

THREE-DIMENSIONAL PARTITION AND REGISTRATION OF SUBSURFACE SPACE

...We are truly about to take our first step into the Interior of the Earth,
never before visited by man since the first creation of the world....

Jules Verne, *A Journey to the Center of the Earth* (1864, M. Dirda tr. 1986).

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Abstract

Traditional legal doctrine pictures land ownership in the form of a cone down to the center of the earth. This article suggests that it is desirable for the law to enable subsurface subdivision into separate, three-dimensional property units, constituting separate subjects for title and transactions. Thus the law would contribute to the public interest in recognizing the subsurface space as a separate property unit from both the functional and the planning aspects.

Before three-dimensional registration can begin, it is necessary to create an infrastructure of professional standards for three-dimensional survey for registration purposes. The creation of such standards constitutes one of the main goals of the world survey profession.

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It may be assumed that there is a downward limit below which the subsurface has no effect on the surface space and *vice versa*. In this case, the traditional doctrine may be seriously contested by the argument that those deep levels of the earth should be defined as a collective property. However, it is not practical to establish a fixed downward limit upon ownership of subsurface space. When expropriating the subsurface, it is necessary to compensate the landowner for the consequential damage, as well as for the direct damage incurred. There is some doubt whether compensation should be paid for subsurface area that the landowner could not reasonably and practically exploit. As soon as the axiomatic impediment to three-dimensional subdivision is removed, the importance of long-term planning for subsurface use will increase.

I. Introduction

A. Use of Subsurface Space: Actual and Future Development Trends

The development of urban space in Israel has been characterized for some years by the extensive use of open spaces for construction and municipal use. Due to its very limited land reserves, this trend could gradually turn Israel into a "City-State".¹ National policy-makers and planners in every country that suffers from a shortage of land have always prayed for the discovery of new land reserves. But there are no new continents to be discovered, and the annexation of land for the purpose of "expanding areas of livelihood" is nothing but a bitter memory. Subsurface space seems, at first glance, the largest untapped land reserve. It is located almost everywhere, including underneath urban core regions. Utilizing underground space could significantly alleviate the shortage of land at the city centers, with minimal damage to the environment, natural as well as urban. Subsurface construction could reduce the pressure to expand the urban area and to reduce the green spaces around it. It could minimize urban sprawl. It could utilize a range of open areas within the urban core.

1 Elisha Efrat, "Israel is Marching Towards Becoming a City-State," (1999) 47 *Karka* 34. [in Hebrew]

The subsurface space can be used to solve traffic and parking problems in areas where any above-ground solution would cause real damage to existing land use. The subsurface area can be utilized without causing damage to existing surface use, or while preserving a “green” top level.

Subsurface space is especially available for use in cities built on hilly slopes (such as Nazareth or Jerusalem). Subsurface space also presents advantages in terms of protection from war risks and insulation from climate conditions. For instance, one of the principal purposes of the “Underground City” project in Montreal, Canada, was to facilitate continued commercial and social activity in the cold winter months.² Utilization of underground space integrates with the multi-level “mega-structures” of the modern urban space and enables the development of three-dimensional and multi-level transportation and traffic grids, both above and below ground level.³

It is customary to distinguish between the space and the content of the land, such as soil, resources or antiquities. The majority of the potential of the subsurface, in contrast to the physical content of the spaces, has not yet been tapped. The usual utilization of underground space worldwide is for mining, access and support,⁴ transport, (trains, roads, parking space), and infrastructure systems (water, drainage, cables, etc.). Multi-level and multi-purpose building above and below traffic routes has been employed in the large cities of the U.S. since the first decades of the 20th century. The shortage of land at the centers of those cities (the “downtowns”) has made the extensive areas occupied there by the railway companies, including service areas (storage facilities, parking areas for carriages, workshops and garages) into resources of multi-level development.⁵ Due

2 Tourisme Montreal “City under the City,” http://www.tourisme-montreal.org/abouttm_target/news/en/html/566_en.asp (Last visited 17/11/2003).

3 Michael Birat, “Implications of Technological Construction Innovations on National Planning in the Coming Decades,” in *Israel 2000, Israel Master Plan for the 21st Century, Phase I Report* (Jerusalem, the Ministry of the Interior, the Ministry of Construction and Housing, the Israel Land Administration and the Jewish Agency, 1993) 243, at 256. [in Hebrew]

4 See, e.g. Michelle Andrea Wenzel, “Comment: The Model Surface Use and Mineral Development Accommodation Act: Easy Easements for Mining Interests” (1993) 42 *Am. U. L. Rev.* 607, at 608.

5 Robert .R. Wright, *The Law of Airspace* (Indianapolis, Bobbs-Merrill, 1968) 224–229;

to the large investment involved in their erection, the growth of complex multi-level constructions usually comes during periods of economic growth. The construction usually takes many years, with the gradual addition of various layers building up a broad fabric.⁶

In the State of Israel, the multi-level partition of land use does not derive solely from modern and universal planning trends. It reflects the historic, political and geographic uniqueness of Israel. On a section of land with thousands of years of history, an archaeological-historical separation between ancient and new levels is a natural attribute of many urban neighborhoods. Thus, for instance, residential buildings are constructed in “ancient” Acre above archaeological remains thousands of years old. Separation between layers of land was also proposed as a possible political solution for the Temple Mount issue. It was suggested that the area of *Haram-al-Sharif* (the Temple Mount) be part of the State of Palestine, and The Western Wall beneath it (the “Wailing Wall”) be part of the State of Israel.⁷ In the future, population growth might significantly increase crowding in the urban centers.⁸ All these considerations join the special topographical structure of Israel, which consists of settled hilly areas and many height drops. Indeed, the government of Israel recognized the importance of using the subsurface when it decided, on August 22, 1998, to prepare for:more efficient land use, including subterranean space, and integrating several infrastructures and various applications in a single locality.⁹

Richard R. Powell, *Powell on Real Property* (New York, Mathew Bender, Vol. 2, Release 82, 1998) 18A-5.

- 6 Patrick J. Rohan and Melvin A. Reskin, *Condominium Law and Practice* (Vol. 1, Part 1, release 69, 1999) Ch. 5, at 8; (Need Publisher and place published)
- 7 See, e.g. the Shalom Bloc, “Peace Agreement (Draft)” Haaretz, 10 August 2001, at 7A. [in Hebrew]
- 8 The population of Israel is expected to increase to nine million in 2020 and more than thirteen million in 2050. Jossef Forrai and Gili Kirschner, “Transition from Two-Dimensional Legal and Cadastral Reality to a Three-Dimensional One”, *Registration of Properties in Strata – International Workshop on 3D Cadastre Proceedings* (P.J.M. Van Oosterom, J.E. Stoter, E.M. Fendel, 2001), [Hereinafter *International Workshop*] 9, at 10.
- 9 Government of Israel, Decision No. 144/1999, as cited, *ibid.*, at 10.

Subsurface space is, then, the “lost continent” of urban space, or the “*terra nullius*” of the era of progress.¹⁰ At the same time the historic and planning experience accumulated worldwide and in Israel shows that use of subsurface space is not a utilization of a remote and isolated “continent”. The “conquered” subsurface space usually integrates with the use of the space above it. The need for inter-space harmony in planning and using the various layers of land should be reflected in the manner in which the law relates to the property rights in subsurface space. However, it seems that the growing scope of the integration of subsurface space into urban architecture, and the anticipated improvement in its quality, might require the “refreshment” of some traditional doctrines dealing with the legal status of subsurface space.

B. Utilization of Subsurface Space as a Challenge to the Legal Doctrine Concerning the Extent of Ownership in Land.

The legal doctrine regulating the legal status of subsurface space in the majority of countries worldwide was created thousands of years ago. According to this doctrine, the subsurface ownership follows the surface ownership. The Talmud states that ownership extends “from the *depth of the earth* to the height of the sky”¹¹. A similar rule was established in Roman law, which is expressed in the well-known Latin phrase: *Cujus est solum, eius est usque ad coelum et usque ad inferos*.¹²

The above phrase was absorbed into English and American law,¹³ and

10 As defined by Israeli Supreme Court President Aharon Barak in CA 119/01, *Akunas v. State of Israel*, 57(1) P.D. 817.

11 Baba Batra, 72: R. Dimi of Nahardea said: “If one sells a house with the intention of giving title to all its contents, although the deed of sale states from the bottom to the top, title is not acquired in wells, etc. (if such there were), unless he writes: ‘You shall acquire title from the depth of the earth to the height of the sky’”. Some attribute the quote to Rabbi Akiva. Some see its sources in the Bible, Isaiah VII: 11: “Ask a sign from the Lord your God, go down to the depths or go high above”.
See Wright, *supra* n. 5, at 15, n. 14.

12 For the sources of the quote, see Wright, *supra* n. 5, at 13–17; Francesco Parisi, “Entropy in Property” (2000) 50 *Am. J. Comp. L.* 595, at 606.

13 Wright, *supra* n. 5, at 15 ff.

also finds expression in European¹⁴ and Israeli¹⁵ law. The traditional doctrine was created in a reality in which the use of subsurface space was relatively rare and minimal. The shapers of the traditional doctrine saw it mainly as theoretical. The present and future possibilities of subsurface use were not taken into consideration even by Coke, Blackstone or Salmond when they wrote their theory, based on the Roman phrase concerning the extent of ownership in the form of a cone down to the center of the earth.¹⁶

An example demonstrating the purely theoretical character of the “cone theory” is the difficulty of implementing it on a particularly steep slope. The straight line to be drawn from the borders of the surface parcels down to the center of the earth could leave in the possession of the surface owner a very limited subsurface space. The boundaries of his subsurface space might be drawn in a sharp angle close to the surface, and the subsurface of the lower parcels would extend underneath it. If, on the other hand, subsurface ownership is established in parallel lines, they will never meet. Instead, they will meet up with the subsurface boundary lines of the parcels on the other side of the slope or of the earth. The designers of the “cone theory” preferred to imagine a planet with a flat, uniform surface. They assumed that the center of the earth is easy to establish, and did not deal with the question of how it should be located and what the circumference of such an imaginary center might be.

The fact that the traditional doctrine concerning the extent of subsurface ownership was erected on a theoretical basis, does not necessarily lead to the conclusion that it is an unworthy doctrine.¹⁷ The emerging revolution in the ability to utilize subsurface space requires us, more than ever in the past, to examine practically the question of the proper law. This was very well described by Prof. Stuart Ball, in 1928:

14 Section 905 of the German Civil Code; Section 667 of the Swiss Civil Code; Section 552 of the French Civil Code; Section 840 of the Italian Civil Code; under European influence, Section 490 of the New Louisiana Code of 1998.

15 Article 11 of The Land Law 5729 – 1969, 23 L. S. I. at 285.

16 Wright, *supra* n. 5, at 12 (n. 7), 13, 16. Parisi, *supra* n. 12, at 607.

17 Merrill and Smith suggest that the “formalistic or bright-line” nature of the doctrine is a result of the tendency of rules that protect *in rem* rights to communicate information about the scope of protected rights at acceptable costs. Thomas W. Merrill, Henry E. Smith, “The Property/Contract Interface” (2001) 101 *Colum. L. Rev.* 773, at 803.

It cannot be denied that the phrase *usque ad inferos* involves much of the apparently absurd and useless. Our deepest mines extend but a few miles under the surface, and it takes the imagination of a Jules Verne to picture man ever finding it possible to penetrate much deeper. *Nevertheless, there is no need of setting a limit on the depth of what the law will recognize as a fit subject of ownership until some situation arises demanding such a solution.*¹⁸ (Emphasis added – H.S.)

