to be unable to overcome the collective action problem facing them.² The same process has already been documented in the brief history of the U.S. space program.³ Difficulties have arisen in efforts to acquire funding and garner legislative support and encouragement for important space initiatives, such as the space telescope. Because the benefits of advances in space technology and information are spread thinly over a broad constituency, marshalling forces to achieve these goals has been problematic.⁴

II

INSTITUTIONAL CENTRALIZATION OF RESOURCE ALLOCATION

In an attempt to overcome the collective action problems facing the space program, mechanisms have been proposed that attempt to allocate space resources and coordinate interests through a centralized agency.⁵ Centralization solves a number of problems, most notably eliminating the transaction costs of locating rights owners and determining the rules of ownership and transfer. These proposals, however, overlook a difficult question—how to rouse the various nations and fractious forces within them to organize into a unified group. These proposals assume an international organization to administer space rights

² MANCUR OLSON, *THE LOGIC OF COLLECTIVE ACTION: PUBLIC GOODS AND THE THEORY OF GROUPS* (2d ed. 1971).

³ See HOWARD E. MCCURDY, *THE SPACE STATION DECISION: INCREMENTAL POLITICS AND TECHNOLOGICAL CHOICE* (1990); ROBERT W. SMITH, *THE SPACE TELESCOPE: A STUDY OF NASA, SCIENCE, TECHNOLOGY & POLITICS* (1989).

⁴ See SMITH, *supra* note 3.

⁵ Cf. Daniel C. Esty, *Revitalizing Environmental Federalism*, 95 MICH. L. REV. 570, 581 (1996) (noting the problem of the commons as a rationale for federal environmental regulation).

and proceed directly to a discussion of how best to structure the organization without considering how such an organization might actually come into existence.

Similar difficulties of unification may confront those who try to organize an outer space resource allocation organization. As attempts at multilateral coordination have demonstrated, it is difficult to get diverse nations together to agree on basic principles and procedures.⁶ This is especially true where there is considerable uncertainty over the future value of the activity being organized, as is the case with many space resources whose values are yet to be determined. It is natural for the parties to such negotiations to try to influence the structure of the resulting organization in a manner that reflects both their current and anticipated interests.⁷ Since space exploration is an area with high future uncertainty, coordination efforts in this field are likely to face difficulties.

Multilateral attempts at coordinated development often end in impasses.⁸ Some of these coordination problems result from differences between industrialized nations and less developed countries. Barbara Heim points out three areas with potential as sources of mineral deposits (Antarctica, outer space, and the deep seabed) all share two fundamental problems that have frustrated agreement between industrialized countries and less developed countries.⁹ One problem is the ability to determine a clear

⁶ Cf. Edwin W. Paxson III, Note, *Sharing the Benefits of Outer Space Exploration: Space Law and Economic Development*, 14 MICH. J. INT'L L. 487, 509-10 (1993) (discussing the difficulties in creating an intergovernmental organization to govern the Moon Agreement and citing the problems in negotiating the Law of the Sea Convention as a prime example).

⁷ See DOUGLASS NORTH, INSTITUTIONS, INSTITUTIONAL CHANGE AND ECONOMIC GROWTH (1990) (pointing out that institutional change always brings an opportunity for specific groups to capture more economic rents, and thus that some beneficial change does not take place because other groups know this and fear it). See also Paxson, *supra* note 6, at 509-13 (arguing the improbability of establishing various types of international regimes for space development).

⁸ See, e.g., Barbara Ellen Heim, *Exploring the Last Frontiers for Mineral Resources: A Comparison of International Law Regarding the Deep Seabed, Outer Space, and Antarctica*, 23 VAND. J. TRANSNAT'L L. 819 (1990); David A. Wirth, *Public Participation in International Processes: Environmental Case Studies at the National and International Levels*, 7 COLO. J. INT'L ENVTL. L. & POL'Y 1 (1996).

