# Reexamining fiat, *bona fide*, and force dynamic boundaries for geopolitical entities and their placement in DOLCE and BFO

# Edward Heath Robinson

Department of Geography, University at Buffalo, The State University at New York, 105 Wilkeson Quad, Buffalo, NY 14261 United States

**Abstract.** This article reexamines fiat, *bona fide*, and force dynamic boundaries as they have been applied to geopolitical entities (specifically states and nations) and the classification of geopolitical entities based on the ontological characteristics of their territorial boundaries. It is argued that state territory is always bounded by fiat boundaries and that no *bona fide* state territory exists. This is due not only to the boundary lines on the surface of the earth lying skew to physical discontinuities, but also because of fiat maritime claims, the three-dimensional structure of the state's territory, and the ontological distinction between political boundaries and any physical markers that might indicate their presence. Force dynamic boundaries have also been reexamined and their meaning extended beyond a defensive territorial boundary, to areas where an entity is capable of and willing to take aggressive action. The alterations and extensions suggested here make geographic ontology more expressive and better representative of the political phenomena. Finally, the placement of nations, states, territory, and their boundaries in the Descriptive Ontology for Linguistic and Cognitive Engineering (DOLCE) and Basic Formal Ontology (BFO) are considered, compared, and contrasted.

Keywords: State, nation, boundary, DOLCE, BFO

#### 1. Introduction

Ontologists Barry Smith and Achille Varzi proposed an ontology of boundaries based on whether the boundary is an intrinsic discontinuity in reality or is created by fiat in a particular location by human cognition. This ontological theory was fleshed out in a series of articles [26, 29-31], and has been used in research on (usually physical) geographic ontology [15, 17, 28, 27]. However, this theory was applied to the ontology of geopolitical boundaries in the article "The Cognitive Geometry of War" [25] as part of an argument for relaxing the geometric constraints on the shape of "nations" for the purpose of reducing international conflict. This ontology of boundaries was also used to classify geopolitical entities based on the types of boundaries they have.

The purpose of this paper is to reevaluate Smith and Varzi's theory of fiat, *bona fide*, and force dynamic boundaries (a kind of boundary introduced specifically for military and geopolitical objects) and the classification of nations based on them as presented in the "The Cognitive Geometry of War" from the perspective of political geography. It is argued that political boundaries are all of the fiat variety. Then it is considered whether geopolitical erritories are physical or nonphysical entities. Finally, the placement of geopolitical boundaries and territories within the Descriptive Ontology for Linguistic and Cognitive Engineering (DOLCE) and Basic Formal Ontology (BFO), both of which are ontologies prepared for the semantic web and described in WonderWeb Deliverable D18, is considered.

<sup>\*</sup> Corresponding author. E-mail: ehr@buffalo.edu.

Referent	Term in Smith's Usage	Term in Political Geography	Examples
The objective legal person of international law	Nation	State	Iraq, Russia, Sudan
A group of people with certain unifying cultural characteristics	Nation	Nation	The Kurds, the Uyghurs, the Tibetans
An objective legal person of international law whose population is predominantly members of a single nation	Nation	Nation-state	Japan, Iceland, Sweden

Summary of geopolitical terminology as used in [25] and in political geography

# 2. Distinguishing geopolitical entities

Political geography has many terms that are often used interchangeably in casual conversation. Terms such as "nation," "state," and "nation-state" are often used as synonyms outside the discipline, but convey different meanings to political geographers. This situation is problematic when terms are used in different ways and projects are evaluated crossdisciplinarily. In his article, Smith uses the term "nation" very broadly. In doing so, he does not distinguish between different kinds of political entities as they are usually distinguished in political geography. Making these distinctions can help clarify the kinds of entities to which Smith assigns different kinds of boundaries. Therefore, political geography's basic distinctions between states, nations, and nation-states will be briefly introduced and followed for the remainder of the paper.

Unfortunately, political geographers do not agree upon unequivocal definitions of these terms, much less a complete "ontology of political geography" to which one can refer for the entities and relationships considered in the domain. Nevertheless, distinguishing between states and nations is often one of the first topics in introductory textbooks on political geography. For instance, Glassner and Fahrer [12] define a state as "an independent country consisting of a specific territory and citizens bound by a sovereign government that demands (but does not always obtain) their loyalty."<sup>1</sup> They contrast this with a "nation," which they [12] define as "a reasonably large group of people with a common culture, a territory they view as their homeland, and sharing one or more important cultural traits, such as religion, language, political institutions, values, and historical experience. They tend to identify with one another, feel closer to one another than to outsiders, and believe they belong together." The compound term "nation-state" refers to "a nation with its own State, a State in which there is no significant group that is not part of the nation" [12].

Other definitions for "state" given in the literature conflict ontologically with one another. For instance, according to The Dictionary of Human Geography [8], a state is "traditionally regarded as an area of land (or land and water) with relatively well defined, internationally recognized, political boundaries.' Dear goes on to note that the people who live in this territory are presumed to be politically independent. This definition was changed by Flint in the fifth edition of that text [10] to be "a centralized set of institutions facilitating coercive power and governing capabilities over a defined territory." although he is quick to follow up by writing, "No one definition of the state is adequate given the way that states have varied in their form and function over time and space."

Defining the state to be an organization is also popular, such as with Muir [19] who writes that a state is "a particular form of organisation of people and territory," and both Short [23] and Paasi [21] define the state as "a political organization covering a particular territory." "The State of Italy" was used in Bottazzi and Ferrario [4] as an example of an organization that fits their DOLCE-based preliminary on-

#### Table 1

<sup>&</sup>lt;sup>1</sup> Glassner and Fahrer define the term "state" in terms of "country" but do not provide any definition of "country" in their text. In fact, whereas the term "state" has a multitude of definitions in political geography's literature, the term "country" suffers from an

almost complete dearth of definitions, and may not be a term with any recognized technical meaning within political geography today.

tology of organizations. However, Robinson [22] argues against states being organizations, but rather identifies them as the objective legal persons of international law. That definition of "state" will be followed here. A summary of these terminological distinctions is provided in Table 1.

Ontology and knowledge engineering has recognized that terms such as "state" and "country" can have two different referents, a nonphysical geopolitical entity and a physical location [13, 20]. This distinction is not specifically made in Smith's article. His article is concerned with territorial boundaries, and as such Smith's classifications do not classify states and nations directly, but rather indirectly by the boundaries of their territory. States are nonphysical objective legal persons of international law that have an ontological relationship with certain areas – their territory.