The first practical test of the doctrine concerning the extent of ownership in space came in the early decades of the 20th century, with regular utilization of above-surface space for high-rise construction and aviation. Thus, for example, high-rise construction raised the question of whether above-surface space could be subdivided into independent ownership units. The development of aviation raised the question of whether ownership of surface space should be limited so as to enable freedom of aviation. The traditional doctrine could not provide satisfactory answers to these two questions.

In the course of the 20th century, various legal institutions were created, in order to enable the subdivision of surface space ownership. The most prominent of these institutions are the various kinds of condominiums (Condominium, Strata Title),¹⁹ and air rights.²⁰ Most legal systems, including the Israeli legal system, restrict the scope of surface space ownership in favor of aviation rights²¹. When tested practically, it was

18 Stuart S. Ball, "The Vertical Extent of Ownership in Land" (1928) 76 *U. Penn. L. Rev.* 631, at 639.

19 Powell, *supra* n. 5, at 18A–15. For a historical review of the development of the institution see C.G. Van Der Merwe, "Apartment Ownership," in Athanassios N. Yiannopoulos Ch., ed. *International Encyclopedia of Comparative Law* (Tubingen, Mohr, 1973) Vol. VI, Ch.5, at 6.

20 See Wright, *supra* n. 5; Powell, *supra* n. 5, at 18A.

21 Federal Aviation Act 49 U.S.C. § 40101; In Israel: Article 11 of the Land Law, stipulating that the range of ownership of surface space "does not prevent passage through elevated space. For a description of the extent of legal protection to air space, see Richard R. Powell, *Powell on Real Property* (New York, Mathew Bender, Vol. 9, Release 93, 12/2000) 64A–12 ff; Fowler V. Harper, Fleming James, and Jr., Oscar S. Gray, *The Law of Torts* (Boston, Little Brown, 3rd ed., 1996) Vol.1, at § 1.5.

hard to defend the traditional doctrine. This was nicely summed up by the late American scholar Powell, in justifying his position on the need for separate ownership of air rights:

...in an era marked by increasing urban concentration, the desirability of maximum utilization of available space is obvious. Moreover, no convincing argument against recognition has been advanced. Virtually all commentators have argued in favor of the validity of horizontal subdivision.²²

The manner in which the traditional doctrine retreated in the face of these two “modern” (at the time) uses of above-surface space, could indicate the direction we must take in regard to the current form of Land Law with respect to subsurface space. The questions raised by the utilization of subsurface space are similar.

The first question is whether it is proper to permit the subdivision of the ownership of subsurface space. Should there be a legal distinction between aboveground space, and underground space? If the law permits dividing the ground or whatever is built on it into sub-parcels, and delineating “vertical” and “horizontal” boundaries between them, why should it preclude the delineation of “horizontal” boundaries between the surface and the subsurface space, or between various spaces within subsurface space? This question will be discussed in sections II and III of this article. In section II we will consider the theoretical aspects of the question. In section III we will confront the technical problems.

The second question is whether the owner of the surface should be deemed the residual owner of the subsurface space, and to what extent should his rights be protected. As long as the subsurface remained largely unexploitable, and indivisible from the surface, this question was essentially theoretical. Now that subsurface space can be practically exploited to quite significant depths, the question may become very topical. Why, then, should society not deal with the subsurface as it did with new continents that were discovered, with abandoned and unutilized areas of land or, in contrast, with aviation space? Should the government

²² Powell, *supra* n. 5, at 18A-15-16;

nationalize or seize all or part of the subsurface so as to allocate it, in an appropriate manner, to individuals? This question will be discussed in section IV of this article.

Before I address the theoretical and practical questions that may arise from the “subterranean revolution”, I should note that many of the questions that will be considered in this article have yet to be decided upon in Israeli law. Nevertheless, some of these questions have been the focus of considerable public and legal interest. Indeed, the issue even reached the Supreme Court in the *Akunas case*.²³ Since the Court’s decision in that case may serve to demonstrate some of the arguments that will be considered in this article, I will briefly present the facts, and the primary elements of the Court’s decision.

C. *The Akunas Case*

1. Background of the Case

Israeli public authorities have shown increasing interest in the subject of ownership of the subsurface over the last few years, due to the planned implementation of several large-scale mass transit projects in the country’s major cities. These plans include the construction of major traffic projects under publicly and privately owned developed areas. These projects will be operated and maintained by public authorities and by private companies – among them multi-national corporations selected by public tenders that will reap the profits generated by operating these projects.

Jerusalem and Tel Aviv are planning light rapid transit networks that will comprise underground routes and service areas, primarily under existing traffic lanes.²⁴ Haifa has already begun work on the “Carmel Tunnels” project, which will provide underground traffic routes tens and even hundreds of meters beneath the Carmel mountain range upon which the city is built.²⁵ What is special about this project is that the planned tunnels will run through the mountains, from one end of the city to the

²³ *Akunas*, *supra* n. 10.

²⁴ Haim Sandberg, “Three-Dimensional Division and Registration of the Subsurface Land Space,” in Shalom Lerner and Daphna Lewinson-Zamir, eds. *Essays in Honour of Joshua Weisman*, (Jerusalem, The Harry and Michael Sacher Institute, 2002) 281, at 285–286 [in Hebrew]

²⁵ *Ibid.*, at 285.

other, under scores of privately owned, developed real estate parcels, including lots developed for residential housing. As a result, this project has raised the practical question of the rights of the owners of the aboveground properties.

The economic scope and character of the project dictated that it be a public initiative. The method that the State adopted for carrying out the project was to expropriate the exclusive rights to the entire route, for a period of ninety-nine years. The notices of expropriation did not precisely specify the dimensions of the tunnels, or their depth. This expropriation met with the objection of the owners of the surface properties, who claimed ownership and inferos, under the traditional doctrine of ownership expressed by Israeli law. The objections revolved around two primary issues. The first was that of fear of direct, real harm to the owners' use of their surface properties. This claim remains the subject of contention among the experts, but would seem to be of no relevance to the deeper sections of the tunnels. The second issue was an objection, in principle, to the State's use of its power to expropriate property. This was the subject of the Supreme Court's decision in the *Akunas* case.²⁶ The case opened a door to an in-depth examination of the definition of the elements that characterize property owners' proprietary rights in the subsurface of his land, and raised questions as to whether the traditional doctrine is justifiable. We may expect further litigation, primarily in regard to the scope of the indemnification to be paid to the owners of the mountaintop properties.

2. The Decision

In the *Akunas* case, the Supreme Court was asked to decide upon the lawfulness of the expropriation of the routes for the Carmel tunnels. Two basic premises went essentially unquestioned: the first, that under the traditional doctrine, the ownership of the tunnel routes resides in the owners of the mountaintop surface properties,²⁷ and the second, that the purpose of the expropriation – the construction of underground traffic arteries – reflects a public need that, in principle, justifies resort to

²⁶ *Akunas*, *supra* n. 10, Justice Na'or, para. 2–12.

²⁷ *Ibid.*, para.30–32.

expropriation, and cannot be attained by means of the marketplace.²⁸ On the basis of these two assumptions, the Court addressed the two central issues underlying the objections.

First, the Court addressed the argument that the traditional doctrine, as expressed in Israeli law,²⁹ does not allow for expropriation that separated the ownership of the subsurface from the surface parcels. The Court held that there was no legal impediment to such an expropriation. This was based upon a statutory provision that permits the expropriation of a specific part of real property.³⁰ The Court did not present a principled discussion of the theoretical considerations – as opposed to the doctrinal ones for preferring this provision to the provisions of the traditional doctrine. Rather, it assumed such a preference to be self-evident.³¹ The Court further held that the authority to expropriate a subsurface section is founded not only upon the authority to expropriate rights of use and possession, and that ownership, as well, could be expropriated. Indeed, it ordered the State to replace the notices of expropriation of possession and use for ninety-nine years with notices of expropriation of ownership.³² It further suggested that cautionary notices be entered into the Land Registry with regard to the relevant parcels. However, the Court deliberately refrained from expressing its opinion as to the method of registering ownership in the expropriated units in the Title Registry, as arguments had not been presented on that point.³³

Second, the Court addressed the question of whether the State could expropriate the entire subsurface space, or could only expropriate the

28 *Ibid.*, para. 21.

29 *Supra* n. 15.

30 *Akunas*, *supra* n. 100, Judge Na'or, Par. 53. Another argument that was raised in the *Akunas* case, but that does not touch upon our subject, concerned the issue of whether the expropriation was consonant with the rule that a transaction cannot be made in a spatial part of a unit of property, as expressed in Article 13 of the Land Law. This provision is intended to prevent the subdivision of property without the prior approval of the planning and surveying authorities. The Court held that there is nothing to prevent such a division, due to the specific statutory provision that expressly permits expropriation or division of a specific part of a property: *ibid.*

31 *Ibid.*, para. 52–53.

32 *Ibid.*, para. 53.

33 *Ibid.*, para. 58.

area intended for use by the tunnels. On the basis of the constitutional protection afforded to property rights under Basic Law: Human Dignity and Liberty, as previously construed by the Supreme Court, it was held that the expropriation could not exceed what was necessary.³⁴ The Court therefore ordered that, in the new expropriation notices, the State specify the precise path required for the project, and that it expropriate nothing beyond it³⁵

The *Akunas* case brought to the fore some of the questions that will be discussed in this article. Not all of these questions received a clear, reasoned answer. Thus, for example, the Court unequivocally recognized the possibility of separating ownership in the subsurface from ownership of other parts of the property in the case of expropriation, but no principled explanation was provided for that recognition. Thus, it did not provide sufficient grounds to answer the question – not addressed in the *Akunas* case – of voluntary three-dimensional subdivision of real property by the owners. There was also no need to consider what legal tools might be required to carry out such a division of ownership. The Court also did not address whether the current method of registration makes it possible – in principle and in practice – to register ownership in part of a three-dimensional subdivision of property. The Court's views on the question of who should preferably own the subsurface arose incidentally, but the question was left unresolved. Perhaps, these issues may be addressed when the courts are called upon to settle the issue of indemnification. In any case, I believe that the Court's revolutionary, principled views in favor of three-dimensional division of real property are correct, and I shall attempt to provide support for them in this article.

³⁴ *Ibid.*, para.. 58.

³⁵ *Ibid.*, para.. 58.

II. *Three-Dimensional Division of Property Rights in Subsurface Space: Theoretical Aspects*

A. Presentation of the Problem

The traditional doctrine on vertical ownership may be understood as foreclosing the possibility of separating subsurface ownership and ownership of the layers above. If that is indeed the conclusion to be drawn from the traditional doctrine, it is undesirable, as it contradicts a number of basic principles shared by every modern liberal legal system. It expresses more than a hint of paternalism not consonant with the basic freedom to dispose of one's property, or to enter into contracts freely.³⁶ It impedes the objective of enabling the optimal, efficient use of land resources. This goal derives from two basic assumptions of economic theory. The first is that the market is the most efficient means for allocating property rights, directing assets to those who value them most, and who will probably exploit them most efficiently.³⁷ The second is the assumption that fixing boundaries may lead to more efficient land use, since it tends to internalize externalities.³⁸ Is there any justification for denying a landowner the freedom to separate subsurface rights from the rights above? Is it justified to preclude contracts that transfer independent subsurface sections to those who will use them more efficiently?