⁹ Heim, *supra* note 8, at 845-48.

definition of the common heritage principle.¹⁰ The second problem is the lack of a workable management regime, which has impeded cooperation among the countries. Although Heim suggests that adversaries may compromise and find a solution quickly, her own research illustrates there is little real hope they will do so.¹¹ Heim argues that a regime should be structured so that both developing countries and wealthy, technologically advanced countries will ratify under a one-nation, one-vote system: "Preferably this system will provide immediate gains and control of development to the countries or entities that take the initial risks and will provide the developing countries with a future opportunity to take part in either the development or conservation of the areas."¹²

Yet, Heim gives no indication of any recent precedent indicating that such a scheme would have any chance of being created. In fact, recent evidence indicates that countries are only too willing to take advantage of existing institutions to further self-interested goals. This trend is especially clear in the space field. A recent article describes how the nation of Tonga successfully acquired six valuable orbital slots through the ITU allocation process, over the objection of INTELSAT.¹³ The author argues that Tonga's actions will affect the satellite telecommuni-

¹⁰ Although there is no single definition of the theory, the common heritage principle generally recognizes that "(1) the area under consideration cannot be subject to appropriation; (2) all countries must share in management of the resources; (3) there must be an active sharing of the benefits derived from exploitation of the resources; (4) the area must be dedicated exclusively to peaceful purpose; and (5) the area must be preserved for future generations." *Id.* at 827.

¹¹ For instance, she points out that problems exist where developing countries are given ultimate control over developed country activities, even though the latter group will bear the risks of development at least in the early years. *Id.* at 846.

¹² *Id.*

¹³ Jonathan Ira Ezor, *Costs Overhead: Tonga's Claiming of Sixteen Geostationary Orbital Sites and the Implications for U.S. Space Policy*, 24 *LAW & POL'Y INT'L BUS.* 915 (1993). The International Telecommunications Union (ITU) is the U.N. supervised arbiter of telecommunications conflicts. *Id.* at 918. INTELSAT is a "multinational organization whose stated purpose is 'to develop and operate the space segment of a global commercial telecommunications satellite system.'" *Id.* at 924. INTELSAT is a public service organization, designed to coordinate international communications efforts. *Id.* From 1988 to 1990, Tonga submitted filings for sixteen geostationary orbit sites over the Pacific Ocean. Five of INTELSAT's member countries protested to the International Frequency Registration Board (IFRB), claiming that the acquisition was "for profit only and . . . not designed to further the purposes of the IFRB . . ."

cations market and pricing structure, and may even influence the identities of the players in the satellite area. The author concludes that this incident should serve as a wake-up call to the United States in particular, which has until now neglected to monitor the allocation process as carefully as it should have.

Even if a centralized institution could be created, rational economic agents can be expected to spend significant sums of money to influence the rights-allocation process. The general nature of such expenditures, as well as the payoffs from them, are familiar to students of administrative agencies responsible for doling out economically valuable rights. For example, consider the vast sums expended to influence the awarding of defense contracts, or government computer processing services contracts. It is wise whenever possible to avoid these expenditures and instead encourage activities that are more directly productive.

Thus, even though one must acknowledge that there might be significant advantages to convening a centralized agency to administer rights to outer space resources, it may be practically impossible to achieve consensus on the specific form such an agency will take. It may turn out to be wasteful to encourage the expenditure of resources on the rights-allocation process, given that total expenditures for all space-related activities are limited.

III

OTHER RESOURCE ALLOCATION METHODS

An interesting question arises whether something short of a centralized administrative agency might emerge (or be agreed upon) to perform some of the same functions in allocating space resources. Institutions of social control, after all, run the gamut from large, formalized agencies to local authorities with common law rules that emerge from isolated disputes over time, and even to informal, nonlegal norms of acceptable and unacceptable conduct.¹⁴ With the caveat that any discussion of such intermediate rules is necessarily speculative, it is useful to explore a few possibilities.

The first possibility is that something less than full international agreement might join together most of the important space-faring nations. For example, an entity such as a "European

Id. A compromise was eventually reached by which Tonga retained six of the requested slots and relinquished the other ten. *Id.* at 915-16.

¹⁴ See, e.g., ROBERT C. ELLICKSON, ORDER WITHOUT LAW (1991).

Economic Community" for space might be feasible. Once such an institution were up and running, other countries would be likely to join as well. This would certainly be likely if membership in the institution were seen as conferring significant benefits such as stability and predictability in the definition and exchange of property rights. New members would "opt in" to avail themselves of these benefits, and the institution would, over time, establish itself as the standard. Alternatively, of course, there exists the possibility of competing groups, some in the system and others outside it, either as non-affiliates or members of a rival group. This is conceivable in the realm of space, but the possibility for conflict under such circumstances would certainly be present. Indeed, it is not hard to imagine a war under this scenario; it certainly matches to some extent the conditions that created conflicts among rival European powers in the then-newly exploited North American colonies in the seventeenth and eighteenth centuries.¹⁵