#### 3. Overview of Smith's classifications

In "The Cognitive Geometry of War," Smith proposed three classes of geopolitical boundaries: bona fide, fiat, and force dynamic. According to this ontological schema, bona fide boundaries are intrinsic discontinuities in physical reality, such as the boundary between the land and water on the surface of the earth. Fiat boundaries are the product of human cognition, such as political boundaries that follow lines of longitude or latitude. Force dynamic boundaries are more complicated and are characterized by elasticity. Smith writes that force dynamic boundaries demarcate the territory over which a certain group of people can exert influence. He uses the boundaries between the British, French, Dutch, and Spanish areas of influence in North America in 1670 as examples of force dynamic boundaries. The boundaries surrounding ethnolinguistic groups and military units are also included in this category. The strength of the influence that can be exerted over the territory is not a consideration in whether or not a boundary is force dynamic. It would seem that it would also be a mistake to reduce a force dynamic boundary to simply a vague fiat boundary. Smith [25] sees force dynamic boundaries as a necessary prerequisite for more formalized boundaries, noting that "historical and anthropological reflection will tell us, now, that objects of the force dynamic type must in every case come first, that force dynamic spatial objects must precede the tidily demarcated fiat and bona fide spatial objects (nations, states, empires) with which we have

grown familiar in the course of recent history." In Smith's ontologies, *bona fide* and fiat are basic distinctions to be made in the boundaries of objects. Force dynamic boundaries are introduced in "The Cognitive Geometry of War," presumably to deal with certain geopolitical situations.

Smith uses his classification of boundaries to organize geopolitical entities into categories based on the kinds of boundaries their territories have. Objects that have only bona fide boundaries are bona fide objects, while those possessing at least one fiat boundary are fiat objects. Likewise, entities with at least one force dynamic boundary are categorized as force dynamic objects. Characteristically, the boundaries of force dynamic objects "are determined by the actual or potential dynamic actions of their respective constituent parts," for example, the area occupied by an infantry unit [25]. Force dynamic objects are "characteristically transient, and tend to form systems with other third-type objects in relation to which they are subject to a very high degree of reciprocal dependence in respect to their size, shape, location and degree of elasticity" [25].

# 4. Critique of Smith's classifications

Each of Smith's categories of kinds of geopolitical entities (*bona fide*, fiat, and force dynamic) will be examined in turn. It is argued that despite the appearance suggested on many maps of the world, the territory of no state is a *bona fide* object. The territories of all states are fiat objects. The territories of nations can be either fiat or force dynamic. It is also important to distinguish a nation's current territory from its homeland, since they may or may not be the same. The meaning of force dynamic boundaries is also extended beyond Smith's original meaning in order to characterize not only a defensive arrangement, but potentially aggressive action as well.

# 4.1. Bona fide "nations"

Smith points to island states, such as Japan, Iceland, and Britain, as examples of *bona fide* "nations." In this instance Smith is using the term "nation" to refer to states as they are understood in political geography. He asserts that Japan is wholly created by physical discontinuities in reality, namely, those between land and water. He writes that only in the rare cases of island "nations" that are "favored by fate" is there a possibility for "a unilateral decision as to where the vague and transient force dynamic territorial frontiers of a given social group shall be converted into geopolitical boundaries of the crisp and stable sort." However, there are several problems with the existence of *bona fide* states. Although Smith admits that a *bona fide* state is a rarity, it is argued here that there is in fact no such thing.

First, this classification does not recognize the distinction between the boundary of the territory of a state (such as the territory of the State of Japan) and the boundary of the island or islands its people live on. Although the islands of Japan are formed by physical discontinuities between land and water (fluctuating with the tides), the boundary of the territory of the State of Japan is not that discontinuity, nor does it coincide with it. Such misunderstandings may be perpetuated by maps of the world that do not show the maritime territory of each state. Instead, many political maps color the states' land territory in contrasting colors, but color all the world's oceans a shade of blue (or sometimes shades of blue corresponding with bathymetry), rather than illustrating maritime territorial holdings.

The territory of the State of Japan does not end at the water's edge. Instead, in accordance with the Law of the Sea, Japan claims a territorial sea of twelve nautical miles (though in specific locations that distance can vary between three and twelve nautical miles), a contiguous zone of twenty-four nautical miles, and an exclusive economic zone of two hundred nautical miles. Therefore, it is possible for a person not to be on one of the physical islands of Japan and yet still to be within the territory of the State of Japan. The boundary of Japan's (or any state's) maritime holdings does not follow physical discontinuities in the earth's surface. Water freely flows into and out of a state's maritime territory.

Smith's boundary classification does not include the category "implicit geometrical boundary." It is introduced in [3]. An implicit geometrical boundary is one that is determined by a geometric relationship with another boundary, whether that boundary is a fiat or bona fide boundary. Maritime territorial claims follow just such a boundary. Whether or not an implicit geometrical boundary itself is a special case of fiat or bona fide boundaries (or something else entirely) depends upon one's larger philosophical outlook. What is of concern here is that the boundary of a state's territory is the result of human cognition, whether or not it is decided that the boundary will run along an arbitrary curve or arc, follow a discontinuity in the physical world, or follow an implicit geometrical boundary. The implicit geometrical boundary

itself would not be the boundary of the territory of a state, but the geopolitical boundary may coincide with it.

Furthermore, the territory of many island states is not constrained to a single island. Neither Japan, Iceland, nor Britain is a single island. Japan has four major islands: Hokkaidō, Honshū, Kyūshū, and Shikoku. While Smith has no problem with "Japan" being composed of multiple discontinuous objects (see [24] for Smith's discussion of Japan and New Zealand on exactly this subject, as well as of geopolitical territory composed of multiple discontinuous objects even within a single landmass, such as with the Holy Roman Empire), it is not the case that the territory of the state of Japan stops at the physical boundary of one island, and then starts again at the next. The territory of the state is continuous across those physical discontinuities.

It is also not clear that social groups that find themselves constrained by the physical boundary of an island are "favored by fate" to develop crisp bona fide geopolitical boundaries of the sort Smith proposes. Perhaps if the social group in question did not possess maritime technology sufficient to travel on water they might constrain "their territory" to being only the land of the island, but even then they might extend "their territory" to include a reasonable swimming distance from the island or even lagoons where the entrance to the sea was relatively narrow. In either instance, the island-dwelling social group would be using a fiat, and possibly vague, boundary for their territory, making it a fiat object. In addition, as maritime technology advances, and the social group develops rafts, canoes, then perhaps caravels, and later motorized watercraft, the amount of the sea the social group considers its territory may expand with their reach. If another island social group with similar maritime technology is near enough, they may come into contact with one other and compete over maritime territory, similar to the way land-based social groups do, especially if the social groups value resources (such as fish) found in certain parts of the sea

Additionally, as with Japan, it is not the case that each social group stopped its territory at the edge of each island. Instead, Hokkaidō, Honshū, Kyūshū, and Shikoku became unified into a single geopolitical entity, regardless of discontinuities between the land and the water. There was not a "natural" division of these four islands into the territories of separate geopolitical entities. Some of the Japanese shogunates even held territory that did not follow island boundaries, and at times was discontinuous across several islands. Thus, even peoples who find themselves on islands may not necessarily think their territory "naturally" ends at the discontinuity of the land and water. This is to say nothing of the fact that both Japan and Great Britain, despite island homelands, turned out to be imperial powers, holding swaths of territory across oceans and far removed from their island homelands.

