

1956

Space Law Bibliography

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Recommended Citation

John C. Hogan, *Space Law Bibliography*, 23 J. AIR L. & COM. 317 (1956)
<https://scholar.smu.edu/jalc/vol23/iss3/5>

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SPACE LAW BIBLIOGRAPHY

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A NEW DEVELOPMENT IN THE LAW

ONLY since the end of World War II has there been a serious interest in the problems of law and activities in the upper regions of the atmosphere. Scholarly articles on this subject have been published recently by lawyers in Canada, England, France, Germany, and the USSR,¹ and there are materials in the American law reviews which apply—either directly or by analogy—to man's activities above the surface of the earth. The immediate problem is State sovereignty in the upper atmosphere. Some attention has also been given to the long-range problem of a system of jurisprudence for activities in space.

The principal contributors to the literature on "Space Law"—thus far—have been: John Cobb Cooper (United States); C. Wilfred Jenks (England); E. Danier (USSR); M. Saporta and Alec Mellor (France); and V. Mandl and Alex von Meyer (Germany). Those who have also made contributions, but to a lesser extent, include: Ming-Ming Peng (Formosa); Nicolas Mateesco (Canada); Oscar Schachter and Michael Aaronson (England); H. B. Jacobini and Oliver J. Lissitzyn (United States); and a few others. The writings of each of these men are referred to in the Bibliography below, and their theories are summarized in a paper entitled "Twentieth Century Theories of State Sovereignty in the Upper Atmosphere" which is being prepared by the present writer.²

GEOGRAPHY, ASTRONOMY, AND THE LAW

A clear understanding of the physical geography of the earth and some basic astronomical facts are necessary before any sensible theory of law can be formulated for the upper atmosphere³ and space. The

¹ E. Danier—Diplômé des Hautes Etudes Juridiques de l'Université de Kazan (USSR), 1952, and Ancien élève de l'École Polytechnique de Riga (Latvia), 1955—has published several articles on this subject in the French journal *Revue Générale de l'Air*.

² The "old" theories of State sovereignty above and below the surface of land are discussed in a number of recent articles. See John Cobb Cooper, "Roman Law and the Maxim *Cujus Est Solum* in International Law," 1 *McGill Law Journal* 23-65 (1952-1955); Stephen Latchford, "Freedom of the Air: Early Theories: Freedom Zone, Sovereignty," 1 *Documents and State Papers* 303-322 (1948). Cf. Arnold D. McNair, *The Law of the Air* (London, 1953, pp. 16-25 and 294-297).

³ The term "upper atmosphere" appears frequently in scientific literature, and its meaning depends largely on the context in which it is used. For the weather forecaster, the term may be understood to refer to the stratosphere, while for the radio physicist it may signify the upper areas of the ionosphere. According to Grimminger, "the region above the stratosphere extending outward to interplanetary space may be called the upper atmosphere." G. Grimminger, *Analysis of Temperature, Pressure, and Density of the Atmosphere Extending to the Extreme Altitudes* (The RAND Corporation, Santa Monica, California, 1948), p. 2.

earth's atmosphere, from the point of view of temperature variations with height, is sometimes described in terms of five gaseous layers known as:⁴ the troposphere (0 to circa 10 km), the stratosphere (circa 10 to circa 40 km), the mesosphere (circa 40 to circa 80 km), the thermosphere (circa 80 to circa 375 km), and the exosphere (above circa 375 km). The troposphere is nearest the earth's surface, and the exosphere merges into space. Most present-day air activities take place in the troposphere, the upper limit of which is about equal to the world's highest mountain.

A variety of man-made objects will soon be operating at different heights and speeds in the upper regions of the atmosphere—some in space—and each of these can be expected to present somewhat different legal problems.⁵ The laws governing an object in "continuous travel" to space must be different from those governing an object which simply "hovers" in the ionosphere. And distinctions will be made in law between objects which have commercial and scientific uses only and those which are primarily weapons.⁶

THE LIMITS OF STATE SOVEREIGNTY

Scientists tell us that if we adopt the *ad coelum* theory of State sovereignty and project present land boundaries upward *ad infinitum* then rocketing into space from the surface of the earth without at some time "overflying" the borders of a neighboring State is a physical impossibility. The speed at which the missile must travel and the physical turn of the earth in its orbit makes this so.⁷

While the projection of State sovereignty to some point in the upper atmosphere seems both practical and necessary, yet any theoretical projection beyond the atmosphere itself is inconsistent with basic astronomical facts. Thus C. Wilfred Jenks points out that:

⁴ See, H. K. Kallmann, *A Study of the Structure of the Ionosphere* (Ph.D. Dissertation, Univ. of California at Los Angeles, 1955), P-638, The RAND Corporation, Santa Monica, California. Scientists have not yet agreed upon the actual upper and lower limits of some of these regions, and limits based upon temperature are subject to vary with latitude, seasons, and from day to day anyway. Cf. Sydney Chapman, "Upper Atmospheric Nomenclature," 55 *Journal of Geophysical Research* 395-396 (December, 1950). See also, Joseph Kaplan, "The Earth's Atmosphere," 41 *American Scientist* 49-65 (1953). The area of the atmosphere above 80 km is generally referred to as the ionosphere.