A second possibility is that some purely national law will emerge as a standard, or at least as a model for other countries to follow. In other legal areas, national leaders have effectively established patterns that have been followed by other countries: commercial law in the United States (as seen in the United Nations Convention on the International Sale of Goods) and patent law in Great Britain come to mind. Similarly, in the space context, other countries could adopt the basic framework devised in the pioneer country. Alternatively, private entities could specifically "opt into" coverage under the pioneer country's laws—for example, by choice of law provisions in private contracts. This scenario is obviously more likely when a single country dominates the industry, as experience shows that legal frameworks often are generated in this way. The effect would be somewhat similar to the limited-membership group just described, with a jurisdictionally limited legal regime emerging as the *de facto* international standard.

A third possibility is that the space industry will settle on a set of informal rules or norms that govern their activities. This is the case in some fields, such as the diamond industry, where disputes are very rarely referred to formal legal institutions such as courts, but are instead resolved by respected industry members

¹⁵ See MERLE EUGENE CURTI ET AL., *AN AMERICAN HISTORY* (1950).

according to well-understood and agreed-upon norms.¹⁶ It should be noted, however, that arrangements such as these are usually stable only in small, closely-knit societies, where nonlegal sanctions such as negative gossip or reduced standing in a common religious or ethnic community are effective disincentives to rulebreaking.¹⁷ Since the parallels between such small, closed societies and the "society" of international space commerce are limited, it is not clear how far shared norms can be expected to carry the international space industry toward stable legal relations.

Lawrence D. Roberts puts forward an argument for non-formal norms to govern space activities.¹⁸ Roberts argues that the unique "gravity-neutral" areas around the Moon and Earth known as the Lagrange Points could be governed by what he calls the "traditional Law of the Commons," which maximizes efficiency and equity without incurring substantial transaction costs.¹⁹ According to Roberts, three main features of the "Law of the Commons" as applied to space resources are: (1) sovereignty is invested in no specific user, but all users are entitled not only to freedom of access but also freedom of use regulated within a strict code of conduct;²⁰ (2) rights are granted only to those entities that exploit the resource;²¹ and (3) because several of the Lagrange Points tend to draw objects toward their centers, creating a high danger of collision, preventative measures (such as placing competing orbital facilities in physical contact) or dispute resolution (such as pre-agreed, binding arbitration) might

¹⁶ See, e.g., Sally Falk Moore, *Law and Social Change: The Semi-Autonomous Social Field as an Appropriate Subject of Study*, 7 L. & Soc'y REV. 719, 721 (1973); Lisa Bernstein, *Opting Out of the Legal System: Extralegal Contractual Relations in the Diamond Industry*, 21 J. LEGAL STUD. 115, 138-43 (1992).

¹⁷ See Janet T. Landa, *A Theory of the Ethnically Homogenous Middleman Group: An Institutional Alternative to Contract Law*, 10 J. LEGAL STUD. 349 (1981); Douglas W. Allen & Dean Lueck, *The "Back Forty" on a Handshake: Specific Assets, Reputation, and the Structure of Farmland Contracts*, 8 J.L. ECON. & ORG. BEHAV. 366, 369-70 (1992); GLENN G. STEVENSON, COMMON PROPERTY ECONOMICS: A GENERAL THEORY AND LAND USE APPLICATIONS (1991); MAKING THE COMMONS WORK (Daniel Bromley ed., 1992); ELINOR OSTROM, GOVERNING THE COMMONS (1991); ELLICKSON, *supra* note 14.

¹⁸ Lawrence D. Roberts, *The Law of the Commons: A Framework for the Efficient and Equitable Use of the Lagrange Points*, 6 CONN. J. INT'L L. 151 (1990).

¹⁹ *Id.* at 154.

²⁰ *Id.* at 166.

²¹ *Id.* at 167.

be necessary as the community grows.²² Since there are only a few Lagrange Points, those states exploiting their benefits may develop a micro-society that more closely parallels a closely-knit society such as the diamond industry than the whole international society of space exploration, making non-formal norms or rules more plausible in the context of the Lagrange Points.²³

IV

ALTERNATIVES TO CENTRALIZED RIGHTS ALLOCATION

The legal forum that applies rules is really only as effective as the content of the rules themselves. Thus, we must return to a discussion of which property rules make sense in the space context. The centralized agencies that are most often discussed presuppose a structure that allocates pre-existing rights on some basis—for example, by auction. A variety of alternatives exist. One alternative envisions an administrative structure to facilitate trading and other exchanges of rights whose ownership is determined outside the exchange system according to a simple rule, such as first possession. It also involves a regime to resolve disputes among multiple claimants.