The notion that social groups will naturally expand until they reach a "natural" boundary to their political power (such as a mountain range, river, or coastline) seems reminiscent of the idea of natural frontiers, popular in the seventeenth and eighteenth centuries, which held that "territory should extend to a designated river, mountain, lake, or some other natural barrier to population movement" and appealed to teleology, which proposed that "the Almighty had divided the surface of the earth into natural units which clearly marked 'frontiers'; each of which was intended to be developed into a separate State" [9]. This idea would later serve as a cover for imperial expansion as states tried to expand to natural or bona fide territorial boundaries. "Expand" is used intentionally here, since states seldom or never voluntarily gave up territory to other states in order to reestablish a new boundary along a more "natural" line within their existing territory.

The second assumption that seems to be made is that the territory of a state is a two-dimensional object. It is not. A state's territory is a threedimensional object whose shape can be approximated by a prism on top of a wedge (see Figure 1). The myth of the two-dimensional state is propagated by the same political maps of the world already mentioned as not depicting maritime political territory. Despite appearing as lines on a map, the boundary of a state is not a one-dimensional line, but a twodimensional surface. Some geographic literature refers to this as a vertical boundary plane that "cuts through the airspace, the soil, and the subsoil" [12]. However, the term "plane" may imply that the boundary between states is, or must be, flat. This may be the case where a line, such as a line of longitude or latitude, is used to define a boundary (and therefore an extrusion of that line into the atmosphere would result in a flat plane) but might not most accurately describe the extrusion of a curve, arc, or more "natural" line, such as one following a river, demarcating the boundary of two states on the surface of the earth

The boundary surface runs directly from the center of the earth to the surface of the earth. It is the product of human fiat and skew to the physical discontinuities of the earth's geologic structure. A state's boundary surfaces below the surface of the earth are fiat objects. It should be noted that whether the territory of a state extends to the center of the earth or whether the center of the earth is merely used as part of the mathematical definition of the state's boundary surface [7] is not relevant. If the territory of a state does not extend to the center of the earth, and instead only extends to a certain depth, that depth serves only to create another fiat boundary for the territory of the state.

The boundary surface also extends into the atmosphere above the earth, delimiting a state's airspace until at some altitude the state's airspace ends and outer space begins. The boundary surface separating the airspace from outer space is fiat. As of yet, no specific altitude has been unanimously accepted as the upper limit of a state's territory, but it can be said to be located (however imprecisely) somewhere between the altitude where airplanes fly and the altitude at which the Space Shuttle orbits. This makes the upper boundary for a state not only fiat, but possibly vague. Thus, it is impossible either to fly over or tunnel under the boundary of a state's territory. Instead, one would always fly or tunnel through a territorial boundary surface, unless one flew over the state's territory at an altitude high enough to be in outer space.

# 4.2. Fiat "nations"

Smith does claim that fiat states exist. He cites the African and Middle Eastern states as examples, because their borders are largely the result of colonial fiat and not due to physical discontinuities on the surface of the earth. Political geographers would recognize this class of boundaries as geometric boundaries, since they often follow straight lines or arcs [12]. Much of the argument against the existence of bona fide state territory is an argument for the existence of fiat state territory, so it need not be repeated. However, it is very important to emphasize the ontological difference between the nonphysical geopolitical boundary and whatever physical markers (natural or otherwise) might be on the surface of the Earth. Although some physical barriers (rivers or mountains) may suggest themselves as potential geopolitical boundaries between groups of people simply because they are obstacles to movement or expansion, the physical demarcation of the boundary is not the boundary itself. "Even where such a boundary is stipulated to follow some preexisting physical



Fig. 1. Diagram of state territory.

boundary, it must still count as institutional" because "The fiat which legitimises the boundary also stipulates the coincidence of the fiat boundary with the pre-existing bona fide boundary" [11].In the case of rivers, the physical discontinuity of the water and the bank may not even be used to mark the geopolitical boundary. Rather, the centerline of the river or the river's thalweg may be used to mark the geopolitical boundary. "The general rule is where a navigable river forms the boundary of conterminous States, failing any special arrangement, the middle of the channel or the 'thalweg', or its principal channel if it has more than one, is taken as the boundary line, although it may divide the river into two very unequal parts" [6]. A geopolitical boundary may move with the natural movement of such a river (as when the river meanders slowly), but in other situations (such as when the river changes course suddenly due to flooding or tectonic activity), the geopolitical boundary may remain fixed despite movement of the physical features on the Earth's surface [12].

Also, marking an unmarked geopolitical boundary on the surface of the earth does not covert it from a nonphysical fiat geopolitical boundary surface into a bona fide boundary. The stones or other markers are simply used to show human beings where the nonphysical boundary is located. Likewise, if the markers are moved stealthily in the middle of the night by one group or another, the geopolitical boundary surface has not moved with it. Montello [18] explains that "even when physical features mark administrative boundaries (quite common at various times and places), or have served historical roles in establishing boundaries, the features are generally not the boundaries, only markers for the boundaries." Such situations require an ontological distinction between the nonphysical and fiat geopolitical boundary surface and the physical markers on the earth's surface. This is in contrast to Smith [24], where the erection of boundary markers (such as border posts, watchtowers, barbed-wire fences, garden posts) is claimed to covert an initially fiat boundary into something tangible and physical.

Finally, Smith [25] writes that in the category of bona fide spatial objects "are included spatial objects that would exist, and would be set in relief in relation to their surroundings, even independently of all human intervention, whether physical or cognitive." The territory of a geopolitical entity seems dependent upon cognitive intervention, further reinforcing the fiat ontological nature of states, regardless of the physical feature, or lack thereof, used to demarcate it. This point was also recognized by Montello [17] when he argued that, especially in the case of what he calls administrative regions, the bona fide and fiat distinctions are overdrawn since, regardless of the whether or not its boundaries coincide with physical discontinuities or not, the boundaries are only put there by cognition.

# 4.3. Force dynamic nations

Smith describes force dynamic boundaries and force dynamic objects by citing an example from tactical military engagement, namely infantry troops. The area occupied by a given infantry troop is a force dynamic spatial object. Critically, Smith does not write that the infantry unit itself is a force dynamic spatial object, a clarification that does not seem so clearly made in the case of geopolitical level entities. It is also important to note the use of the word "occupied" in the text. Units of infantry consist of individual persons. The area the unit occupies would be the sum of the areas occupied by the persons who constitute it. This would not be a force dynamic area. Instead, Smith is referring to the territory controlled by an infantry unit at any given time. This might be an area roughly corresponding to the effective range of its weapons. Of course, if an enemy infantry unit were within that range, the first unit could hardly be considered to control that area. In fact, that area might be violently contested! According to Smith's article, a fiat boundary could be produced in the aftermath of such a conflict.