The view that ownership of subsurface space is indivisible also raises some difficulty with regard to a division imposed by means of expropriation (Police Power, Eminent Domain). While the trend in the western world is to strike a proper balance between public needs and the individual's property interests, the traditional doctrine, strictly interpreted,

36 On the relationship between the recognition of private property and the recognition of the principle of freedom of contract, see Patrick Selim Atiya, *The Rise and Fall of Freedom of Contract* (Oxford, Oxford University Press, 1979), at 330; see also Morton J. Horowitz, "The Historical Foundations of Modern Contract Law" (1974) 87 *Harv. L. Rev.* 917.

37 See Guido Calabresi and A. Douglas Melamed, "Property Rules, Liability Rules and Inalienability: One View of the Cathedral" (1972) 85 *Harv. L. Rev.* 1089.

38 Robert C. Ellickson, "Property in Land" (1993) 102 *Yale L. Rev.* 1315, at 1327-1328; Richard R. Powell, *Powell on Real Property* (New York, Mathew Bender Vol. 9, Release 83, 6/1998) 68-7.

unnecessarily harms both interests. Public needs that justify expropriating only subsurface space cannot be satisfied without expropriating the surface as well. This causes the owners damage that is not justified by any public interest. Does the traditional doctrine present any justification for such a far reaching result?

Another question that arises in this context concerns the choice of the legal arrangement that will encourage the most efficient exploitation of subsurface resources. Would it be better to permit the subdivision of layers of land into separate property units, or should all the layers of the property be subject to co-ownership?³⁹ The prevailing view is that a demand for subdivision of property normally justifies the adoption of a private proprietary regime, subject to considerations of the cost efficiency of privatization.⁴⁰ Under this approach, individual ownership is assumed to be the most efficient means for the preservation and exploitation of property, because co-ownership brings with it such related costs as increased negotiating costs due to holdouts,⁴¹ and collective action problems.⁴² This approach attaches great importance to the cost of transferring to an individual ownership model. This cost may be influenced by technological advances. Thus, for example, Ellickson points out that: "The efficiency thesis predicts that innovations in technologies for marking, defending and providing boundaries lead to more parcelization..."⁴³

As opposed to this, others emphasize the economic and social advantages of the common ownership model, even where the partners do not share any particular common interest.⁴⁴ In some situations, the exploitation of larger parcels may be more efficient than the exploitation of smaller

39 The question of whether the proprietary rights should be held by the State will be addressed in Section IV.

40 Among the more prominent supporters are Demsetz and Ellickson. For a description of the approach and its supporters, see Hanoch Dagan and Michael A. Heller, "The Liberal Commons" (2001) 110 *Yale L. J.* 549, at 559–563.

41 Harold Demsetz, "Toward a Theory of Property Rights" (1967) 57 *Am. Econ. Rev.* 347, at 354–356; Ellickson, *supra* n. 38, at 1327–1333.

42 A "Collective Action" problem occurs when a group of individuals agree on both their collective purpose and the best means to promote it, but still face difficulties in achieving it. Dagan and Heller, *supra* n. 40, at 575, n.107.

43 Ellickson, *supra* n. 38, at 1330.

44 Prominent supporters of this view are Dagan and Heller, *supra* n. 40, at 572–574.

subdivisions.⁴⁵ Common ownership makes it possible for partners to spread the risk involved in exploiting the property.⁴⁶ Common ownership, itself, has a social value, at least in certain types of relationships.⁴⁷ The supporters of this approach emphasize the importance of a partner's strong right of exit as a condition for preferring the common ownership model.⁴⁸ They admit that the preference of common ownership is not appropriate to all relationships,⁴⁹ and that there are many instances in which "locking people together to manage a resource has disastrous effect".⁵⁰ One of the consequences of common ownership may be "the tragedy of the anticommons", which Heller defined as occurring "when multiple owners are each endowed with the right to exclude others from a scarce resource, and no one has an effective privilege of use. When there are too many owners holding rights of exclusion, the resource is prone to be underused".⁵¹ Heller points out that the tragedy of the anticommons can also come about in a system that creates independent private land units. This can result when the initial governmental design of the independent unit does not allow for its efficient exploitation. The resultant interdependence of the independent units may lead to a bilateral monopoly that poses problems not unlike those presented by the common ownership model.⁵² The success of a subdivision is largely contingent upon the initial endowment of property rights. A new unit will be more marketable if its initial design constitutes "coherent bundles of endowments in familiar objects."⁵³

Consideration of all the aspects of this scholarly debate goes well beyond the scope of this article. Indeed, the debate has yet to be settled, and "the problem remains a puzzle".⁵⁴ In any case, it should be noted that the

45 *Ibid.*, at 572.

46 *Ibid.*

47 *ibid.*, at 573.

48 *Ibid.*, at 576-577.

49 *Ibid.*, at 574.

50 *Ibid.*, at 564, n.56.

51 Michael A. Heller, "The Tragedy of the Anticommons: Property in the Transition from Marx to Markets" (1998) 111 *Harv. L. Rev.* 621, at 622.

52 *Ibid.*, at 653, n.157.

53 *Ibid.*, at 650.

54 Dagan and Heller, *supra* n. 40, at 561, n.45.

voluntary separation of ownership in the subsurface from the ownership of other parts of the property creates, in this context, two special problems. The first, which will be addressed below, derives from the question of whether the interdependence of the layers makes it possible for the subsurface to function as an independent unit. The second, which will be discussed in Part C, relates to the question of whether the costs of registration and subdivision of subsurface property exceed the benefits.

B. Dependence between Land Layers as a Reason for Denying Horizontal Boundaries to Land Ownership

The prohibition upon dividing subsurface property can be justified by the argument that it is not functionally possible to detach the subsurface from what is above it, because the two are inseparably dependent. The dependence of the surface on the subsurface is stronger than that often existing between neighboring parcels, due to the vertical layering of the units, and the very nature of the earth's gravity. The subsurface always supports what is on it. This support has a mutual effect. Incorrect use of the subsurface could damage what is above it. At the same time, use of the surface soil and the surface space requires inserting foundations deep into the subsurface. Too great a load may damage what is below the surface. The mutual damage may be expressed not only in terms of gravity and support. Subsurface space is more exposed to problems of drainage, which derives from what lies above. It also depends on the "good graces" of the upper layer because often the only exit is upwards, while aboveground there are openings to the sides. The subsurface depends upon what is above it for ventilation, drainage and transit. The surface also relies upon various opportunities over which the subsurface holds a monopoly or a significant advantage, such as better protection or parking possibilities.

Absolute separation of the subsurface from the surface is almost impossible. Obviously, there are cases where it is possible to achieve total functional separation, such as a deep tunnel, where there is a very broad partition between it and the surface. But these are not prevalent cases. The expected development of the subsurface, especially in the urban environment, is in the direction of integrated multi-level use.

Functional division of subsurface property into separate units is

required even at depths relatively close to the surface. Optimum utilization of the subsurface in these common cases is not amenable to absolute separation between the subsurface and the surface. Any change in the use of one of the layers could affect the others. Any such change would require prior thought, appropriate planning, and mutual consideration.

Moreover, hold-out problems may often arise. For instance, when a structure on one level is destroyed, and its reconstruction requires some assistance from another existing layer, the owners of a lower layer might hold-out and take advantage of the upper layer's distress.⁵⁵ Similar conduct might be displayed by the owner of an upper layer when the lower layer needs the cooperation of the higher layer for escape or ventilation.

It can be argued that the interdependence of the layers is so great that it imposes a partnership upon the owners of neighboring layers, and therefore, cases of extreme interdependence will lead to the "tragedy of anticommons", regardless of the formal nature of the division of their rights.

C. *Grounds Supporting the Possibility of Dividing Property into Layers*

Does the "vertical common fate" among the various ground layers require a merger of the property rights in all layers into a single legal entity? The answer to that question, in my opinion, is no. Despite the dependence between the subsurface and what is above it, this dependence does not in itself justify prohibiting the partition of the subsurface and its division into separate property units. The reasons may be stated as follows:

Firstly, the dependence described above between the subsurface and what is above it is not absolute. Not every physical or legal action concerning the subsurface necessarily affects the use of what is above, and *vice versa*. The trends I reviewed above with respect to subsurface utilization are expected to divide the subsurface and what is above it into independent

55 A similar situation may arise in condominiums. Thus, Section 60 of the Israeli Land Law justifies the compulsory reconstruction of a condominium that was destroyed. This section was unsuccessfully challenged after the first Gulf War in connection with the reconstruction of a Tel-Aviv house that was destroyed by a missile. CA 7112/93, *Tzudle v. Yosef*, 45(5) P.D. 550; For an economic analysis of the case see Hanoch Dagan, "Interpretation of the Laws Concerning Property, Condominiums and the Problem of Common Action" (1996) 45 *Tel-Aviv University Law Review* 79-91. [in Hebrew]

layers in terms of their function and designation. The technical and planning solutions already available make it possible to overcome the constraints imposed by the interdependence between the layers. Depriving an owner of the potential of dividing up his rights in the layers of ground in a manner consistent with economic realities, planning possibilities, and technological advances will severely impinge upon his ability to use the subsurface. It will restrict and often even prevent the owner's ability to realize his rights and to profit from the economic benefit accruing from "conquering" the subsurface. Indeed, the dependence between the ground layers could justify *limiting* the possibility of subdividing the title in the land in layers. However, subject to regulation of the reciprocal relationships among the three-dimensional spaces above and below the surface, it is desirable that the law enables three-dimensional subdivision of the land, and correspondingly encourages the advantageous planning and economic trends described above. Traditional doctrine itself cannot justify the unity of the surface and the subsurface when there is public interest, economic incentive and practical technological ability to recognize subsurface space as a separate functional unit.

Secondly, the "unity" of the owners in the surface and subsurface is not the only way to regulate the fields of mutual dependence and influence among the land units. It is not even the customary way to do it. Interdependence is not unique to the relationship between the subsurface and the land above. Even neighboring parcels above ground can be dependent on each other for support, passage, drainage, view or pollution. The use of these parcels can require a very high level of mutual consideration.⁵⁶ Indeed, the law of torts traditionally intervenes in the relationship between two neighboring parcels. Many rules of torts law are intended to protect one parcel from damage caused by the owner of a nearby parcel. Among these rules one finds the various rules concerning nuisances, which protect the use of land,⁵⁷ prevention of support,⁵⁸ and

56 According to Ellickson, adjoining owners "are likely to be bound by norms that dictate cooperative behavior in routine interactions". Ellickson, *supra* n. 38, at 1330, n.56.

57 Richard R. Powell, *Powell on Real Property* (New York, Mathew Bender Vol. 9, Release 86, 3/1999) 64-6.

58 See Richard R. Powell, *Powell on Real Property* (New York, Mathew Bender, Vol. 9, Release 95, 06/2001) Ch. 63.

trespassing.⁵⁹ Another field in which the law similarly regulates the conduct of “lateral” neighbors’ is that of right of way.⁶⁰ At the same time, the traditional fields of statutory intervention are rather minor. In the absence of binding and detailed regulation of the relationships among neighboring parcels, it must be regulated by means of agreements among the parcel owners. The most common method is that of easement agreements among neighboring parcels, serving to regulate the dependence relationships among them with respect to passage, support, nuisance, and others.⁶¹ The law also treats of the regulation of neighbors’ relationships with respect to Party Walls.⁶² This regulatory intervention does not deny the owners of neighboring parcels the independent character of their properties, and does not erase the boundary between them. Just as the dependence between parcels does not *obligate* the unification of existing parcels, and does not deny their status as units constituting a separate issue with regard to property rights, so also the absence of such dependence is not a condition *sine qua non* for the creation of a separate independent unit of land. If a partition is acceptable in terms of the planning and zoning aspects, and there is no functional reason to object to it and certainly in a case where all the owners desire it, it is possible to subdivide, despite the dependence. The extent of the legislature’s intervention in regulating “lateral” relationships is relatively limited and leaves considerable room for contractual agreement.