It is difficult, and perhaps foolhardy, to specify the precise content of property rights before the economic activity they will cover has matured. Consider the emergence of property rights in beaver hunting territories among native inhabitants on Labrador in the eighteenth century.²⁴ Harold Demsetz argues that before property rights emerged the expense did not justify the cost of voluntary agreements on the optimal beaver harvest, or of enforcement of the agreement by policing.²⁵ This lack of a coordinated property rights system was not a problem until, as a result of the growth in the European fur market, western traders increased the value of beaver pelts by paying more for them. At this point the lack of coordination among the native inhabitants

²² *Id.* at 169-70.

²³ *Id.* at 155.

²⁴ See 1 HAROLD DEMSETZ, OWNERSHIP, CONTROL AND THE FIRM: THE ORGANIZATION OF ECONOMIC ACTIVITY 107-09 (1988) (arguing that before the advent of the fur trade made furs more valuable and increased the rate of beaver hunting, property rights for beaver hunters were not necessary).

²⁵ *Id.*

became too costly to continue.²⁶ The problem was solved by creating a system of private ownership. Under private ownership, it is the owner who suffers due to overharvesting; since she knows this, and, critically, since she alone controls the harvest rate, she will adjust that rate so as to harvest only the optimal number of beavers. That is, she will make her plot self-sustaining, if possible. The key is that she cannot foist off the negative consequences of her decisions onto the community at large; she must internalize these externalities and hence take account of them in her decision-making. The point is generalized in the article as follows:

What converts a harmful or beneficial effect [e.g., the effect of harvesting one more beaver] into an externality is that the cost of bringing the effect to bear on the decisions of one or more of the interacting persons is too high to make it worthwhile . . . "Internalizing" such effects refers to a process, usually a change in property rights, that enables these effects to bear (in greater degree) on all interacting persons.²⁷

The environmental implications of this statement with respect to space should be evident. Through internalization of environmental effects, the costs of these effects are borne by all interacting parties. The Coase theorem makes a related point.²⁸ It states that, given some initial assignment of property rights, those rights will be traded until they reach the hands of the highest-valuing user, regardless of who holds the rights in the first place. It is crucial to note, however, that this model assumes low transaction costs, an assumption that is generally not true in the real world. The Coase theorem is most famous as applied to legal rules; at least in its "strong" form, it implies a thought that

²⁶ See *id.* at 108 (noting an "unmistakable correlation between early centers of fur trade and the oldest and most complete development of the private hunting territory").

²⁷ *Id.* at 105. Yoram Barzel makes a similar statement:

People choose to exercise rights when they believe the gains from such actions will exceed their costs. Conversely, people fail to exercise rights when the gains from owning properties are deemed insufficient, thus placing (or leaving) such properties in the public domain. What is found in the public domain, therefore, is what people have chosen not to claim. As conditions change, however, something that has been considered not worthwhile to own may be newly perceived as worthwhile; conversely, what was at first owned may be placed in the public domain.

YORAM BARZEL, *ECONOMIC ANALYSIS OF PROPERTY RIGHTS* 65 (1989).

²⁸ See R.H. Coase, *The Problem of Social Cost*, 3 *J.L. & Econ.* 1 (1960).

chills many a lawyer and judge—that legal rules are irrelevant, at least in terms of their impact on overall output.²⁹

Applying these theoretical points to the design of a regime for space entails ensuring that greater specification of rights is not precluded in the future. Although under the “strong” form of the Coase theorem the initial allocation of rights does not matter, in practice it surely will. Transaction costs are likely to be high, at least where rights holders are widely dispersed and the value of rights is subject to a great deal of imprecision. Such is the case with space exploration, with its international scope and high future uncertainty. If, for instance, space minerals are discovered that were not known at the time rights were initially allocated, it may be practically difficult for a company that is well-positioned to take advantage of the new mineral to locate and bargain with all rights holders whose permission must be obtained. The system of property rights must be designed with this sort of future contingency in mind. Yet, it must also be uniform enough to create settled expectations.³⁰ For present purposes, it is important to keep in mind that the initial allocation of rights will be subject to subsequent refinements—and, as a consequence, subsequent transactions—and to design it accordingly. Still, an overarching goal should be to ensure that individuals and entities bear a significant share of the environmental costs, as well as the economic benefits, that their activity creates.