Smith [25] writes that territoriality is "a type of relation between an individual or group and an area of space which is of such a sort that the former will seek to *defend* the latter against invasion by other individuals or groups" (emphasis in original). Smith also quotes Brown [5], noting that a territory is "a fixed area from which intruders are excluded by some combination of advertisement, threat, and attack." However, this understanding of territory may not completely capture the intention of force dynamic boundaries and may need to be expanded. In the case of the infantry unit, it may not only have a territory that it defends from invaders (such as with infantry units manning machine guns in fixed positions in the trenches of World War I) but also itself be actively advancing, invading, and attacking. In this case, the force dynamic area is not fixed, but rather constantly changing as the unit advances, and it is not only defending territory against intruders but also acting aggressively and engaging targets as they come within range. The unit may even seek out targets not inside its force dynamic boundary and move toward them in order to engage them. This makes the force dynamic concept not only a fixed and defensive idea, but also potentially useful for characterizing aggressive action as well. Smith claims that the idea of force dynamic boundaries and force dynamic objects in tactical environments can be scaled up to geopolitical entities.

Smith [25] labels a geopolitical entity with force dynamic boundaries a "force dynamic nation." In his own words, force dynamic nations are such things as the "diaspora of Jews, of gypsies, of Saami and Inuit, of Swedes in Finland, of Slovenes in Carinthia, of Poles in the era of partition whose members feel themselves (to different degrees) as one, but who have been denied or have renounced any claim to a physical territory over which they would maintain exclusive jurisdiction." Here, Smith seems to be using the term "nation" in the same way political geographers do (and thus no quotation marks have been used in the heading of this section). This means that his article is concerned with bona fide and fiat states and force dynamic nations, a distinction made in political geography that is not made in his article.

Therefore, the "force dynamic" designation may be superfluous, but an ontological distinction needs to be made between the group of people, the people's homeland, and the area the people might currently occupy, since, due to forced migration or other factors, these may not be the same. Definitions from political geography make it clear that nations are groups of people and not areas of any kind. While some definitions require a nation to have a homeland, it is not required that the nation occupy it. Thus, it would be a mistake to assume that the Kurdish nation is synonymous with its homeland or the land it might occupy at a given time. The boundary of the area over which a nation can exert influence may be force dynamic (even though potentially much weaker than the influence that can be exerted by other entities, such as military units), but the territory it considers to be its homeland may not be. The nation may have delimited it with crisp fiat boundaries.

Strictly speaking, in order to locate the nation itself (and not its territory or homeland), one must locate its people. Substituting a portion of Johnston's [14] definition of "community" for the word "nation" in Graham Smith's [32] definition, one can define a nation as "a social network of interacting individuals, usually concentrated in a defined territory, whose members are bound together by a sense of solidarity rooted in a historic attachment to a homeland and a common culture, and by being conscious of being different from other social networks of interacting individuals." Thus, one would map the nation of the Kurds by mapping each Kurd connected in the Kurdish social network.

In the geographic literature, nations can be classified based on whether or not they are seeking to create their own states. If they are, geographers dub them "stateless nations," defined as "peoples living as a minority in one or more States who want a State of their own carved from the territory currently included in one or more States" [12]. Again, the Kurds in the Middle East are an excellent example. Smith combines nations that have no desire for their own states (or have at least renounced the claim to them) and those that do, but that for one reason or another have been denied that opportunity, into a single category. This seems reasonable from the perspective of his ontology of territorial boundaries, and in political geography, since if a group is simply described as a "nation," it is not clear what the people's prevailing attitude toward creating its own state is. Political geographers also do not systematically address how many or what percentage of the people in a nation must be interested in creating their own state from the territory of other states in order to be considered a stateless nation. Certainly there could be situations where the vast majority of the nation is happy with the status quo of occupying land within the territory of one or more other states, but a vocal (and possibly violent) minority is interested in establishing its own state.

Smith's statement that "objects of the force dynamic type must in every case come first" is debatable, and at times he appears to contradict himself. The territory of Iraq was not a force dynamic geopolitical object that later was able to establish its borders into the crisp boundaries of a state's territory. The opposite is true. The boundaries of modern Iraq were superimposed on the existing ethnolinguistic landscape skew to the (force dynamic) boundaries of its nations. Although Smith notes the arbitrariness of Iraq's boundaries, he never reconciles this with this statement about the essential nature of force dynamic boundaries coming first.

Of course, in a more general sense, it is important to consider that while fiat boundaries may not arise from the force dynamic boundaries of indigenous nations, they may arise from the force dynamic boundaries of opposing foreign forces occupying an area. A historical understanding of the area is important before it is decided that a fiat boundary had been established without a previous force dynamic boundary first being in its place. However, it does seem that fiat boundaries can be established contrary to military or cultural/ethnic force dynamic boundaries on the ground at the time of a cease-fire. This might arise if the return of captured areas or portions of captured areas were negotiated while military units still occupied them. Two states might even negotiate the partition of a third's territory according to their interests prior to the start of a joint invasion. Political boundaries may even be negotiated prior to the end of hostilities. The partition of Germany was decided by the Allies prior to Germany's general surrender and regardless of the force dynamic boundaries of invading armies in Germany at the cessation of hostilities. This resulted in situations where armies had control of territory already decided by the political leadership to belong to another state and major efforts were made by those armies to remove anything of value (art, treasure, intelligence, technology, etc.) before the armies of the other allied state arrived.

Force dynamic boundaries demarcate the area over which an entity is capable of exerting influence. This boundary of capability might coincide with, or be produced by, physical discontinuities in reality if the entity in question did not have the capacity to overcome that obstacle. To return to the tactical example, if an infantry unit did not have indirect fire capabilities, physical vertical boundaries might limit the area in which it can take action in that direction. Also, force dynamic boundaries may be fluid and changing, but they should not be confused with rapidly changing fiat boundaries. Fiat boundaries might be redefined weekly, daily, or with even greater frequency without changing their ontological nature. Force dynamic boundaries are not created by the consensus agreement of deliberative bodies, which could potentially reestablish fiat boundaries with whatever frequency they desired, but rather by the capabilities of entities and the way they interact. While they may change very rapidly, as with the force dynamic

boundary of a unit of AH-64 Apaches moving across the desert, they may settle for extended periods in some locations. If the balance of power between two entities is maintained for an extended period of time, the force dynamic boundary may become relatively stable, but remain force dynamic.

# 4.4. Force dynamic states

Smith does acknowledge that force dynamic states have existed and were more common earlier in history than today. He provides the Seljuk Kingdom of Iconium and the Khanate of the Golden Horde as examples of force dynamic states. This idea has been explored in geography through terms such as borderlands, border zones, or border regions [1, 2], where there is no crisp demarcation between geopolitical entities, and instead there is an area not quite under either's control that separates them. The Roman Empire and Chinese Empire are traditional examples of historic states with such a political boundary configuration [2]. Today, states are generally not allowed to claim as their territory any area they can exert influence over, but rather define their territory by crisp fiat boundaries. If the nation of the Kurds were to be able to establish a State of Kurdistan, likely the vague force dynamic boundaries of the territory over which the nation exerts influence would have to be to codified into the crisp fiat boundaries of a modern state.