Finally, dependence no less intimate exists between the surface and the various layers in the above-surface space. Nonetheless, we find that

59 See Richard R. Powell, *Powell on Real Property* (New York, Mathew Bender, Vol. 9, Release 93, 12/2000) Ch. 64A.

60 Equity law in England recognized the right of a landowner without egress to pass by virtue of necessity through the neighboring parcel. With respect to a landowner who sold part of his parcel and consequently the part he sold remains without egress. See Jonathan Gaunt and Paul Morgan, *Gale on Easements* (London, Sweet and Maxwell, 17 ed., 2002) at 149ff.

61 See, e.g. Julius L. Sackman and Russell, D. Van Brunt, eds. *Nichols on Eminent Domain* (New York, Mathew Bender, 3rd ed., Vol. 2, Rel. 73–6/03) ch. 5.04[2][a],[b], 203–208.

62 On the laws of Party Walls in England, see Robert Megarry and William R. Wade, *The Law of Real Property* (London, Stevens, 5th ed., 1984) 462–4; In the USA, see: Richard R. Powell, *Powell on Real Property* (New York, Mathew Bender, Vol. 9, Release 74, 3/1996) Ch. 61. In Israel, see Articles 49–51 of the Land Law, *supra* n. 15, at 291.

in the majority of legal systems, a way has been found to subdivide the above-surface space into independent property units. Reinforcement for this position can be obtained from a comparative review of two models in principle serving to regulate the relationships among independent property units *above ground*. One is the “independent” model, enabling the ownership of “air rights” to be subdivided. It apparently allows the parties absolute freedom in designing separate and independent property units, while regulating the relationships among them by means of contracts, subject to a few deviations from the realm of the torts laws. The other model is the “cooperative” model, which interferes with the parties’ ability to design their property units as they wish, and enforces a particular framework imposing an unavoidable measure of cooperation. This model finds expression in the manner in which the condominium laws or strata title laws regulate the spatial partition of land units into “apartments” or “units”, within an overall master framework, which contains certain elements of cooperation. There are legal systems, such as the Israeli system, in which the cooperative model is adopted by the legislature as the exclusive model for regulating three-dimensional division of certain land units.⁶³ The following sections are devoted to an examination of the lessons to be learned from these models for the possibility of dividing real property into layers.

D. The “Independent” Model of Dividing Above-Surface Space into “Air Rights”

Support for the conclusion that nothing, in principle, prevents recognizing three-dimensional subsurface spaces as independent property units, can be found in the manner employed by some Western countries to divide above-surface space into separate property units. As mentioned above, the need to construct multi-level buildings above ground put the traditional doctrine to the test already in the first years of the 20th century. One of the solutions adopted enabled the division of the above-surface space into

63 The Israeli legislature does not, *prima facie*, leave any alternative for horizontal absolute separation of ownership, except by registering a condominium (Article 54 of the Land Law, *supra* n. 15, at 292).

separate, independent property units. Since, before utilization, these units consisted of empty space designated for use, they were called “Air Rights” or, if one wished to distinguish between the three-dimensional delineation of the unit and its physical content – “Air Space Rights”.⁶⁴ The legal arrangements created in this way enabled the creation, by contract or by expropriation, of three-dimensional “blocks” containing above-surface spaces, whether used or unused. These blocks were recognized in judgments and legislation as separate real property “tracts,” constituting a separate subject for real property rights and transactions.⁶⁵ The relationship between the various units was determined, as between lateral units on the surface, by agreements among the unit owners and under the general law dealing with neighboring relationships between parcels. These agreements sometimes take the form of easements. When the ownership in the various units is in the possession of one entity wishing to retain title, these arrangements are expressed in lease agreements or mutual agreements with restrictive clauses.⁶⁶ Famous “Air Rights Projects” are scattered all over the large U.S. cities.⁶⁷ One of the most famous examples is the United Nations Plaza in New York. This project consists of two residential towers constructed over a commercial center. The two towers and the commercial structure were designed and registered from the start as independent “air blocks,” and the relationship between them was determined by means of a series of easements and reciprocal agreements. The main practical reason for this separation was the desire to enable a separate lien on each unit. The units were created by means of registering creation deeds in the local registry of deeds. A three-

64 Wright, *supra* n. 5, at 224–225.

65 Richard R. Powell, *Powell on Real Property* (New York, Mathew Bender, Vol. 2, Release 85, 12/1998) 18A, at 12.1–14.

66 Richard R. Powell, *Powell on Real Property* (New York, Mathew Bender, Vol. 2, Release 95, 6/2001) 18A, at 7.

67 Among the most prominent of them are the following projects: In Chicago – the Chicago Post Office, the Sun times Building; in Illinois – Marina City Apartments, Outer Drive Apartments over the Illinois Central right of way; in New York City – United Nations Plaza, Pan Am Building (over Grand Central Station), the housing complex over the approaches to George Washington Bridge; in Boston – a giant project above the Massachusetts Turnpike. For a review of the bibliography on these projects, see *ibid.*, at 6 (footnote 4). For a detailed review of additional projects, see Wright, *supra* n. 5.

dimensional diagram was attached to the deeds, describing the height of the units, taking account of the "Manhattan Datum Level".⁶⁸ The content of the easements and the reciprocal agreements drawn up among the various parcels in the project reflects the fields in which there is special dependence between the vertical layers of land lying one upon the other. Included among the rights conferred on the top units were various "ingress/egress" rights, rights concerning support of the top structure, piping, drainage, shafts, elevators, and entry rights for the purpose of future maintenance and construction. The bottom level was given the right to locate "geographically" within its boundaries the easements granted to the buildings above, ventilation rights and the rights to discharge gases via the towers above, rights of passage to the roof and rights to enter for the purpose of repairing passages, machinery or water tanks which are also connected to the lower level.⁶⁹

Legislation and judgments in certain regions of Canada⁷⁰ and Australia⁷¹ recognize the ownership of "Air Rights". Section 7 of the Model Airspace Act (hereinafter – the "MAA"), which was approved by the American Bar Association, summarizes its innovation with respect to the above-surface space:

Airspace may be divided or apportioned horizontally and vertically, and in any metric shape or design, in the exercise of any of the powers, rights or duties by public bodies or private persons under this Act.⁷²

Application of the air rights model to subsurface space leads to the

68 Powell, *supra* n. 676, at 6–7.

69 *Ibid.*, at 7.

70 In Canada, air rights were generally not recognized. Explicit legislation recognizing the possibility of acquiring property in air rights was adopted only in New Brunswick. See A.H. Oosterhoff and W.B. Rayner, *Anger and Honsberger Law of Real Property* (Ontario, Canada Law Book, 1985) Vol.2, 1782.

71 On judgmental recognition of air rights in Australia, see Adrian .J. Bradbrook, Susan.V. MacCallum, and Anthony P. Moore, *Australian Real Property Law* (North Ryde, LBC Information Services, 2nd ed., 1997) Ch.15, at 14–19.

72 Committee of the Section of Real Property, Probate and Trust Law, "Model Airspace Act," (1973) 8 *Real Property, Probate and Trust Journal* 504.

conclusion that just as “tracts” of air can be created, so can “units” be created in subsurface space, and the relationships among them can be arranged independently by means of agreements. It would appear that the interdependence among the above-surface complexes that create the “air rights” is not inferior to the similar interdependence between the subsurface and what is above it. Within a year of publication of the MAA, the applicability of the “Air Rights” model to the subsurface was addressed in the U.S.:

“The same concepts can be applied equally to transfers of subsurface spaces as well as of air spaces.... The separations of portions of the mass from the balance of the property frequently create the same problems of life support as when a spaceman leaves his spaceship during space flight. He must either maintain a life support connection with the mother ship [or.....] So it is, too, with a space parcel – it must have life support in the form of a means of access and a means of physical support for any structure that will occupy the space parcel” (emphasis added – H.S.).⁷³

It would appear that, at least from the functional aspect, there is no point in following the traditional doctrine and preventing the division of subsurface space merely because the subsurface and the above ground are bound up with each other. At the same time, there is reason to ensure that “life sources” vital to utilizing a subsurface unit of land be assured as part of the mutual relationship between the units.

E. The “Cooperative” Model of the Condominium

Condominium Law supports the conclusion that there is reason to recognize subsurface three-dimensional property units. Although the concept of subdividing ownership in land units in multi-unit buildings is ancient, 20th century urbanization introduced very high, broad, multi-

⁷³ J.M. Pedowitz, “Transfers of Air Rights and Development Rights” (1974) 9 *Real Property, Probate and Trust Journal* 183, at 183.

unit buildings.⁷⁴ Condominium laws were drawn up as a response to this phenomenon that presents two contradictory trends. On the one hand, the “apartment” or the “unit” was conceived as an independent property unit. On the other hand, the independent unit was conceived as part of a larger complex, the “condominium”, which presupposes a significant measure of cooperation in its management. This inherent need for cooperation makes the condominium not only an architectural phenomenon, but a sociological one, as well. The need for cooperation derives, first and foremost, from the common facilities that serve the various units in the building. In the case of condominiums, cooperation does not result from the vertical layering of the structure in floors built above the ground, although this layering has a material effect on the strength of the cooperation in high-rise buildings (constituting the majority of condominiums). The areas of cooperation that vertical layering imposes upon the residents of a condominium are similar to the areas of dependence between the subsurface and what is above it, such as support, passage, drainage, and piping.

The condominium laws that developed during the 20th century were designed to provide a solution embracing the two contradictory trends that characterize the condominium phenomenon – independence and cooperation. They enable the creation of vertically layered independent land units,⁷⁵ and establish a detailed regime of cooperation in the condominium.⁷⁶ Although parties may regulate their common relationships by contract, the default enforces very close cooperation.⁷⁷ The subordination to cooperative institutions, and the existence of these institutions, is an integral part of the legal structure of a condominium. The residual basic concept of condominium law is that the apartment owners are partners in the land and in other components of the building

⁷⁴ *International Encyclopedia of Comparative Law*, supra n. 19, Vol.6, Ch.5, p.3.

⁷⁵ The Uniform Condominium Act 1977 (hereinafter – UCA) defines “Unit” (Article 1–103–25) as “a physical portion of the condominium designated for separate ownership or occupancy...” *Uniform Law Annotated* (Vol.7, Part II, Master ed., 2002), at 468. See also Article 1–105 to UCA, at 477.

⁷⁶ See e.g. UCA, Article 3, *ibid.*, at 540ff.

⁷⁷ UCA, Article 3–106 (“Bylaws”), *ibid.*, at 555.

with regard to which no specific stipulations were made.⁷⁸ Generally, the condominium model entails a greater measure of cooperation than the independent model. It is more suitable for buildings that require a large degree of cooperation because it offers the residents a ready-made regimen of cooperative relations, and thus frees them from the need to create one from scratch.