This emphasis on future flexibility and reduction of externalities does not preclude any of the models of rights allocation mentioned so far. Certainly the international rights “condominium” could be founded with the principle of future flexibility in mind. On the other hand, if flexibility is the most important attribute of the system, it must be conceded that a centralized administration is not the only system that will work. If there are costs to such a system—for example, as argued above, the costs of activities designed to influence the allocation and content of rights (in other words, “rent seeking” costs)—then alternatives

²⁹ See Robert D. Cooter, *The Coase Theorem*, in 1 *THE NEW PALGRAVE: A DICTIONARY OF ECONOMICS* 457-60 (John Eatwell et al. eds., 1987). See also Robert C. Ellickson, *Property in Land*, 102 *YALE L.J.* 1315, 1337-41 (1993) (noting that assignment of private land plots greatly increased agricultural productivity in the earliest colonies).

³⁰ See Ellickson, *supra* note 29, at 1362 (“A group that is willing to recognize private property in land must decide what standard bundle of rights to confer on a meritorious occupier of a part of its territory.”).

that provide the same flexibility without these costs must be explored. We turn to this task in the following section.

V

MODIFIED FIRST POSSESSION AND DEED REGISTRY AS AN ALTERNATIVE

Economic theory in general does not look favorably upon a rule of first possession, at least in the terrestrial context.³¹ Most economists who have considered the question agree that "squatting," as well as the various forms of "homesteading" that were used to settle the American West in the nineteenth century, probably encouraged people to enter the land earlier than they would have under a system of competitive bidding.³² Aside from the assumptions inherent in the economic models used (for example, the assumption of complete information concerning future activities on and therefore the value of the land), this consensus view makes a realistic point: the race to possess free (or nearly free) land can be expected to pull resources out of other productive uses at a faster rate than may be optimal.³³ Importantly, what empirical evidence there is on the topic seems to support this view: the failure rate among farms started on cheap (in other words, "underpriced") homestead lands appears to have been significantly higher than it was on other farms.³⁴ Other historical sources support the same point:

[I]nnumerable tumults must have arisen, and the good order of the world been continually broken and disturbed, while a variety of persons were striving who should get the first occupation of the same thing, or disputing which of them had actually gained it.³⁵

³¹ See Dean Lueck, *The Rule of First Possession and the Design of the Law*, 38 J.L. & ECON. 393 (1995).

³² *Id.* at 414-16.

³³ One branch of economics has consistently concluded that goods whose prices are regulated will come to be rationed by a combination of price and non-price "expenditures," for example, waiting in line, that are always less efficient than allocation by price alone. See BARZEL, *supra* note 27.

³⁴ See, e.g., R. Taylor Dennen, *Some Efficiency Effects of Nineteenth-Century Federal Land Policy: A Dynamic Analysis*, 51 AGRIC. HIST. 718, 734 (1977). See also Terry L. Anderson & Peter J. Hill, *The Race for Property Rights*, 33 J.L. & ECON. 177 (1990); David D. Haddock, *First Possession Versus Optimal Timing: Limiting the Dissipation of Economic Value*, 64 WASH. U. L.Q. 775 (1986).

³⁵ 2 WILLIAM BLACKSTONE, COMMENTARIES *4.

In the face of this theory, how can anyone oppose a centralized rights-allocation authority to auction space rights? In a sense, the answer is no one, at least so long as the rather optimistic assumptions underlying the theory hold true. But this ignores an important point. As mentioned earlier, the forces that will be called upon to form this authority go beyond—and in many ways, can be expected to be inconsistent with—the forces of reason in support of efficient space development.

In short, politics will enter the picture. When this happens, the efficient auction mechanism could be transformed into a bureaucratic monster. In the international arena where space issues arise, great potential exists for bureaucratic nightmares. To some extent, an approximation of the ideal solution may be worse than a different solution entirely—a classic case of the “theory of the second best.”³⁶ Thus, although considerable centralized authority is necessary for the efficient auction schemes mentioned here, it should be recognized that strong centralized authority could be far from efficient if used for more than rights auctions. The fall of the Soviet Union and many Eastern European governments represents the only evidence that need be cited here.