However, while geopolitical entities of much earlier eras are cited as examples of states with force dynamic boundary segments, this idea has not completely vanished in more modern times. For instance, prior to World War II, German scholars of the (now discredited) school of *Geopolitik* claimed that boundaries of the force dynamic sort (although they did not use the term) were the ideal kind for a vibrant and growing state, as opposed to the British Empire, which sought to define crisp boundaries around its imperial holdings [9].

Smith does not address the situation where a state may have a complete and crisp fiat boundary enclosing its territory, but also has a larger force dynamic boundary. For example, even though the territory of the United States is well defined by international boundaries, the area the United States is willing to defend and take action in is broader than those crisp boundaries. The United States currently defends, and takes aggressive action in, parts of Iraq and Afghanistan. It sought to defend Saudi Arabia from Iraqi incursion during Operation Desert Shield, and operated in Kuwait and Iraq during Operation Desert Storm. The area the United States (and other states) will defend or operate in is variable across time and often vague. At times, the limit of this region may be unknown and debated. For instance, whether or not the United States should have intervened in the Russian invasion of Georgia, or if the United States should intervene if China were to attack Taiwan, have been and are debated. This debate could be about where the force dynamic boundary of the area in which the United States is willing (or able) to take action in is located.

A further distinction can be made between the area in which one is capable of taking action and whether or not one actually chooses to take action in it. It is easy to imagine a situation where a carrier battle group is physically capable of taking action in a certain territory, but when an incident occurs the political leadership forbids the carrier battle group to engage. In other situations, one could have an artillery unit that had a force dynamic boundary based on the range and capabilities of its weapon system, but the leadership had constrained the area where it was permitted to take action in a certain direction to be less than that within the effective range of its weapons. Does the artillery unit's force dynamic boundary continue to correspond to its capabilities, or does the force dynamic boundary contract to follow the limitation imposed by its leadership?

Whether or not a state's having a force dynamic boundary that extends beyond the boundary surfaces that mark its territory makes that state a force dynamic object is not addressed in Smith's article. However, the state's boundary surfaces enclose an area that is different in character from the area between the boundary surface and the force dynamic boundary. The area between the boundary surface and the force dynamic boundary is not the state's territory in the same way as the area bounded by the state's boundary surface. For instance, the fiat boundary surfaces mark the area over which the state is sovereign. The state is not sovereign over the territory between the boundary surface and force dynamic boundary. A different relationship appears to hold.

The remainder of this article will discuss integrating some of the features and characteristics of geopolitical territory into DOLCE and BFO. BFO is considered because it was developed by the Institute for Formal Ontology and Medical Information Science (IFOMIS) in Leipzig, is based on the ontological research of Barry Smith, and as such includes *bona fide* and fiat boundaries in its ontology. Both DOLCE and BFO are included in the library of ontologies for the semantic web described in WonderWeb Deliverable D18, produced by the Laboratory for Applied Ontology in Italy. First, however, it will be considered whether geographic objects move, as this will have important bearing on the placement of geopolitical objects in the ontologies. Then the placement of states, nations, their territory, and their boundaries within the DOLCE and BFO *is-a* hierarchy is discussed.

## 5. Do geographic objects move?

Before the above geopolitical boundaries are integrated into DOLCE, it is important to address whether or not geographic objects *move*. Previous ontological research on the subject suggests that they do not. That assertion is challenged here. Mark, Smith, and Tversky [15] conduct a study primarily of the cognitive categorization of objects in physical geography. They write, "Because geographic objects are (paradigmatically) immovable, it follows that they are not merely located in space, they are tied intrinsically to space in such a way that they inherit from space many of its structural (mereological, topological, geometrical) properties."

While it may be, generally speaking, that objects in physical geography remain stationary relative to the surface to the earth (or at least typically move so slowly that human beings using their own senses do not perceive the movement), there is still plenty of movement to be considered ontologically. Continents, which seem to be in fixed locations, do drift through time, and that movement is detectable through sophisticated measuring devices. Of course, they also can move suddenly in the event of earthquakes. As recounted earlier, international law and scholars of geopolitics have already accounted for the movement of physical geographic objects, and have created rules for how the geopolitical boundaries should be adjusted when the physical geographic objects move. Thus the movement of objects such as mountains, rivers, and coastlines is accounted for in political geography, and an ontology of geography should permit their movement.

But even beyond the movement of these objects on the surface of the Earth, it is also important to consider that the Earth itself is moving, and although this is generally not perceptible by human beings, moving quickly. Not only is the earth rotating on its axis, but also it is orbiting the sun, which itself is hurtling through space. Thus, the Earth may never again occupy the same space it occupies at any given time. This means all of the physical geographic objects discussed in Mark, Smith, and Tversky [15], as well as all the nonphysical geopolitical objects on the surface of the Earth, are in constant motion and may never occupy the same space twice. If one visits the territory of the State of Germany one summer, and then the next summer wants to visit the territory again, one does *not* return to the same spatial location. Not only would it require a spaceship to return there, one would not find the territory of Germany. Instead, one should return to the same location relative to the surface of the Earth, even though that means visiting an entirely new spatial location.

# 6. Geopolitical territory and boundaries in DOLCE

In the previous portions of this article, it has been argued that there is no such thing as a *bona fide* geopolitical boundary. This section will consider the placement of different boundary types (fiat, *bona fide*, implicit geometrical, and force dynamic), as well as geopolitical territory itself, within DOLCE, as it is described in WonderWeb Deliverable D18 [16].

# 6.1. State territory as an abstract region

The Abstract (AB) branch of DOLCE's is-a hierarchy is a potential location for the territory of a state, which does indeed seem to be a kind of "region." Moreover, DOLCE, as described in [16], leaves some room for child categories of *Physical Region* (*PR*) other than *Space Region* (S) and leaves *Abstract Region* (AR) without specified child categories.

There are, however, at least two major problems with placing state territory in the *Abstract* category. First, this category is used for the immovable space regions that entities can occupy. In keeping with the forgoing material on the movement of geographic objects, the territory of Germany is not a *Space Region* (*S*), but it occupies a *Space Region* (*S*) any time it exists and has the *Physical Quality* (*PQ*) of *Spatial Location* (*SL*)

The second problem with the territory of a state being any kind of *Abstract* (*AB*) entity is the limitation on parthood imposed on *Abstract* entities. DOLCE recognizes atemporal and time-indexed parthood. Time-indexed parthood holds for endurants, whereas atemporal parthood is used for entities that do not change in time, such as members of the classes *Perdurant* (*PD*) and *Abstract* (*AB*). Not allowing time-indexed parthood for the members of the class *Region* because they are constant through time is immediately problematic if "territory" is to be included here. The notion that sometimes a state's territory may have a certain area as a part and not at other times requires time-indexed parthood.

Take for example Alsace–Lorraine, which at different times was part of the territory of France, and at other times part of the territory of Prussia. In order to make the claim "*Alsace–Lorraine* is part of *Territory of Prussia* during *1873*," DOLCE's axioms regarding parthood must be followed. This requires both Alsace–Lorraine and the territory of Prussia to be endurants. Endurants are wholly present at any time they exist, although they may change (such as by adding or losing parts) through time. This seems to be characteristic of state territory, and thus its placement as an *Abstract (AB)* entity should be rejected. The question now becomes whether or not the territory of a state is a physical or nonphysical endurant.