Urban development in Western countries has led to the improvement of the cooperative model, and has expanded the range of cases in which it can be employed. The cooperative model is good for all types of built-up or utilized land spaces divided into sub-units, where an inevitable measure of cooperation is required. While it is frequently utilized for high-rise buildings, in principle, there is nothing to prevent it from being used for subsurface construction. In practice, condominiums commonly use the subsurface for parking, residence, bomb shelters, stores and service facilities. The cooperative model is also suitable for arranging relationships among buildings constructed linearly across the surface. Generally, the cooperative model serves to divide up built-up systems, but it can also be used in order to divide up the use of natural physical spaces (such as caves), or spaces that combine built-up units with natural areas (e.g. marinas and beaches). Adjacent bare and undeveloped parcels of land can also be regulated under the cooperative model. Such a phenomenon is known in Canada as “Bare Strata Title”.⁷⁹ The modern approach in the Anglo-Saxon world⁸⁰ makes the options of using the cooperative model as flexible as possible. It no longer speaks of “apartments”, “offices” or “cells”, but of “spaces” or “units”. Thus, for instance, Section 2 of the Unit Title Act 1972 in New Zealand defined the independent unit as follows:

“...in relation to any land, means a part of the land consisting of a *space of any shape situated below, on or above the surface of the land*, or partly in one such situation and partly in

78 UCA defines (Article 1-103-4) Common Elements as “...all portions of a condominium other than units”, *ibid.*, at 466. See also UCA, Article 2-102 (“Unit Boundaries”), *ibid.*, at 491.

79 In British Columbia, Ontario and Manitoba, but not in Quebec or Newfoundland. See Oosterhoff and Rayner, *supra* n. 700, at 1869-1873; See also *International Encyclopedia of Comparative Law*, *supra* n. 19, Vol.6, Ch.5, p.31.

another or others, all the dimensions of which are limited, and that is designed for separate ownership.” (Emphasis added – H.S.)⁸¹

In the U.S., the unit is defined as a “physical portion” of “Real Estate”, a term which, as defined in the Uniform Condominium Act 1977, and in other legislation, also includes: “...parcels with or without upper or lower boundaries and *spaces* that may be filled with air or water...”⁸²

The cooperative model can certainly serve to formalize relationships among below-surface property units. It is already applied in Israel and elsewhere to regulate relationships among subsurface units in built-up complexes. If the landowners wish it, they can turn the various land levels into a “condominium” by dividing them into three-dimensional sub-units. The reciprocal relationship between the units can also be determined by means of the contractual model used to formalize relationships in the cooperative model.⁸³ Another model that is encountered is commonly referred to as “Lollipop Condominiums”, where there is division between layers subject to the condominium regime and “independent” layers that do not form part of it.⁸⁴

At the same time, condominium laws are not flexible enough to be used in every type of built-up complex and in every possible variation of its partition. The advantage of the cooperative model over the independent model purports to be that it proposes a ready-made list of rules for cooperation, the majority of which can be amended, while others are imposed on the parties who adopt the model. It is doubtful whether the rules provided in the current condominium laws are capable of delivering

80 The expanding approach is customary in the U.S., Canada, Australia and New Zealand, but not in Western Europe or Latin America. *International Encyclopedia of Comparative Law*, *ibid.*, at 45–49.

81 Andrew Alston, Tom Bennion, Michele Slatter, Rod Thomas, and Elizabeth Toomey, *Guide to New Zealand Land Law* (Wellington, Brooker's, 1997) 604. See also in Victoria, Australia, *ibid.*, at 602 and Bradbrook at al., *supra* n. 71 at 489, 491.

82 UCA, Article 1–103, Uniform Law annotated, *supra* n. 75, at 467.

83 According to UCA, the unit owners may pass bylaws (Article 3–106) and have a statutory easement in the common element (Article 2–117). *Ibid.*, at 555, 521.

84 See Powell, *supra* n. 5, at 18A–15. See also UCA, Article 2–110 “Exercise of Development Rights”, Uniform Law Annotated, *supra* n. 75, at 513.

this advantage to the anticipated forms of subsurface development. The “house” on which the condominium laws is based is a house or group of houses, including houses built one on top of the other, in which there are *many* units dispersed among many owners, and serving mainly for residence or commerce. The cooperation rules stipulated by the condominium laws did not necessarily foresee the inter-level problems which might be raised by the “mega-structures” of the next century, above or underneath the ground. A large complex can consist of only two or three large units. Often, it is created between large entities, which want, and can afford, to outline the relationship between them independently. In a large complex there may be an aspiration for more independence.⁸⁵ The residual design of the condominium institutions, and the cooperation rules in a condominium could, at times, restrict the ability for efficient management of a large complex.

On the other hand, the condominium laws do not provide any guidance for settling specific problems that arise, especially in connection with large complexes, particularly when they are constructed underground. These problems can be deduced from the content of the easements customary in air rights projects. Thus, for instance, the condominium laws in Israel do not say anything concerning the duty to enable ventilation openings or passage from the subsurface upwards.⁸⁶ It is true that the parties have the right to stipulate such arrangements, but if we permit them to be stipulated, why do we restrict them to the particular framework of a “condominium”? It seems to me, therefore, that there is no justification for the cooperative model in general, and the condominium laws in particular, to have a monopoly on three-dimensional partition of land units. It is also desirable to enable three-dimensional partition of large complexes by means of an independent model, which would enable owners to freely delineate both the three-dimensional boundaries of the property units and the mutual relationships among them.

85 Compare with Prof. Parisi's contention that when only a few parties are involved “...the risks of horizontal forms of property fragmentation are limited”. Parisi, *supra* n. 12, at 608.

86 Article 2-117 of UCA Provides for an easement only through the common elements. Uniform Law Annotated, *supra* n. 75, at 521.

F. *Is there Cause for Regulating Multi-Level Relationships?*

It may be argued that there is no reason to enable independent three-dimensional partition of ownership in land levels without first outlining a detailed system of rules of enforcement that will reflect the special fields of dependence between the subsurface and what lies above. In my opinion, creating such a system *at this stage* of subsurface development is undesirable. Indeed, one may conjecture what fields will require compulsory regulation in connection with the relationship between the subsurface and what is above it: support, passage, drainage, ventilation, effect on future use of levels, mutual dependence in reconstruction and maintenance.

At the same time, we are addressing a phenomenon that has not yet properly developed. The experience required characterizing the unique nature of subsurface use, and to identify the required fields of intervention has not yet been accumulated. It is not yet possible to foresee the appropriate arrangements for landowners. It would be best to enable them to freely delineate their mutual relationships by means of the existing models.

The independent model is more suitable for parties wishing to delineate for themselves the inter-level relationship between them. No three-level partition will be created without the initiative of parties who want it, and who are probably aware of the need to formalize the inter-level relationship. It will never be possible to anticipate *every* problem that may arise and solutions for loopholes will be found in the courts. However, planning and zoning regulations presently restrict the use of any land, including the subsurface. It may well be that, with time, and after accumulating greater experience with the problems characterizing subsurface use, there will be cause to intervene in a more definitive or compulsory manner.⁸⁷

Support for this conclusion can be found in the Norwegian experience. A draft bill for the registration of independent property units in built-up areas proposed that there be an obligation to register in the Land Registry

⁸⁷ Such intervention is very common in regulating the mutual relationships between surface and mineral owners. See Wenzel, *supra* n. 4, at 640ff.

an agreement formalizing the relationship between the owners of the various layers.⁸⁸ At the same time, no dispositional legislation was proposed to formulate this relationship in detail, and therefore, the requirement of an agreement constitutes nothing more than a “reminder” to the owners of the various levels of the need to formalize the relationships between them. In practice, Norway has developed an *ad-hoc* system that enables the creation of three-dimensional subsurface parcels under the general existing subdivision laws. In this system, the interested parties set up their inter-level relationships automatically, by means of agreements. The Director General of the Norwegian Ministry of the Environment sums up:

“...in fact ‘volumes’ have simply been divided from the surface property, using the regular rules for controlling subdivision... It has generally been left to the involved parties to make the necessary contracts for mutual rights, as required for the individual case.”⁸⁹

G. Three-Dimensional Division of Land Ownership v. Division by Means of Lease and Easement

One of the methods by which three-dimensional subdivision of land is effected is by lease.⁹⁰ Leasing has many advantages for the lessor who does not want to relinquish ownership of his assets. The trouble is that leasing does not always serve the lessor’s interests. At times, maintaining the lease model can make things unnecessarily difficult for both parties, when their interests could be more adequately addressed by subdividing ownership. Why should they be denied the ability to achieve their goal when the subdivision of ownership involves independent three-dimensional units?

88 The information was given in a letter from the Director General of the Norwegian Ministry of the Environment dated May 2, 2000 to the Israeli Ministry of Justice.

89 *Ibid.* See also in Oslo: Tor Valstad, “The Oslo Method: A Practical Approach to Register 3D Properties,” *International Workshop*, *supra* n. 8, at 1, 5; Helge Onsrud, “Making Laws for 3D Cadastre in Norway,” *International Workshop*, *supra* n. 8, at 191,195.

90 Wright, *supra* n. 5, 345–349.

What has been said up to now can also be said with respect to registration of three-dimensional easements either below or above the surface. Indeed, one of the most common methods worldwide of expropriating the subsurface is by creating subsurface passage easements for the purpose of transportation, piping or other needs.⁹¹ The trouble is that the possibility of acquiring easements is not suitable by definition for a project in which there is an intention to take *possession* of the subsurface unit, since easement confers only usage rights, the customary meaning of which is activity of limited scope that does not compromise the landowner's possession.⁹² It is doubtful whether the term "usage" is suited to the type of activity represented by permanent occupation by roads or means of transportation in subsurface projects, especially when these are close to the surface or they have a real effect on the possession thereof. Moreover, compressing all subsurface activity into the confines of easement does not enable freedom to subdivide tunnels or three-dimensional blocks into independent sub-units. Thus, for instance, is it possible to register as a condominium a structure built inside a tunnel the title to which is registered as an easement? Compressing the subsurface area into the narrow framework of easement also restricts the ability to establish reciprocation between the easement owners and others. Can the owner of a subsurface easement grant an easement in his property to others? Furthermore, registering subsurface title as a lease or easement also requires subjecting the boundaries of the subsurface unit to the boundaries of the two-dimensional parcels above ground. Recognition of the subsurface as an independent unit enables delineation of the subsurface independently, according to its planning and functional delineation. This would save the costs of contracting and registering transactions with many owners above ground.⁹³ Finally, partition based on lease agreements or easements is effected in accordance with agreements and administration orders, which are naturally non-uniform and free from governmental surveying inspections. Regular use of such

91 Julius L. Sackman and Russell, D. Van Brunt eds., *Nichols on Eminent Domain* (New York, Mathew Bender, 3rd ed., Vol. 9, Rel. 20-11/84) Appendix B-2(O), p. 102.557.

92 Gaunt and Morgan, *supra* n. 60, at 5.

93 Compare with Ellickson's explanation to rights of aviation in Ellickson, *supra* n. 38, at 1363, fn 242.

partitions as an alternative to the creation of independent units could damage the clarity and accuracy of the title registration or title record and could obscure its standard patterns,⁹⁴ including professional survey standards for delineating borders, and clear and accessible registration forms. Use of lease and easement models cannot, therefore, constitute an appropriate alternative for the possibility of creating an independent three-dimensional ownership unit.

The Israeli Supreme Court recently expressed support for this view in the *Akunas* case. Referring to expropriations made by the State of Israel on Mount Carmel for the purpose of building underground tunnels at a depth of between 30 and 100 meters, the court rejected the attempt to give the expropriation the character of easement, or lease for 99 years. The court held:

“In the circumstances of the case before us, the character of the planned possession and use of the tunnels establishes the type of expropriation as an *ownership* expropriation” (Emphasis added – H.S.).⁹⁵

III. *Practical Registration Limits and the Ability to Subdivide the Subsurface Property*

A. *Title Registration and the Ability to Subdivide the Subsurface Property*

Three-dimensional subdivision of land title could encounter a special difficulty in legal systems where title registration exists. In these countries, a three-dimensional cadastre has never been conducted, and rules for three-dimensional mapping and surveying for registration purposes have

94 Bernard Rudden, “Economic Theory v. Property Law: The *Numerus Clausus* Problem,” *Oxford Essays in Jurisprudence* (Oxford, Oxford University Press, 3rd Series, 1987) 239; Hanoch Dagan, “The Craft of Property” (2003) 91 *Cal. L. Rev.* 1517, at 1567.