At the same time, history also teaches that pure anarchy has its costs as well. Indeed, an analysis of the emergence of informal (or, perhaps better, quasi-formal) property rights among gold miners in the lawless (in other words, “state-less”) gold mining country of California in the 1850s recapitulates a story that must have been common in pre-history: the gold miners discovered that it was cheaper to respect certain rights than to fend off usurpers. In a lawless regime, in other words, they found that too much effort was devoted to physical defense of a claim, leaving too little time and effort to actually develop it. They consequently formulated a classic Hobbesian bargain where power was ceded to some “authority” for definition and protection of rights, resulting in more stable claims and therefore more efficient eco-

³⁶ Professor Leff described the “theory of the second best” as follows: [I]n complex processes . . . a move in the right direction is not necessarily the right move. To pick a simple illustration, if I am on a desert island, subsisting solely on coconuts [sic] and oysters and beginning to hate it a lot, and across the bay from me there is another island, lush and fertile, I do not improve my position in life by swimming half way across.

Arthur A. Leff, *Economic Analysis of Law: Some Realism About Nominalism*, 60 VA. L. REV. 451, 476 (1974).

conomic production.³⁷ Despite the technological advances since the 1850s, defense of space claims presents problems of time, effort, and expense. It is hoped that explorers and developers of space resources will not repeat the experience of the early gold miners. If they fail to institute some minimalist state in the early days of space industry, however, they surely will.

What is needed, then, is arguably a simple rule for allocating space property rights, together with something akin to the semi-centralized, fairly minimal system of deed registries that flourishes in many countries. This system has the benefit of simplicity and ease of administration, yet includes sufficient coordination to make property transactions feasible. Both parts of this "minimalist proposal" will be explored in the sections that follow: the first possession rule of title acquisition, and the deed registry system for claims.

VI

WHY FIRST POSSESSION?

As indicated above, first possession is often a poor way to allocate property. Nevertheless, three factors make it attractive in the space context.

First, allocation by first possession is simple and requires very little government involvement. Aside from a method of recording claims and some threat or sanction to deter stronger second-comers from displacing rightful first possessors (discussed below), very little in the way of governmental authority is needed.³⁸

Second, its theoretical defect—too-rapid development—may be a needed countermeasure when people are (inefficiently) risk averse, which is almost certainly the case regarding space-related investment,³⁹ and when important non-economic goals are also served by development. Given the reality of weapons of mass destruction and environmental threats on earth, it is plausible to assert that encouraging space development might be a

³⁷ See JOHN R. UMBECK, *A THEORY OF PROPERTY RIGHTS WITH APPLICATION TO THE CALIFORNIA GOLD RUSH* (1981).

³⁸ See Richard Epstein, *Possession as the Root of Title*, 13 GA. L. REV. 1221 (1979).

³⁹ See Heidi Keefe, *Making the Final Frontier Feasible: A Critical Look at the Current Body of Outer Space Law*, 11 SANTA CLARA COMPUTER & HIGH TECH. L.J. 345, 361-71 (1995).

good insurance policy for the survival of the species.⁴⁰ If special incentives are needed which might be viewed as excessive from the limited perspective of maximizing current expected net profit, then they may well be justified in light of the importance of this overriding goal.

Finally, while the first possession method of land allocation dissipated frontier land values, it economized on enforcement costs in establishing land rights.⁴¹ Yet, the dissipation of frontier land values itself probably constituted non-trivial economic waste. In space, however, inefficient races to claim and develop space resources will come with a significant spillover benefit: the development of more rapid and more diverse space exploration vehicles. This is a very important difference from the land development analogies, where racing depletes fixed resources in the context of largely static technologies. In much the same way that society encourages technical progress through what might be described as "racing for patents," on the belief that the spillovers to society exceed the costs of racing, it should consider encouraging a race ever deeper into space.⁴²

Robert Ellickson has written that "[i]ndividual ownership . . . generate[s] some new transaction costs, mainly those arising from the proliferation of boundaries and ownership entities."⁴³ For this reason, private ownership, at least where population growth begins to cause some degree of crowding, entails the creation of a system for proving title claims and keeping them straight—a deed registry.⁴⁴ Note, however, that Ellickson provides an interesting prediction applicable to the space context:

The efficiency thesis predicts that innovations in technologies for marking, defending, and proving boundaries lead to more parcelization because they reduce the transaction costs of private property regimes. According to this view, for example, Glidden's invention of barbed wire in 1874 should have stimu-

⁴⁰ See David Everett Marko, *A Kindler, Gentler Moon Treaty: A Critical Review of the Current Moon Treaty and a Proposed Alternative*, 8 J. NAT. RESOURCES & ENVTL. L. 293, 325-26 (1992-93).