# 6.2. State territory as an endurant

One might be tempted to conclude that if an object has a fiat boundary, then it is must be a nonphysical object, but this is mistaken. For example, consider a homogenous glass tabletop. The left side of the tabletop is a fiat object, since the boundary between the right and the left side is defined by human cognition and not by any physical discontinuity in the glass, but the left side of the tabletop is still a physical object. The boundary of the left side is even part of the left side of the tabletop, despite being fiat. Therefore, the presence of one or more fiat boundaries alone is not sufficient to conclude that the territory of a state is nonphysical.

Within the state's boundaries is an area of land, water, and air, but when physical material moves across the nonphysical boundaries, it will cease to be included in the territory of the state if it is moving out, or start being included in the territory if it is moving in. For example, consider water flowing into and out of a maritime political boundary. While it is within the boundary, it seems to be part of the territory of the state, but it ceases to be so when it crosses the boundary out of the territory. There is a similar situation with molecules of air as they move through the atmosphere heedless of political boundaries. Even in the case of the soil, if someone were to take a shovelful of soil from the territory of the United States and then tosses it across the boundary into Canada, the United States would no longer have a legal relationship with that shovelful of soil. It would then fall under Canadian jurisdiction. At first this might be thought to be the equivalent of the territory of a state gaining and losing parts through time (a characteristic of endurants), much in the same way the human body gains and loses particular atoms and cells, but upon further investigation this is not the case. With the shovelful of soil, the United States has not "lost" a portion of its territory. The boundary has not changed and the territory has neither shrank nor grown. It simply has within it (slightly) less soil and (slightly) more air.

In fact, what is *not* part of a state's territory is critical in determining whether or not the territory of the state is a physical or nonphysical endurant. The territory of a state is not a resource of the state, in the sense that it is something that can be "used up." Sometimes the physical material within a state's political boundaries is very valuable and useful for consumption or export. If a large body of oil reserves lies within the territory of a state, it might accuse a neighbor of "slant drilling" near the border and taking the oil. This accusation is not that the neighboring state is stealing part of its territory, but rather that it is taking the resources located within its territory. There is a distinction between a foreign state taking physical material (such as resources) from another state, and a foreign state actually attempting to take part of its territory.

If the state's territory were the physical matter within its territorial bounds, then when a state extracted, refined, barreled, and exported its oil, it would be exporting part of its territory. The territory of a state would be a finite resource that could be exported, consumed, and used up. This is not the case. When one buys oil from Saudi Arabia, one is not buying a barrelful of the territory of Saudi Arabia. It may be from Saudi Arabian territory, but it is not and was not part of the territory itself. There are many physical resources besides oil that are part of the physical material within the territorial boundaries of a state that might be collected and then exported to others or consumed by the state's population, but the state is not consuming or exporting its own territory.

Thus, if moving physical material out of the boundaries of state territory does not cause the state to gain or lose parts (and, potentially, it is even possible to remove all of the physical material from within the state's territorial boundaries and not affect the existence of the state's territory), what does cause the territory of a state to gain or lose parts? The answer seems to be adjustment of the nonphysical boundaries. The territories of France and Prussia can gain and lose parts as their boundaries are shifted to include or exclude Alsace–Lorraine. But if, when Alsace-Lorraine is part of Prussian territory, the French remove physical material (such as timber) from the region, they have not taken "part" of Alsace–Lorraine from the Prussians. For these reasons, state territory is placed as a *Non-agentive Social Object (NASO)* in DOLCE.

## 6.3. Nations and nation-states in DOLCE

With the understanding that agentivity is a very preliminary part of DOLCE, and that there are still philosophical issues relating to agentivity that need be addressed (such as those described in [4] and [22]), a few remarks can still be made concerning the placement of nations within the ontology. Nations do not have objective legal personality in international law – the definition of what it means to be a state. Instead, nations are groups of people with certain unifying cultural characteristics. In some situations, a nation's objective may be to fulfill the criteria of statehood and create an objective international person. If nations can have goals, objectives, and intentions, then this seems to argue for their agentivity, especially in the context of DOLCE where the "common sense" and surface structure of language are intended to have ontological relevance. DOLCE provides two different categories of agentive social objects, Social Agent (SAG) and Society (SC), although the distinction between these two is not quite clear, as discussed in [22]. For present purposes, a nation is categorized as a Society (SC). Nations have human beings (who belong to the category Agentive Physical Object) who fit the nation's cultural/ethnic/linguistic criteria as members.

Given present considerations, little need be said on the subject of nation-states. Nation-states are a particular kind of state (one whose population belongs predominately to a single nation) and so the foregoing discussion about state boundaries and state territory also goes for nation-states. The situation with nations that have not formed states is more complicated.

National boundaries<sup>2</sup> and national territory warrant their own investigation, beyond that which can be

conducted here. In some sense, since both the territory of nations and the territory of states are "territory," there may be the same relationship between the state and its territory as between the nation and its territory. Both states and nations may attempt to exclude intruders from this area by advertisement, threat, and/or attack. However, the relationship that a state has with its territory is different from the relationship between a nation and its territory. As one specific example, a state has a legal right to defend the territory under international law that the nation does not have.

Furthermore, as mentioned above, the area a nation is currently occupying may not be its territorial homeland. In the event that a nation has been displaced from its homeland, what is difference between the relationships that hold between it and the area it currently occupies and between it and its homeland?

# 6.4. Boundaries in DOLCE

Because DOLCE divides endurants into physical and nonphysical categories straightaway, there seems to be no single place where the category "boundary" can be placed. Thus, this article recommends a distinction between physical boundaries (such as those of the *bona fide* sort) and social boundaries (such as those of the fiat sort). Physical boundary is a subclass of the category *Non-agentive Physical Object* (*NAPO*), and social boundary is a subclass of *Nonagentive Social Object* (*NASO*).

Force dynamic boundaries do not seem to be physical objects at all, and thus candidates for placement in the nonphysical division of endurants. However, unlike fiat boundaries, they have not been declared to exist in a certain place. Instead, they arise directly through the interaction of social agents. In DOLCE, all social objects depended on a community of agents. Thus, force dynamic boundaries are considered social boundaries, but distinct from fiat boundaries.

Implicit geometrical boundaries are also nonphysical. Consider the implicit geometrical boundary ten miles offshore of a particular island. There is no physical boundary present. Neither is this boundary fiat. One cannot declare, by fiat, that the implicit geometrical boundary ten miles offshore is now located five miles offshore. It is also certainly not a

<sup>&</sup>lt;sup>2</sup> It is unfortunate that English uses the adjective "national" as the adjective form of "state." States have national boundaries, national territories, and national militaries. This leaves no particular word for the boundary of a nation, or the territory of a nation, or armed forces that might have been raised by a nation. For the purposes of this article the term "state" has been used as its own adjective. Thus states have state boundaries, state territory, and

state militaries. This leaves the term "national" as the adjective form of "nation." This is a more consistent, although unconventional, usage of the term.

force dynamic boundary that comes to exist through the interacting capabilities of social entities.