95 *Akunas*, *supra*n, 10 President Barak’s judgment, para. 2. As compared with an Australian judgment that ruled that a right to build in airspace is simply a grant of the fee in the airspace and not an easement. *Bursill Enterprises Pty Ltd v. Berger Bros Trading Co. Pty Ltd.* (1971) 124 C.L.R.73.

never been established. Since the concept of title registration requires full reflection of every title in the register,⁹⁶ it is not possible to execute such division in the absence of practice and legislation to regularize the mapping of three-dimensional subdivision. Nevertheless, there is no theoretical contradiction between the concept of title registration and three-dimensional subdivision of property units. If it were possible to overcome the limitations of mapping and surveying, there would be no pertinent legal impediment to three-dimensional subdivision of parcels. There is no reason to deny *a priori* the possibility of registering three-dimensional subdivision in the Title Register, when it is functionally justified, and planning permission exists under the planning and building laws. The title registration method denies the subdivision of these parcels only when it is not properly surveyed or mapped.

Indeed, in Oceania, where title registration was first developed, it has been established that there is no contradiction between title registration and registration of three-dimensional units (in Australia,⁹⁷ and New Zealand⁹⁸). Practical solutions for registering three-dimensional units have also been found in England.⁹⁹ As mentioned above, in Norway, as well, a method has been found to create three-dimensional parcels under the

96 Theodore B.F. Ruoff, *An Englishman Looks at the Torrens System* (Sydney, Law Book Co., 1957) 8.

97 Bradbrook et al., *supra* n. 71, at 534; Robin Clements and Rod Hager, "Strata Subdivision of Commercial Premises" (1984) *LJ* 931.

98 *Ruapekapeka Sawmilling Co. Ltd. v. Yeatts* [1958] NZLR 265 (sc), as quoted in *Guide to New Zealand Land Law*, *supra* n. 81, at 602.

99 Rule 54 of the Land Registration Rules, headed "Registration of a flat, tunnel, etc.", stipulates:

"On the registration of a proprietor of ... a cellar or tunnel or other underground space apart from the surface, a plan shall be furnished of the surface under or over which the tenement to be registered lies, and such further verbal or other description as the Registrar may deem necessary, together with notes of any appurtenant rights of access, whether held in common with others or not, or obligations affecting other tenements for the benefit of the tenant the title to which is being registered: Provided that if the applicant leaves in the Registry a reference to the General Map showing with sufficient accuracy the land affected by his application, it shall not be necessary for him to leave, deposit or furnish any plan." Theodore B.F. Ruoff, Robert. B. Roper, E. John Pryer, Christopher West and Richard Fearnley, *The Law and Practice of Registered Conveyancing* (London, Sweet and Maxwell, 1991), appendix B, at 24.

existing subdivision laws.¹⁰⁰ Norway is also working on preparing a draft bill to formalize separate registration of three-dimensional parcels of construction property.¹⁰¹ In summary, there should be no impediment, in principle or in law, to enabling title registration of a three-dimensional parcel, provided that an appropriate technological solution is found to describe the parcel at the required level of precision.

B. Three-Dimensional Map for Registration Purposes: the Need for New Legislative and Professional Regulations

Robert Ellickson once stated that “the efficiency thesis predicts that innovations in technologies for marking, defending and providing boundaries lead to more parcelization”.¹⁰² There is a vital need to create a doctrinal and practical infrastructure for enacting three-dimensional mapping and surveying rules for the purpose of registration in the title register. The creation of such an infrastructure is, first and foremost, a matter for those engaged in the surveying profession.

The registration maps currently recognized in Israel and in most countries of the world are two-dimensional. The delineation of vertically layered land units requires a three-dimensional description. Such description necessitates indication of the elevation at which each horizontal boundary between units is located. Although a map, by its very nature, has only two dimensions, the three-dimensional measurements of a parcel can be indicated on a two-dimensional map. Technically, three-dimensional presentation of objects is nothing new. Even measuring elevation is nothing new. The starting point for measuring elevation is usually sea level, which is considered an absolute elevation. Indicating elevations is common on topographical maps.¹⁰³

100 See letter from the Director General of the Norwegian Ministry of the Environment, *supra* n. 56.

101 *Ibid.* See also Onsrud *supra* n. 56, at 193 ff.

102 Ellickson, *supra* n. 38, at 1330.

103 In the U.S. three methods are recognized for indicating the third dimension (elevation): indicating spot elevations, by means of cross-sections, and by contouring, as is customary in topographical maps. For a description see Julius L. Sackman and Russell, D. Van Brunt ed., *Nichols on Eminent Domain* (New York, Mathew Bender, 3rd ed., Vol. 9 Rel 41–9/95) Ch. 33.08[6], pp. 68–72.

In order to delineate horizontal boundaries at the level of precision customary on maps drawn for registration purposes, it is necessary to prepare a dense grid of vertical control points. In the State of Israel, statutory provisions have already been enacted for the establishment of vertical control points, and the preparation of an active three-dimensional control grid (GPS – Global Positioning System) has also begun.¹⁰⁴

The principal difficulty lies in three-dimensional surveying, and adapting it to the maps' standards for registration purposes. In practice, it appears that the surveying profession worldwide has not yet formulated an unequivocal position with respect to standardization of surveying and three-dimensional presentation of land maps for registration purposes. Recently, a number of international conferences have been held on the subject.¹⁰⁵ Endeavors to formulate technical and theoretical solutions for topological and visualization problems with respect to three-dimensional registration maps have been made in various countries, among them Holland,¹⁰⁶ Canada,¹⁰⁷ and Greece.¹⁰⁸ Even in Israel great advances have been made in this field. In 1999, the Survey of Israel conducted a surveying

104 State of Israel, "The Survey of Israel" (R. Eldar, ed., 1999), 1. place and publisher

105 The subject was discussed at an international conference organized by the International Federation of Surveyors (FIG) in Seoul, in May 2001. Furthermore, in November 2001, an International Workshop on the subject was held at the Delft Technical University, in Holland. The workshop was held under the auspices of the Bureau of the UN Economic Commission for Europe and its Working Party on Land Administration (WPLA). The workshop was attended by representatives from about thirty countries, including a prominent delegation from Israel. The studies presented at the workshop were published in *Registration of Properties in Strata – International Workshop on 3D Cadastre Proceedings*, supra n. 8.

106 The interest in the subject in Holland arose due to practical problems in Amsterdam. See Jantien Stoter and Martin Salzmann, "Towards a 3D Cadastre; Where do Cadastral Needs and Technical Possibilities Meet?," *International Workshop*, *ibid.*, at 115.

107 In New Brunswick a theoretical model was designed for three-dimensional registration of strata on the coast and the continental shelf. See Sam Ng'ang'a, Michael Southerland, Sara Cockburn and Sue Nichols, "Toward a 3D Marine Cadastre in Support of Good Ocean Governance," *International Workshop*, *ibid.*, at 99.

108 In Greece, national cadastre projects were begun only in 1994. The need for the three-dimensional aspect was felt primarily due to the existence of separation of ownership between fixtures and land especially in regions of old construction. See Dimitris Rokos, "Conceptual Modeling of Real Property Objects for the Hellenic Cadastre," *International Workshop*, *ibid.*, at 137, 139, 148.

experiment for subsurface registration purposes by means of ground penetrating radar.¹⁰⁹ Geodesists and legal scholars and practitioners have also shown increased interest in the issue.¹¹⁰

Prior to commencing three-dimensional registration, it is necessary to regulate, professionally and legally, the three-dimensional surveying and mapping methods. The community of surveyors and legal practitioners will have to assimilate the new practices. It is reasonable to assume that the solutions that will be found to the mapping and surveying problems will lead to far-reaching changes in registration methods. Thus, for instance, it is doubtful if it will be possible to represent three-dimensional registration units by means of hard copy paper maps. It is possible that the only practical way to display a three-dimensional registration map is by means of virtual presentation on a computer screen.¹¹¹ Three-dimensional land registration will display information with a precision greater than what we have come to expect until now in land registries, such as a parcel's three-dimensional spatial location, or its volume. It may also be worthwhile altering the numbering method of parcels, so that the number provides information about a parcel's features. Thus, for instance, it should be possible to indicate a parcel's location above or below the surface.

109 Jossef Forrai, Gili Kirschner, "Preparation for Three-Dimensional Digital Cadastre in Israel" *Geodesy and Survey 2000 – A Collection of Articles* (January 4, 2001) 2place and publisher

110 This increased interest produced a number of publications:

Moshe Benhamu and Yerah Doytsher, "Research Toward a Multilayer 3D Cadastre: Interim Results," *International Workshop, supra* n. 9, at 35; Jad Jarroush and Gilaad Even-Tzur, "Reinstating and Marking Spatial Parcel Boundaries as a Base for 3D Digital Cadastre by Means of Real Time Kinematics GPS," *International Workshop, ibid.*, at 211; Armi Grinstein, "Different Aspects of a 3D Cadastre in the New Town Modi'in, Israel," *International Workshop, ibid.*, at 25; Haim Sandberg, "Three-Dimensional Division and Registration of Title to Land: Legal Aspects," *International Workshop, ibid.*, at 201; A general report on four experimental projects had been recently presented during FIG Working Week 2004, Athens, Greece, May 22–27, 2004. See Uri Shoshani, Moshe Benhamu Eri Goshen, Saul Denekamp and Roy Bar "Registration of Cadastral Spatial Rights in Israel – A Research and Development Project" *FIG Working Week 2004-Proceedings* (International Federation of Surveyors, Athens, 2004) at http://www.fig.net/pub/athens/papers/ts25/TS25_2_Shoshani_et_al.pdf (Last visited 19/09/2004).

111 Benhamu and Doytsher, *ibid.*, at 40–4.

C. *Registration of Spaces or of Actual Construction – Which is the Desirable Choice?*

One of the questions that must be resolved in order to create three-dimensional title registration is whether it is worthwhile to enable registration of imaginary three-dimensional spaces (the “space method” or the “polyhedron system”),¹¹² or whether one should enable subdivision only in accordance with what has actually been constructed and used (the “actual construction system”). The polyhedron system has an advantage with respect to surveying. It is easier to measure the boundaries and volume of a space than to measure and mark the particulars of what is actually constructed and located in it. Surveying spaces requires minor penetration into the subsurface and there are means of doing this even without penetrating the subsurface at all.

Another advantage of the polyhedron system is that it enables the subsurface to be divided into independent property units even before use or exploitation. The polyhedron method does not negate more detailed subdivision after construction or exploitation is completed. The surveying particulars of the space boundaries can serve as a basis for a more detailed survey in the future. The polyhedron method was used in some of the air space projects mentioned above.¹¹³

However, one can argue that the polyhedron system is not commensurate with the concept of title registration. Registering a space does not give information with respect to the actual construction and might even mislead someone relying on this record. The Israeli legislature adopted this position when it enabled registration as condominiums only for houses that are actually built and can be identified and described in a drawing, giving a true “picture of the house and its apartments”.¹¹⁴ This position can be understood as more appropriate for the cooperative regime

112 Copyright on the use of the term “polyhedron” as a name for a three-dimensional property unit is reserved to New Zealand Justice O’Regan. See *Guide to New Zealand Land Law*, *supra* n. 81, at 605.