⁴¹ Lueck, *supra* note 31, at 414-15.

⁴² Cf. Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839 (1990) (criticizing economists' patent race models along these lines).

⁴³ Ellickson, *supra* note 29, at 1329.

⁴⁴ See, e.g., George L. Haskins, *The Beginning of the Recording System in Massachusetts*, 21 B.U. L. REV. 281 (1941) (discussing earliest colonial recording systems).

lated more subdivision of rangeland in the American West. And this indeed appears to have occurred.⁴⁵

According to this hypothesis, which is simply that legal rules maximize overall efficiency in closely-knit societies, property boundaries in space are important enough that we can expect innovations in the technology of marking, defining, and recording them, so that over time the task of keeping track of claims becomes cheaper and easier.

VII

POTENTIAL PITFALLS OF FIRST POSSESSION, AND SOME MODEST SUGGESTIONS ON HOW TO AVOID THEM

At the outset, we must clarify precisely what interest we intend to perfect via possession; that is, what content we will assign to the "bundle of rights"⁴⁶ obtained by first possession. In western legal systems, the variety of property rights is vast, but one basic distinction can be used to separate rights into two broad classes. This is the distinction between the usufruct, a right to continued use for a limited time, and the fee, a more permanent interest that can be traded, devised, or otherwise transferred. For some purposes, the usufruct may prove to be valuable in the space environment, but generally we have in mind a fee interest, more specifically a right akin to the fee simple of Anglo-American law.⁴⁷ The fee interest has the advantages of predictability (given the thousand-plus year history of these interests) and flexibility which, as mentioned earlier, is a key advantage given our current lack of knowledge about the full range of resources that may be encountered in space.

Second, we need to clarify what we mean by "possession." This is important for more than definitional reasons: ignored in our discussion up until now has been the problem of overclaiming. If possession is defined too loosely (for example, the apocryphal "I claim this continent for Spain"), then the first visitors or inhabitants in a given area of space would have almost limitless

⁴⁵ Ellickson, *supra* note 29, at 1330.

⁴⁶ Property rights are often viewed as a "bundle." See J.E. Penner, *The "Bundle of Rights" Picture of Property*, 43 UCLA L. REV. 711 (1996).

⁴⁷ For further explanation of the basic features of Anglo-American fee simple, see Roger W. Anderson, *Present and Future Interests: A Graphic Explanation*, 19 SEATTLE U. L. REV. 101, 104 (1995).

rights. But a narrow definition could cause other problems. For example, if a certain mineral is distributed unevenly in various extraterrestrial rock formations, it may be difficult to predict how wide an area must be claimed to ensure a viable mining operation. Limiting the definition of possession unduly must necessarily create uncertainty under these circumstances.

The solution to the problem will come in two parts, one theoretical and the other empirical. The theoretical portion entails placing some "reasonable" limits on the geographic scope of claims. This is the rationale behind a number of provisions in other regimes where property rights are defined. Patent law, with its explicit attention to claim scope, comes most readily to mind.⁴⁸ Indeed, the theoretical rationale for the tradeoff between adequate property rights to spur investment and excessive property rights that concentrate an inefficient degree of control in a single pair of hands (and hence slow down those who follow) has been described at length.⁴⁹ But other property regimes have arrived at similar schemes. The law of gold mining, for example, limits the size of individual claims, requires claims to be recorded and surveyed, requires them to be perfected by some minimum investment of time and/or labor, and causes them to be forfeit for failure to perform any of these requirements.⁵⁰ In his study on the evolution of property rights among prospectors during the California Gold Rush, John Umbeck observes that even the earliest contracts establishing such rights included limitations on claim size and minimum working requirements.⁵¹ So the theoretical point is straightforward: rights must be limited to prevent overclaiming.⁵² The costs of paying off extortionate claim holders would add too much to an already uncertain enterprise. This is true in the space context as well.

The empirical point is simpler to make, but harder to implement. The "reasonable" scope of rights will have to be arrived at over time. It may vary from one region or type of resource to

⁴⁸ See Merges & Nelson, *supra* note 42.

⁴⁹ See *id.*

⁵⁰ See Comment, *The General Mining Law and the Doctrine of Pedis Possessio: The Case for Congressional Action*, 49 U. CHI. L. REV. 1026 (1982).

⁵¹ UMBECK, *supra* note 37.