DOLCE does include another category of nonphysical objects aside from social objects, *Mental Object* (*MOB*). It is proposed that implicit geometrical boundaries belong to this category of objects. The criterion for differentiating *Non-physical Object* (*NPOB*) into *Social Object* (*SOB*) and *Mental Object* (*MOB*) is that social objects are generically dependent upon a community of agents, whereas private experiences belong to the class *Mental Object* (*MOB*). Unfortunately, D18 does not provide much additional information on the nature of mental objects, so this placement can only be considered preliminary at this time.

No claim is being made that the *location* ten miles offshore a particular island is a mental object. That location would still exist independent of human cognition. The implicit geometrical boundary located there, however, is dependent on minds. A fiat social boundary might be established in that location, if, for instance, it were decided that a political maritime boundary, would follow at implicit geometrical boundary. See Figure 2 for a diagrammatic depiction of the proposed placement of these entities in the DOLCE *is-a* hierarchy.

#### 7. Geopolitical boundaries in BFO

BFO provides an interesting contrast to DOLCE on the subject of boundaries because Boundary of *Object* is included as a basic category. According to the BFO manual, the boundary of an object is an "independent continuant entity that is a lowerdimensional part of some other continuant entity" [33]. Examples provided include the surface of the skin, the surface of the earth, the surface of the interior of the stomach, and the outer surface of a cell. The boundary of an object is the part of the object that exists at exactly the point where the entity is separated from the rest of the world [33]. In D18, BFO includes primitives for boundaries of both the bona fide and fiat varieties. It does not include any mention of force dynamic boundaries nor of implicit geometrical boundaries.

It seems that BFO can easily capture the notion of the state's territory as an entity that moves through spatial regions. BFO's distinction between *Site* and *Spatial Region* is very relevant to state territory. BFO defines *Spatial Region* as "an independent continuant entity that is neither the bearer of qualities nor inheres in any other entities" and provides as examples "the sum total of all space in the universe and parts of the sum total of all space in the universe" and "the space occupied by a tomato at a given time" [33]. Spatial Region is contrasted with Site, "an independent continuant consisting of a characteristic spatial shape in relation to some arrangement of other continuant entities and of the medium which is enclosed in whole or in part by this characteristic spatial shape. Sites are entities that can be occupied by other continuant entities" [33]. Critically, sites can be located at many different spatial regions while maintaining their identity [33]. This seems to be an important distinction in the ontology of state territory. The territory of a state does not change its identity every time the earth moves to a new location.

At BFO's basic level of granularity, the entities this article is concerned with can be seen diagrammed in Figure 3. Nations and states belong to the category *Object*. All four kinds of boundaries discussed in this article are subcategories of the category *Boundary of Object*. The territories of nations and states are subcategories of *Site*. This presumes the sites can have boundaries and those boundaries are members of the class *Boundary of Object*.

However, given the intervening time between the establishment of the *bona fide*/fiat dichotomy theory and the creation of D18 [16] and the BFO Manual [33], it seems that force dynamic boundaries may have been intentionally disincluded from the ontology (implicit geometrical boundaries were not introduced until after their creation). However, Smith leaves open the door for other kinds of boundaries outside of the *bona fide*/fiat dichotomy. Smith writes, "It is my intention that the opposition between fiat and bona fide boundaries should be regarded, modulo the existence of these mixed cases, as exhaustive and exclusive," but that "I do not with to deny that there types of spatial boundary which are difficult to classify under one or other of the two rubrics" [24].

It is also worth considering whether or not implicit geometrical boundaries are truly boundaries in the strict since of the term. This could be an argument against them in both DOLCE and BFO, but especially in BFO, which includes much more consideration with regard to boundaries. In the island example given above, it can only have one boundary. There is only one lower-dimensional part of it where it is cut off from other entities in the world. However,



Fig. 2. Selected categories from the DOLCE *is-a* tree. Preliminary placement of the geopolitical entities discussed in this article shown in gray. Based on the material in WonderWeb Deliverable D18 [16].

if one were to include its implicit geometrical boundaries, one would be forced to admit that it had an infinite number of them (the implicit geometrical boundary one mile from its shore, one and one-half miles from its shore, and at all the infinite number of distances between those, for instance). Perhaps, then, the implicit geometrical boundary ten miles from the shore of an island is not the boundary of any object at all, but rather uses a boundary of an object to define it. For this reason, *Implicit Geometrical Boundary of Object* is left with a question mark beside it in the BFO diagram.

DOLCE seems to have less of a problem with implicit geometrical boundaries, especially if they are regarded as mental objects, but there is still plenty of room to deny that they are boundaries at all if warranted.

# 8. Conclusions and further research

Despite the theoretical development of the fiat, *bona fide*, and force dynamic boundary distinctions, they can better describe the boundaries of geopolitical entities, such as the territories of nations and states, with the revisions and extensions presented in this article. When the ontological distinctions between geopolitical entities and the physical areas people may occupy are examined, the boundaries they have are more complex than the physical boundaries of islands, rivers, or ridges of mountain ridges. This paper has revised and extended this ontological theory of geopolitical objects by distinguishing between states and nations (as the terms are used in political geography), distinguishing between nonphysical states and their territories, and considering a state's maritime territorial holdings and also its three-dimensional structure. Through those clarifications, as argument against bona fide state territory has been made.

Force dynamic boundaries have been reexamined and their meaning has been extended beyond a defensive territorial boundary from which intruders are excluded, to areas where an entity is able and willing to take aggressive action. From this emerges the previously unexplored situation where geopolitical entities have both crisp fiat boundary surfaces that mark the end of their territorial sovereignty, and also overlapping force dynamic boundaries marking the area which they are capable of taking action in (either to defend against intruders or to take aggressive action against others). Whether or not this makes the geopolitical entity fiat or force dynamic is left to future consideration.

Finally, some thought was given to the placement of the geopolitical entities discussed in both DOLCE and BFO. DOLCE appears to have a greater expres-



Fig. 3. Selected categories from the BFO *is-a* tree. Preliminary placement of geopolitical entities discussed in this article shown in gray. Based on the material in [33].

sive capability with regard to the differing natures of geopolitical objects, especially with regard to the distinctions between physical and social entities. However, BFO incorporates boundaries of objects and the *bona fide*/fiat distinction as part of its foundational ontology. Of course, a fully developed domain ontology of political geography built as an extension of either DOLCE or BFO would be significantly more expressive than either top-level ontology alone. However, the expressiveness of the material provided by the top-level ontology for the domain is an important consideration in choosing one to extend with a more detailed domain ontology.

Building a domain ontology for political geography, hopefully taking into consideration the material presented in this article, is left to future research. Further work is also required to formalize a more expressive ontology of geopolitical boundaries into a toplevel ontology. Additionally, this article has only provided very preliminary notes on the relationships that geopolitical entities might have with their territory. This subject deserves its own more detailed treatment, and is especially relevant to the subject of geography.