⁵ The *Journal of Space Flight* recently published a list showing model, type, and flight characteristics of twenty-five different high altitude vehicles which the Soviet Union has under development. These include a satellite vehicle, an intercontinental ballistic missile, a medium range ballistic missile, a supersonic glide missile, a guided aircraft rocket, several manned rocket planes, etc. A comparable development in this technology also exists in the United States. See, Alfred J. Zachringer, "Table of Soviet Missiles," 8 *Journal of Space Flight* 1-4 (May, 1956).

⁶ An intercontinental ballistic missile being used, by agreement, for the delivery of mail from Soviet Russia to the United States would require strict regulation because of its other utility.

⁷ An "overflight" in fact—under such circumstances—may still not constitute an actionable *trespass* in law, however. It is (1) the flight path of the missile as originally established at the time of firing from a point on the surface of the earth, or (2) the physical turn of the earth in its orbit *after* the missile has left the surface of the earth which is the proximate cause of the "overflight"? The latter case does not sound like *trespass quare clausum fregit*—nor any other trespass to land known to the law.

"The revolution of the earth on its own axis, its rotation around the sun, and the motions of the sun and the planets through the galaxy all require that the relationship of particular sovereignties on the surface of the earth to space beyond the atmosphere is never constant for the smallest conceivable fraction of time. Such a projection into space of sovereignties based on particular areas of the earth's surface would give us a series of adjacent irregularly shaped cones with a constantly changing content. Celestial bodies would move in and out of these cones all the time. In these circumstances, the concept of a space cone of sovereignty is a meaningless and dangerous abstraction."⁸

Jenks concludes that the space beyond the atmosphere of the earth must be viewed in law as a *res extra commercium*, incapable of appropriation by any world state by projection of land boundaries.

John Cobb Cooper in 1951 suggested the following "upper boundary" to the territory of a subjacent State:

"Under no possible theory can it be said that a State can exercise sovereign rights in outer space beyond the region of the earth's attraction . . . the outer boundary of the State cannot be further than the point where the earth's attraction will govern the movement of an object in space so that such object will 'fall' on to the earth.

"On the other hand, this boundary cannot be lower than the upper limit of the airspace. The rule of international law—that the territory of the subjacent State includes at least the region above it known as airspace—need not be challenged. In other words, it would appear that the upper boundary of the State's territory lies at a point between the upper limit of the 'airspace' and the upper limit of the earth's attraction. Somewhere in this vast intervening region the rights of the State below cease to exist as against other States."⁹

Cooper concluded that any theoretical possibility of a State controlling far distant regions in space is absolutely out of the question, and he added: "I am convinced that we must abandon the theory that the State has the right to claim territory out into space as far as the earth's attraction extends, and that we must admit some such reasonable rules as . . . namely, that at any particular time the territory of each State extends upward into space as far as then scientific progress of any State in the international community permits such State to control space above it."¹⁰

Professor Cooper cautioned in 1951 that this was not put forward as a final solution, and subsequently, on April 26, 1956, in an address before the annual meeting of the American Society of International Law, he announced that "long and careful consideration during the

⁸ C. Wilfred Jenks, "International Law and Activities in Space," 5 *International and Comparative Law Quarterly* 103-104 (1956).

⁹ John C. Cooper, "High Altitude Flight and National Sovereignty," 4 *International Law Quarterly* 417 (1951).

¹⁰ John C. Cooper, "High Altitude Flight and National Sovereignty," 4 *International Law Quarterly* 418 (1951).

past five years has convinced me of the existence of almost insuperable difficulties in applying the rule which I then suggested."¹¹ The only practical way to solve the question as to the legal status of the areas above those covered by a strict construction of Article I of the Chicago Convention of 1944, he said, would be by adoption of some form of international agreement which might include solutions such as these:

- (1) To reaffirm the Chicago Convention of 1944 giving the subjacent State full sovereignty in areas of the atmospheric space above it, up to heights where "aircraft," as now defined, may be operated; such areas being designated "territorial space."
- (2) To extend the sovereignty of the subjacent State upward to 300 miles above the earth's surface, designating this second region as "contiguous space"; and to provide for a right of transit through this zone for all non-military flight instrumentalities, when ascending or descending.
- (3) To accept the principle that all space above "contiguous space" is free for the passage of all instrumentalities.

Professor Cooper's proposal is illustrated below.

	<i>"Space"</i>	
	Free for Passage of all Instrumentalities	(EXOSPHERE)
300 miles		
	<i>"Contiguous Space"</i>	
	State Sovereignty Subject to Right of Transit for Non-military Flight Instrumentalities when Ascending or Descending	(THERMOSPHERE) (MESOSPHERE) (STRATOSPHERE)
Circa 10 km ?		
	<i>"Territorial Space"</i>	
	Full State Sovereignty	(TROPOSPHERE)
Earth's Surface		

This proposal introduces two new terms—"territorial space" and "contiguous space"—both of which are compatible with the terminology of science mentioned above for describing the upper regions of the atmosphere. If the Cooper proposal is accepted for consideration by the I.C.A.O. nations to whom it has been submitted,¹² one area for immediate discussion might be the upper limit of "territorial space." The

¹¹ John C. Cooper, "Legal Problems of Upper Space," an address before the annual meeting of the American Society of International Law, April 26, 1956, mimeographed, 7 pp. Reprinted at page 308 of this issue.