⁵² Arguably we should not be worried about granting rights that are "too broad." If a third party is in a better position to exploit the rights than the original rightholder, the two should strike a deal. Perhaps the concern stems from the costs involved in striking and enforcing these deals.

another and it may be subject to refinement and revision over time. But, ultimately, it will have to be decided not upon the premises of theory, but on the accretion of experience.' The concept of property rights in space is far newer than rights in terrestrial tangible property such as gold or intangible property such as patents or copyrights. We have far more information regarding terrestrial property rights on which to base theory than we have regarding the unique problems posed by property rights in space.

Finally, some technology for indicating possession and marking the boundaries of claims will be necessary.⁵³ Ideally, whatever devices are used for this purpose would be coordinated with a "deed registry" on Earth, so that the positions of boundaries could be confirmed remotely from the registry office. Given the advent of (terrestrial) global positioning technology,⁵⁴ it is realistic to anticipate such a technology. It certainly would have the benefit of reducing the cost of establishing and enforcing claims, which should make it an attractive technology to develop. Like the development of barbed wire on the American frontier, such demarcation technologies can have significant overall benefits. Indeed, these potential benefits may well be sizeable enough that the U.S. government might consider investing funds in research to develop such a technology at the outset of space development activities.

VIII

SETTING ASIDE PRESERVED AREAS

The preceding discussion has quietly trumpeted the virtues of private property. It has pushed aside the concerns of those who back the application of the common heritage principle to space development. We must admit one troubling aspect of our analysis, however. Although in theory developing nations will bid on space resources when they have attained the economic wherewithal to exploit such resources, and granting rights to these nations before this time would be inefficient, there are reasons to believe that some system of "development preserves" would make sense, perhaps totaling ten percent of the area capable of development. For one thing, an argument akin to "intergenerational equity" can be made for giving developing

⁵³ See Ellickson, *supra* note 29.

⁵⁴ See Comment, *Global Positioning System (GPS): Defining the Legal Issues of its Expanding Civil Use*, 61 J. AIR L. & COM. 243 (1995).

countries some opportunity to exploit near-earth resources well after the initial development period by advanced nations has passed. For another, it makes good political sense since it will give developing countries a greater stake in peaceful space development, and perhaps even bring them more readily into an international regime to recognize property rights in the first place, rather than encouraging them to adopt the role of spoilers.⁵⁵

In addition to development preserves, there should be environmental research and conservation preserves. Perhaps ten to fifteen percent of the area capable of being developed ought to be preserved for this purpose, though the size and character of such preserves may depend in part on the specific resources in question. If preserves are built into the development scheme from the beginning, many of the problems of terrestrial environmental preservation can be avoided. If it turns out over some suitably long period of time that little interest is expressed in the preserved areas, then they can be auctioned off or given to developing countries.

Preserves would be established and maintained by the same recording authority that keeps title records, arranges transfers, and the like. One possible way to enforce the boundaries of preserves would be to give a bounty to any party who discovers encroachment on preserve lands—for instance, in the form of a grant of title over some moderately large claim. This would create an incentive for enforcement without the need for the enforcing authority to have an extensive presence in the area. The basic point, however, is that preserved space for future development and pure conservation should be built into the space property regime at the outset, to avoid the cost and political difficulties of creating such preserves after property becomes valuable. Of course, if possession plus adherence to some minimal formalities are recognized as the international standard for securing a claim, all spacefaring nations must be made to agree to recognize preserves and abide by their boundaries. Initially, this should not be too difficult on a practical level, since the number of spacefaring nations will be small. Over time, a simple mechanism may come to be used to ensure multilateral recognition of

⁵⁵ For arguments along these lines, see Paxson, *supra* note 6. Paxson argues that a regime to use lunar mining, involving transferable credits based on a nation's population and allowing mining for only finite periods, would benefit developing countries and therefore merits investigation.

preserves—for example, a rule that claims will not be enforced if made by a national of a country that does not recognize the legitimacy of preserves, or that has permitted incursions into them by claimants.

CONCLUSION

The waning of enthusiasm for common heritage schemes in the space context poses a challenge for space law, and for space development enthusiasts: the challenge of coming up with something that addresses the most important concerns motivating “common heritage” proposals without embodying the statist and anti-market character that such proposals tend to share. Properly crafted, property rights approaches are likely to be lower in cost, and better at protecting the environment, than are centralized bureaucratic regimes. We have suggested some considerations involved in applying property rights to space resource development. We hope that others will join in the conversation.