#### Acknowledgments

This article is based upon work supported by National Science Foundation Grant No. DGE 0333417 Integrative Geographic Information Science Traineeship Program awarded to the University at Buffalo. Thanks go to the Institute for Geoinformatics at the University of Münster for its support of this research. Further thanks go to Antony Galton, Michael Uschold, and Brandon Bennett for their helpful commentary on previous versions of this article.

#### References

- Borderland, The Dictionary of Human Geography, R. J. Johnston, D. Gregory, G. Pratt, and M. Watts, eds., Blackwell Publishing, Malden, 2000, pp. 49–50.
- [2] J. Agnew, Boundary, The Dictionary of Human Geography, R. J. Johnston, D. Gregory, G. Pratt and M. Watts, eds., Blackwell Publishing, Malden, 2000, pp. 52–53.
- [3] B. Bennett, D. Mallenby and A. Third, An ontology for grounding vague geographic terms, in: Formal Ontology in Information Systems (FOIS 2008), C. Eschenbach and M. Grüninger, eds., ISO Press, 2008, pp. 280–293.
- [4] E. Bottazzi and R. Ferrario, Preliminaries to a DOLCE Ontology of Organisations, International Journal of Business Process Integration and Management 4 (2009), 225– 238.
- [5] J.L. Brown, The Evolution of Behavior, Norton, New York, 1975.
- [6] A.O. Cukwurah, The Settlement of Boundary Disputes in International Law, Manchester University Press, Manchester, 1967.
- [7] S.W. Cushing, The Boundaries of the New England States, Annals of the Association of American Geographers 10 (1920), 17–40.
- [8] M. Dear, State, in: The Dictionary of Human Geography, R. J. Johnston, D. Gregory, G. Pratt, and M. Watts, eds., Blackwell Publishing Ltd., 2000, 788–790.
- [9] R.D. Dikshit, Political Geography (New Delhi: Tata McGraw-Hill Publishing Company Limited, 2000).

- [10] C. Flint, State, in: The Dictionary of Human Geography, D. Gregory, R. Johnston, G. Pratt, M. J. Watts, and S. Whatmore, eds., Blackwell Publishers Ltd., Malden. 2009, pp. 722–724.
- [11] A. Galton, On the ontological status of geographical boundaries, in: Foundations of Geographic Information Science, M. Duckham, M. F. Goodchild, and M. F. Worboys, eds., Taylor & Francis, New York, 2003.
- [12] M. Glassner and C. Fahrer, Political Geography John Wiley and Sons, Hoboken, 2004.
- [13] N. Guarino and C. Welty, An Overview of OntoClean, The Handbook of Ontologies, S. Staab and R. Studer eds., (Berlin: Springer-Verlag, 2004), 151–172.
- [14] R. Johnston, Community, The Dictionary of Human Geography, R. J. Johnston, D. Gregory, G. Pratt and M. Watts eds., (Malden: Blackwell Publishing Ltd., 2000), 101–102.
- [15] D.M. Mark, B. Smith, and B. Tversky, Ontology and geographic objects: An empirical study of cognitive categorization, in: COSIT'99: Lecture Notes in Computer Science, C. Freksa and D. M. Mark, eds., Springer-Verlag, (Berlin/Heidelberg, 1999, pp. 283–298.
- [16] C. Masolo, S. Borgo, A. Gangemi, N. Guarino, and A. Oltramari, WonderWeb Deliverable D18: Ontology Library, Trento, Italy: Laboratory for Applied Ontology – ISTC-CNR, 2003.
- [17] D.R. Montello, Regions in geography: Processes and content, in: Foundations of Geographic Information Science, M. Duckham, M. F. Goodchild, and M. F. Worboys, eds., Taylor & Francis, London, 2003, pp. 173–189.
- [18] D.R. Montello, Geographic regions as brute facts, social facts, and institutional facts, In: The Mystery of Capital and the Construction of Social Reality, B. Smith, D. M. Mark, and I. Ehrlich, eds., Open Court Publishing, Chicago, 2008, 305-330.
- [19] R. Muir, Modern Political Geography (New York: John Wiley & Sons, 1975).
- [20] D. Oberle, A. Ankolekar, P. Hitzler, P. Cimiano, M. Sintek, M. Kiesel, B. Mougouie, S. Baumann, S. Vembu, M. Romanelli, P. Buitelaar, R. Engel, D. Sonntag, N. Reithinger, B. Loos, H.-P. Zorn, V. Micelli, R. Porzel, C. Schmidt, M. Weiten, F. Burkhardt and J. Zhou, DOLCE ergo SUMO: On Foundational and Domain Models in the SmartWeb Integrated Ontology (SWIntO), Web Semantics: Science, Services and Agents on the World Wide Web 5 (2007), 156–174.
- [21] A. Paasi, Territories, Boundaries and Consciousness, John Wiley & Sons, New York, 1996.
- [22] E.H. Robinson, An Ontological Analysis of States: Organizations vs. Legal Persons, Applied Ontology 5 (2010), 109– 125.
- [23] J.R. Short, An Introduction to Political Geography, Routledge, New York, 1993.
- [24] B. Smith, On drawing lines on a map, in: Spatial Information Theory: Proceedings of COSIT '95, A. U. Frank, W. Kuhn, and D. M. Mark eds., Springer Verlag, Berlin/Heidelberg/Vienna/New York/London/Tokyo, 1995, pp. 475–484.
- [25] B. Smith, The cognitive geometry of war, in: Current Issues in Political Philosophy, P. Koller and K. Puhl, eds., Holder-Pichler-Tempsky, Vienna, 1997, pp. 394–403.
- [26] B. Smith, Fiat Objects, Topoi 20 (2001), 131–148.
- [27] B. Smith and D.M. Mark, Ontology and geographic kinds, in: International Symposium on Spatial Data Handling, Vancouver, 1998.
- [28] B. Smith and D.M. Mark, Do Mountains Exist? Toward an Ontology of Landforms, Environment and Planning B: Planning and Design 30 (2003), 411–427.

- [29] B. Smith and A.C. Varzi, The Formal Ontology of Boundaries, Electronic Journal of Analytic Philosophy (1997).
- [30] B. Smith and A.C. Varzi, Fiat and bona fide boundaries: Towards an ontology of spatially extended objects, in: Spatial Information Theory: A Theoretical Basis for GIS, S. C. Hirtle and A. U. Frank, eds., Springer, Berlin/Heidelberg, 1997, pp. 103–119.
- [31] B. Smith and A.C. Varzi, Fiat and Bona Fide Boundaries, Philosophy and Phenomenological Research 60 (2000), 401–420.
- [32] G. Smith, Nation, in: The Dictionary of Human Geography, R. J. Johnston, D. Gregory, G. Pratt, and M. Watts eds., Blackwell Publishing Ltd., Malden, 2000, p. 532.
- [33] A.D. Spear, Ontology for the Twenty First Century: An Introduction with Recommendations, Institute for Formal Ontology and Medical Information Science (IFOMIS), Germany, 2006.