113 See, e.g., in the U.N. Plaza project, New York. See Powell, *supra* n. 68 and text accompanying it.

114 Section 50 of the Land Regulations (Administration and Registration) 5730–1969, Israel Subsidiary Legislation, 657. [in Hebrew]

of the condominium, in which the apartment owners, who chose it, have an interest of delineating every “fraction of an inch”.¹¹⁵ It is not desirable with respect to the initial subdivision of land parcels. The experience with registration of condominiums in the State of Israel indicates that putting off the registration until after construction is completed creates a significant postponement in completing registration and detracts from the Title Registry.

The current two-dimensional mapping system does not limit the subdivision of land only to built-up parcels either. Registration of a parcel does not depend on what is constructed on it, and does not reveal what is and what is not within it. Registration of three-dimensional spaces will not adversely alter this situation. Even registration of construction does not actually assure that there will be no discrepancy between the registration and the final product following natural or deliberate changes in the actual construction.

The polyhedron system mapping shapes the three-dimensional parcel by means of more stable outlines, the stability and reliability of which are not affected by changes on the ground. One of the supporters of the polyhedron system (“polyhedronists”) in New Zealand summarized his objection to the actual construction system as follows:

...The argument that a principal unit must be a building, founders by resulting absurdity. It is not practicable for survey data on unit plans to depict the exact outline of buildings or structures. The information is invariably approximate. Even if the survey definition is intended to follow the external surface of a building, extrusions and recesses created by roof and window eaves and doorway recesses are not depicted on a plan. As a result, the survey definition invariably allows for open space.¹¹⁶

115 This expression was used at the time by the Registry Director in England, when he expressed his surprise at the strange aspiration of the Torrens method for two-dimensional accuracy. See Ruoff, *supra* n. 96, at 52–53.

116 *Guide to New Zealand Land Law*, *supra* n. 81, at 606.

D. *Should an Overall Three-Dimensional Cadastral Survey Be Made?*

The traditional doctrine assumed that the underground border between parcels was delineated by lines (diagonals) drawn from any point on the surface down to the center of the earth. The theoretical assumption concerning “cones” to the center of the earth could entail many practical problems. The traditional doctrine was created in a reality in which actual use of subsurface space was rare and minimal. As has already been mentioned,¹¹⁷ the framers of the traditional doctrine considered it mainly theoretical. They probably assumed that the center of the earth is a place that is easy to determine. Thus, they did not deal either with the question of exactly how its location and circumference would be determined, or with the survey of the exact boundary lines to be drawn to that imaginary center.

In fact this imaginary boundary has never been mapped or surveyed. Its location and delineation are not part of the information contained in the land registry. When it becomes possible to register parcels three-dimensionally, it will be necessary to determine the location of the existing subsurface boundary. It will be necessary to give concrete form to the cone theory and to face up to the problems it raises. It will be necessary to examine changes made in the past in the imaginary boundary with the consent of the titleholders, but which could not be registered. It will be necessary to examine whether this boundary does not constitute damage to parcel owners or the public. Thus, for instance, it may create parcels that are too narrow. It may create over-dependence between parcels. It may require the delineation of roads, or egress and ventilation strips. It may require adaptation in view of topographical or geographical conditions.

The establishment of a subsurface boundary between parcels, therefore, is not only a private matter between title owners in a particular parcel. It has implications on the environment. Neighbors, the State and holders of various titles in a certain parcel, could have justified claims with respect to the location of the horizontal boundary of a three-dimensional unit. It is not sufficient that it is technically possible to delineate subsurface spaces on a map. It is necessary to decide the question of where exactly they

¹¹⁷ *Supra*, at text after n. 17.

should be delineated. A three-dimensional land title settlement is required.

In view of the cost of such a process, it would be better if it were not implemented in a manner encompassing the entire territory of the state or a particular region, but on each parcel or number of parcels, at the request of the parcel owners desiring to do so, and according to the market requirements.¹¹⁸ For this purpose, it is recommended that a system of voluntary title settlement be adopted, more similar to the English method, which performs title settlement whenever parties wish to make a transaction.¹¹⁹ It must be assured that the three-dimensional boundaries of a particular parcel will be delineated in compatibility with the bordering parcels and the immediate vicinity, and according to rigid and precise professional criteria. It is also necessary to ensure that an appropriate opportunity to be heard will be granted to anyone who might be injured by the subsurface boundary delineation before it is made final.

IV. Limiting Subsurface Private Ownership

A. Is it Desirable to Determine a Downward Limit for the Extent of the Subsurface Ownership?

Another question that might arise due to the possibility of registering three-dimensional parcels is that of the depth of ownership in the bottom layer of the subdivided subsurface. For thousands of years, when the subsurface space was for the most part unattainable and quite close to the surface, this was only a theoretical question.¹²⁰ Now that society is capable of reaching subsurface space, even to very significant depths, the question has become topical. Why, then, shouldn't society deal with the subsurface as it dealt with new continents that were discovered, or with abandoned and unused tracts of land or, in contrast – aviation space? Is there cause for governments to nationalize or take possession of subsurface space below a certain level?

118 Compare with Heller, *supra* n. 51, at 628, n.30.

119 Ruoff and Roper, *supra* n. 99, Ch.1 at 7.

120 Ball, *supra* n. 18, at 639.

Traditional doctrine determined that subsurface ownership belongs to surface owners. Subsurface property rights were not conferred on the possessor or user, since the majority of subsurface space is neither occupied nor utilized. Neither are property rights in subsurface space conferred on the government in order to allocate them to individuals, unless it also owns the surface. Property rights always belong to the owners of title on the surface. Is this an arbitrary and inefficient arrangement? What are the grounds behind this unusual approach?

The traditional doctrine can be justified as long as it can protect the surface and its attached and used subsurface. Thus, for instance, the statement that subsurface penetration constitutes trespass can be justified on the argument that it compromises the support of the surface or the possibility of future use of the surface and the subsurface.¹²¹ On the same grounds it is possible to justify a law that expropriating the subsurface space requires paying compensation to the landowner.¹²² But does every subsurface use damage what is above it? It can be assumed that there is a downward limit below which the subsurface has no effect on the surface space and *vice versa*.

In this case, the traditional doctrine may be seriously contested by the argument that those deep levels of land should be defined as collective property (or state property) since they are resources that are answerable to the needs and purposes of society as a whole rather than to the needs of particular individuals.¹²³ It can be argued as well that the theoretical ownership of a landowner in these deep spaces is nothing but an empty box, with no real content.¹²⁴ Since taking or reallocating this resource imposes no real burden on the original owner, the taking can be explained by virtue of social responsibility and long-term reciprocity of advantage.¹²⁵

121 For an overview of American authorities concerning subsurface trespass see: *ibid.*, at 684–689; Powell, *supra* n. 21, at 64A–14, 15.

122 *Nichols*, *supra* n. 61, Ch. 5.04[1] at 259.

123 Paraphrase of Jeremy Waldron's definition of collective property and state property in Jeremy Waldron, *The Right To Private Property* (Oxford, Clarendon Press, 1988) at 40 and n.30.

124 Compare to J.H. Merryman, "Ownership and Estate," (1974) 48 *Tulane L. Rev.* 916, at 927.

125 Hanoch Dagan, "Takings and Distributive Justice," (1999) 85 *Va. L. Rev.* 74, at 776;

There were echoes of the above considerations in the decision of the Israeli Supreme Court in the *Akunas* case. President Aharon Barak expressed incidental support of the possibility of determining a fixed downward limitation as follows:

“I noted in one of the cases that the exercise of social responsibility of property requires legislation...That is the case with respect to the property right extending into the subsurface space. It seems that it is necessary to rethink the limitations of such extension, and to adapt them to the needs of modern life.”¹²⁶

Accepting the principle according to which a line should be drawn to distinguish between the “top” subsurface, which will belong to the landowners, and the “bottom” subsurface, which will belong to the State, will require the location of the appropriate level at which to draw such a line. I doubt whether drawing such a precise line is possible or desirable. Firstly, it is doubtful whether it is possible today to determine with certainty that a certain subsurface layer has or will have any effect on what is above it. Secondly, even if such a determination is possible, it is clear that the location of a precise imaginary line cannot be uniform, and it must change in accordance with the type of land, its topography and possible types of use of the subsurface and the surface. It would appear difficult, if not impossible to determine a uniform formula that would ensure that, underneath a line that has been drawn, there will never be subsurface sections that would adversely affect the surface space. Alternatively, the line might be drawn at such a low level that beyond it use of the space beneath it would not be possible. Of course, there would be no practical current benefit in drawing it. Indeed, in the *Akunas* case, the Supreme Court Justice Miriam Na’or tended to give effect to subsurface traditional private property rights, even if they are not presently useable, because:

Hanoch Dagan, “Just Compensation, Incentives, and Social Meanings” (2000) 99 *Mich. L. Rev.* 134, at 136.

¹²⁶ *Akunas*, *supra* n. 10, President Barak’s judgment, Paragraph 3.

“We must remember that the possible use of land tomorrow may be different from today.... *The limit of the practical ability to exploit is a vague term, which could change with time...* (Emphasis added – H.S.) The Appellants have the title even over those layers of land underneath their homes that *today* (emphasis original – H.S.) cannot be practically used. The conclusion from the principles that I have described is that there should be no expropriation, *even to the depths* (Emphasis original – H.S.), beyond the required amount.”¹²⁷

It is possible to ascertain the difficulties in drawing a horizontal line that will block the spread of the ownership in the subsurface space from the manner in which the drafters of the Model Airspace Law in the U.S. coped with the interest in drawing the top limit, dividing between the ownership of the surface space and the aviation space. They avoided stipulating a particular elevation that would delineate the upper boundary (“fixed upward limitation”) to define “airspace”. Their grounds for that could also be relevant regarding the delineation of the bottom boundary for the extent of ownership in the sub-space:

...since it is not possible to determine the eventual upward extent of reasonable use and the necessary buffer zone to prevent interference with such reasonable use.¹²⁸

A similar position was taken by the Israeli legislature, which avoided drawing an upper ownership boundary, and only gave a general passage permit for the elevated space.¹²⁹

The difficulty in determining the proper, precise location of the downward limit that would block the initial spread of ownership in the subsurface space can be removed, *prima facie*, by means of a legislative stipulation of the general principle according to which the limit must be located in every case. Two approaches may be assumed with respect to

127 Akunas, *ibid.*, Justice Na'or's judgment, Paragraph 3.

128 See J. Rohan and A. Reskin, *Condominium Law and Practice* (New York, Mathew Bender, Vol.1, part 1, release 69, 1999) Ch.5 at 4.

129 Article 11 of the Land Law, *supra* n. 15..

the location in principle of the said boundary. The first – according to which the boundary will be drawn deeper – will focus on the damage that might be caused to the landowner due to activity in the depths. It appears that such an approach characterizes the determination of the civil codes of Germany¹³⁰ and Italy¹³¹ that the spatial spread of ownership will not prevent activity that the landowner has no real interest in preventing. Another possible approach is to place the line where the practical ability to use the subsurface by the landowner above ends. This type of approach can often locate the boundary higher, although it does not obligate negating the landowner's right to prevent damage that he may incur as a consequence of activity performed below the bottom ownership line, or to compensation for such damage. The advantage is that it denies the landowner all other benefits that would have been available to him if he had remained the owner of the layer below that line, such as the right to determine what should be done with that layer, the right to refrain from any action, the right to appropriate remuneration, or the right to execute transactions. Examples of this approach can be found in the civil codes of Switzerland,¹³² France,¹³³ and Louisiana,¹³⁴ as well as the definition of the upper boundary of "air rights" by the MAA, as follows:¹³⁵

130 Section 905 of the German Codex (B.G.B.) does not limit the extent of ownership but stipulates that: "...the owner may not, however, prohibit interferences which are performed at such height or depth that has *no interest in their exclusion*", *The German Civil Code* (I.S. Forrester tr.) (New Jersey, Rothman, 1975) at 150.