¹² The special correspondent for the *London Times* attending the tenth assembly of the International Civil Aviation Organization meeting at Caracas reported on June 28th, 1956 that Professor Cooper, in a document made available to all members of I.C.A.O., tentatively suggested the adoption of a new convention which would contain the above mentioned solutions. In the newspaper report, the words "non-military devices" are substituted for the words "non-military flight instrumentalities" in paragraph (2) of the proposal, and the words "such mechanical contrivances" for the word "instrumentalities" in paragraph (3). See, *London Times*, June 29th, 1956.

term "aircraft," as now defined by law,¹³ is sufficiently broad to include many of the vehicles which are now "operational" above 10 kilometers. Presumably, the limit would be placed somewhere in the stratosphere.

REASONING BY ANALOGY IN THE LAW

The surface of the earth is a guide, but not the full measure of the extent of State sovereignty.¹⁴ The territory of a State is three-dimensional, and it includes not only the surface of the earth, but the area below the surface—sometimes divided into "horizontal strata," especially in mining districts—and the area above the surface—commonly referred to as the "airspace" and anciently believed by lawyers and judges to extend upward *ad infinitum*. There are analogies in law which can be drawn between each of these areas, and there are established legal principles which are common to all of them.

Chief Justice Greene has correctly observed that the law adapts itself to the new relations and interests which are constantly springing up in the progress of society, but he cautions that "this progress must be by analogy to what is already settled."¹⁵ The most recent legal literature concerned—either directly or by analogy—with law and activities in the lower and upper atmosphere and in space is referred to below.

¹³ There is no established definition of the term "aircraft" at common law, and the usages of the term both in domestic statutory law and in international treaty law seem sufficiently broad to include most of the new vehicles which are now "operational" above 10 kilometers. See discussion of classification and definitions of the term "aircraft" in *Shawcross and Beaumont on Air Law* (London, 1951), pp. 12-18. In the United States, the term has been defined as ". . . any contrivance now known or hereafter invented, used, or designed for navigation of or flight in the air." *Civil Aeronautics Act of 1938*, s. 1 (4). Shawcross and Beaumont, *op. cit.*, p. 15, note *n*, say "this would probably cover what otherwise might be classified as a projectile." In England, the term "aircraft" has been defined as ". . . including all balloons (whether captive or free), kites, gliders, airships and flying machines." *Air Navigation Order of 1949*, Article 71 (1), in Shawcross and Beaumont, *op. cit.*, p. 954. The Paris Convention of 1919 defined "aircraft" as comprising all machines which can derive support in the atmosphere from re-actions in the air. *Paris Convention of 1949*, Annex A, in the first edition (1945) of Shawcross and Beaumont, *op. cit.*, Appendix 1 par. 644. The main text of the Chicago Convention of 1944 distinguishes between "civil aircraft" and "state aircraft" (Article 3), expressly prohibits the use of "pilotless aircraft" over the territory of a contracting state (Article 8), and contains a list of definitions (Article 96) which does not include the term "aircraft." See, *Proceedings of the International Civil Aviation Conference, Chicago, Illinois, November 1 to December 7, 1944* (Washington, 1948), Vol. I, pp. 147-148 and p. 173. Annex H of the Convention, however, which is concerned with aircraft registration and identification marks, defines "aircraft," for these purposes, as follows: "aircraft shall comprise all apparatus or contrivances which can derive support in the atmosphere from reactions of the air." *Ibid.*, p. 341. The annexes are not considered a part of the Convention, however.

¹⁴ Only about 29 per cent of the earth's exterior consists of exposed continental surfaces suitable for permanent human habitation—V. C. Finch and G. T. Trewartha, *Physical Elements of Geography* (McGraw-Hill, New York 1942), p. 9—and it is over this very limited area that the various States exercise sovereignty. The remaining 71 per cent of the earth's exterior is made up of the oceans and the great seas which are "free." Thus, less than one-third of the earth's atmosphere is situated above the land surfaces of all the present world states combined. The remaining 71 per cent is located over the oceans and the seas, and it would, like these bodies themselves, be "free." So far as man's peaceful activities in the upper regions of the atmosphere are concerned, therefore, the "free" areas above the oceans and the seas may eventually be the most important since these will be less desirable for high altitude flight (and perhaps even more desirable) than the areas above land.

¹⁵ *Hodges v. New England Screw Company*, 1 Rhode Island 312, at p. 356 (1850).

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¹⁶ The introduction to Krull's bibliography contains the following statement: "The legal aspects of this subject have not been treated thoroughly here. The extent of analogous legal material dealing with space law is larger than one might think at first." Krull, *op. cit.*, p. 369.