131 Section 840 of the Italian Code stipulates that the extent of ownership in the subsurface does not enable owners to prevent third party activities when the owner "... has no interest in excluding them". See *The Italian Civil Code* (M. Beltramo tr.) (New York, Oceana, 1969) at 228.

132 Section 667 of the Swiss Code stipulates that ownership extends under the surface line "...as far as the exercise of the ownership requires." *The Swiss Civil Code* (R. R. Shick tr.) (Westport, Ct., Hyperion Press, 1980) at 158.

133 Section 552 of the Code Civil describes positively the subsurface actions that the owner may perform: "The owner ... may do below all the constructions and excavations which he judges proper..." *The French Civil Code* (John H. Crabb tr.) (New Jersey, Rothman, 1977).

134 Section 490 of the New Code of Louisiana as adopted at the end of 1997, stipulates that: "The owner may make works... below the land as he pleases, and draw all the advantages that accrue from them..." A.N. Yiannopoulos ed., *Louisiana Civil Code 1998* (St. Paul, West, 1998) at 96.

135 See *supra* n. **שגיאה! הסימניה אינה מוגדרת.** See also in *Boehringer v. Montalto*, 142

...Airspace is defined as that space which extends from the surface of the earth upward, and which is either occupied or utilized or is reasonably subject to being occupied or utilized or is otherwise necessary for the reasonable enjoyment and use of the land surface.

Is there room, then, to determine a principle whereby ownership does not extend beyond the realm of reasonable subsurface use, or beyond the area in which the landowner has no interest in preventing activity, instead of determining a general fixed and precise downward limitation for the extension of subsurface ownership? I believe that there might be no practical benefit in drawing such a line in principle. In view of the constitutional protection of the right to property, it is not possible to deny the landowners their subsurface rights without conferring on each person so injured the possibility of arguing that he has actually utilized the expropriated section or that he is entitled to compensation for the damage incurred due to the expropriation.¹³⁶ The creation of a general horizontal boundary invites conflicts between owners, and it may be justified only where it would yield substantial benefit.¹³⁷ In practice, the subsurface can be expropriated today, when such expropriation is necessary for a public need.

B. *Compensation*

Indeed, the question of the rate of compensation to be awarded to landowners on expropriation of a subsurface layer may derive from the nature of their subsurface ownership. The types of damage caused as a result of subsurface expropriation can be classified in two groups.¹³⁸ The

Misc.560, 254 N.Y.S. 276 (1931): "Title of an owner of the soil will not be extended to a depth below ground *beyond which the owner may not reasonably make use thereof*" (emphasis added – H.S.).

136 As might be anticipated according to the ruling of *United States v. Causby*, 328 U.S. 256, 66 S. Ct. 1062, 90 L. Ed. 1206 (1946).

137 Compare Ellickson, *supra* n. 38, at 1364; Thomas W. Merrill and Henry E. Smith, "What Happened to Property in Law and Economics?" (2001) 111 *Yale L. J.* 357, at 389.

138 See opinion prepared following an expropriation carried out in 1979 by the New York City Transit Authority in order to excavate a tunnel for the new subway route between

first group is the “consequential damages”. This type of damage expresses the effect on the layers above the expropriated section caused by taking a section of the subsurface. The damage caused to the future ability to construct on the surface (limitation of the load that can be constructed, the number of floors, the depth to which it is possible to penetrate in order to construct underground parking lots, penetration and moving the earth in the “wedge” above the tunnel), as well as vibrations, noise or other nuisances caused due to the use of the tunnel. The second group of damages comprises “direct damages,” i.e. damage caused due to subtraction of the subsurface area from the overall area in the landowner’s possession. It is the compensation for this type of damage that raises the question of the meaning of subsurface ownership. Simply put, if the expropriated area could have been reasonably used by the landowner, then this damage must be recognized. But what should be done with an area that cannot be utilized by the landowner at all, and the only use can be affected by way of expropriation? Does the landowner deserve compensation due to the subtraction of an area that belonged to him only theoretically?

It may be argued that any subtraction of the subsurface reduces its value. The accuracy of this argument weakens as the expropriation deepens. Justice Na’or noted this in the *Akunas* case, as follows:

A purchaser of an apartment in the expropriated area will relate differently to expropriation located somewhere in the depths of the earth from expropriation that is relatively closer to the foundations of the building. Ambiguity with respect to the depth of the expropriation may adversely affect the value

Queens Plaza and Manhattan. For this purpose a permanent subsurface easement was expropriated under a parking lot in the built-up vicinity of Queens Plaza. The fact that the property in question was an undeveloped parking lot affected the location of the route and the site designated for expropriation. Following the expropriation an appraisal firm assessed the damage, relying on opinions by an engineer, a construction expert and a town planner. The opinions were presented in full in Julius L. Sackman and Russell, D. Van Brunt eds., *Nichols on Eminent Domain* (New York, Mathew Bender, 3rd ed., Vol. 9, Rel.20 11/84) Appendix B-2(O), pp. 102, 557. The opinions attached were by The Albert Appraisal Company Inc., the James Ruderman engineering firm, the Martin Gross partnership (builders). The opinion on the damage to the future planning possibilities was submitted by Appraisers and Planners Inc.

of the surface land above it. A potential purchaser's knowledge that the expropriation is close to the surface, may lead to the reduction of its value...¹³⁹

Even when dealing with subtraction of a very deep area, the landowner or buyer may attach economic importance to the expropriated section due to the expectation of future expansion of the possibilities for use, or due to the expectation of obtaining future compensation on the subsurface expropriation. This situation could constitute a real test for the different approaches presented above. A position taking the side of strict protection of existing title could justify the award of compensation in this case as well. The distributive justice approach could justify denial of compensation. It should be noted that far-reaching expectations of future planning, especially post-expropriation, are not usually taken into account in Israel in calculating the compensation for expropriation or damage to land.¹⁴⁰

C. Planning the Subsurface

From the above it may be deduced that the price of subsurface expropriation greatly depends on the extent of its effect on the use of the surface level in the present and in the future. For this reason, expropriation in areas that are intensively built-up and utilized is expensive, because its damage to the surface level is greater. Consequently, it is clear that the ability in principle to separate the subsurface from what is above it does not make every urban region suitable for such separation.

Old areas requiring renewal are more suited to subsurface re-planning. Thus, for instance, the subsurface project Forum de Halles in Paris was built underneath the old De Halles quarter, as part of its renewal.¹⁴¹ Underground railways are often situated beneath public streets. Stations are situated in places where there is no intensive development or

¹³⁹ Akunas, *supra* n. 10, Justice Na'or's judgment, paragraph 43.

¹⁴⁰ See CA 483/86, *Birnbach v. Local Planning and Building Committee*, 42(3) P.D. 228 [in Hebrew], *per* President Shamgar.

¹⁴¹ See historical review on the site <http://www.insecula.com/musee/M0104.html> (last visited 13/9/2004).

development rights.¹⁴² Mass transit plans in the State of Israel are also taking this direction. Land held by a public authority is a cheaper target for development both above and below ground.

Many of the projects mentioned in this paper were built above and below land belonging to transportation companies or municipalities. The Underground City project in Montreal was developed mainly under land purchased and accumulated in the course of decades, in periods of depression in the real estate market, by the Canadian National Railways (at the end of the 19th century) and by the Municipality of Montreal (in the 1960s).¹⁴³

The conclusion is that subsurface development, just like the development of surface space, requires the formulation of a broad planning strategy that targets in advance areas for subsurface use, and prepares the appropriate infrastructure over many years. Urban planning authorities as well as public land management policy officials must identify in advance appropriate targets for subsurface development, taking account of the above-ground land reserves. An expropriation policy for public needs must prepare reserves of subsurface land suitable for use when they are still under inexpensive private ownership. The earlier such policy is shaped, the lower the cost of title acquisition and future subsurface use.

As soon as the axiomatic property impediment to three-dimensional subdivision is removed, planning restrictions and planning supervision will be of decisive importance in shaping the relationship among the three-dimensional units. The importance of long-term planning for subsurface use will increase. Town planning theory will have to solve new questions. It will be necessary to consider where, from the planning aspect, it is possible to conduct multi-level subdivision, and where such subdivision cannot be performed. Thus, for instance, it will have to be decided whether residential construction is worthwhile above or below roads. Because

142 See, the example, *supra* n. 138: A permanent subsurface easement was expropriated under the parking lot in the built-up vicinity of Queens Plaza for the sake of a new subway route between Queens Plaza and Manhattan. The fact that the parking lot was undeveloped affected the location of the route and the site designated for expropriation.

143 See Internet site referred to in *supra* n. 2.

subsurface construction leads to gradual imperviousness to the percolation of rainwater into the ground water, it will be necessary to enact planning regulations to propose alternatives to above-surface drainage methods. It will be necessary to specify underground spaces for the transportation of infrastructure (electricity, cables, telephone, etc.). Every subsurface penetration will require a preliminary study of existing infrastructures. It will be necessary to plan the optimum subsurface designation and to prevent waste of subsurface space for unnecessary designations.

V. *Summary*

In this paper I have argued that it is desirable for the law to enable subsurface subdivision into separate, three-dimensional property units, constituting a separate subject for title and transactions. Thus the law will contribute to the public interest in recognizing subsurface space as a separate property unit from both the functional and the planning aspects. It would be proper to enable the subdivision of land into three-dimensional units, either by registering three-dimensional parcels in the Land Registry, or by registering a condominium, at the owner's choice.

Although, in principle, there is nothing to prevent registration of three-dimensional subdivisions of land units in the title registry, such registration is not presently possible because technical and legislative preparations must first be concluded to enable three-dimensional surveying and mapping for registration purposes. Before three-dimensional registration can begin, it is necessary to create an infrastructure of vertical reference points, and to standardize the three-dimensional surveying and mapping methods for registration purposes. It would be desirable to adopt a method that would enable registration of three-dimensional spaces even before they are actually used or built-up, and even without precise delineation of what is actually constructed and used. Since three-dimensional boundaries of parcels have never been delineated, it is recommended that special legal provisions be adopted with respect to the formalization of three-dimensional title. The aim of these provisions would be to provide various parties that might be injured by the delineation of the three-dimensional boundary with the right to

present arguments, and to enable a legal body to decide upon the location of the boundary line.

In the last part of this paper, I have argued that it is not practical to establish a fixed downward limitation upon ownership in subsurface space. A country wishing to take over subsurface sections that do not belong to it will have to acquire them by the currently available means of expropriation. When subsurface division into sub-units becomes possible, the State will be able to “surgically” expropriate subsurface sections in accordance with its needs. It will no longer be necessary to expropriate the whole of the subsurface and the surface only because they cannot be separated. Except for mapping and surveying limitations, there should be no legal limitation upon the location or shape of expropriated subsurface spaces. For expropriating the subsurface it should be necessary to compensate the landowners for the consequential as well as direct damage incurred by them. Where the expropriation does not cause any damage, there is some doubt whether compensation should be paid for subtraction of subsurface area that the landowner could not reasonably and practically use.

As soon as the axiomatic property impediment to three-dimensional subdivision is removed, planning restrictions and planning supervision will be of decisive importance in shaping the relationship among the three-dimensional units. The importance of long-term planning for subsurface use will increase and town planning theory will have new questions to solve.

