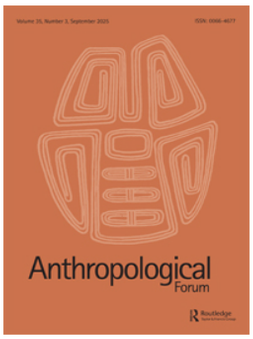

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REVIEW ARTICLE

Metaphysical Commitments: The Uses of Volumetric Abstraction Across Peru's Tropical Timber Supply Chains

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ABSTRACT

This article examines how volumetric abstraction operates as a site of political and ethical contestation within Peru's tropical timber supply chains. While recent scholarship on vertical and volumetric ecologies has demonstrated the analytical power of 'volume' for understanding environmental governance, less attention has been paid to what volumes are and how they relate to the practices and objects they purport to describe. Drawing on ethnographic research across three key nodes - state technocratic offices, industrial sawmills, and remote logging camps - I argue that abstractions such as volumes emerge through distinct 'metaphysical orientations' embedded in practice. First, I show how state-led traceability infrastructures rely on a realist ontology in which timber volumes are treated as measurable, homogeneous magnitudes that can be aggregated and monitored across scales. Second, I examine how sawmill industrialists approach volume as something to be actively extracted and maximized through labor, negotiation, and unequal exchange, revealing its entanglement in longer histories of regional exploitation. Third, I explore how loggers and field technicians articulate empiricist critiques of volumetric standardization, emphasizing the instability and contingency of measurement in dynamic forest environments. By tracing these contrasting metaphysical orientations, the article demonstrates how different conceptions of abstraction sustain distinct ethical and political commitments. Rather than resolving what volumes 'are,' I argue for an ethnographic approach that attends to how abstractions are enacted in practice and how they shape divergent dispositions within contemporary tropical timber supply chains.

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Introduction

Over the last fifteen years, a growing body of critical scholarship has examined how vertical and volumetric ecologies saturate diverse realms of environmental governance, including contemporary deliberations on expanding hydrocarbon recovery technologies (Rogers 2019), atmospheric circulation monitoring systems (Zee 2021), peatland fire prevention mechanisms (Goldstein 2020), new mining frontiers (Collins et al. 2025), and

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underground water estimation (Ballestero 2019). As authors such as Stuart Elden and Franck Billé have argued more programmatically, the concept of the volumetric is useful because it draws attention to complex spatial dimensions and forms of relationality that often escape more conventional cartographic imaginaries: the irregular infiltration of liquids in porous rocks and viscous sediments; the turbulent particle dynamics through which dust moves and settles at both regional and planetary scales; or the incandescent proliferation of fire beneath and above the expanse of Indonesian forests. While space conceived as flat, fixed, and bidimensional remains arguably a dominant form of cartographic imagination, the encounter between shifting political ambitions and the affordances of new sensing and computational technologies is generating novel spatial dimensions and dynamics. Attending to these volumetric formations, therefore, is essential for understanding contemporary configurations of power and knowledge in environmental governance.

But while the idea of volume has quickly come to organize this growing body of scholarship, thus demonstrating its practical relevance and pervasive analytical power, what exactly a volume is, and how this notion relates to the various tangible objects—rocks, atmospheric circulations, peatlands—whose interrogation it seeks to facilitate in both political and epistemic terms, has remained largely unaddressed in the literature. After all, while volumes are pervasive terms across extractive industries, commodity supply chains, and environmental monitoring practices, they are quintessentially *abstract* objects, with no obvious relation to the specific practices and infrastructures that instantiate them. References to the volumetric have proven useful in bringing into focus underexplored features of people's encounters with complex spatial formations: the turbulent, the deep, the undefined. Yet in each of these instances one may wonder: how are abstract volumes meant to relate to the concrete practices, media environments, and social scenes under examination?

If we orient our practices and technological infrastructures toward treating an underground natural gas reserve as a volume, does this mean that such a complex geological formation *has* a volume, thus severing the physical formation from the three-dimensional space it arguably occupies? Does it mean that it can be *represented* as a volume, rendering the volume a mere artifact of human conventions imposed onto an external thing? Or should we instead say that it *is* a volume: a homogeneous portion of three-dimensional space within an encompassing continuum of which we ourselves are a part?

I would like to argue that the answer to this question is not politically trivial. How practices and infrastructures are oriented toward particular metaphysics of abstraction —how abstractions are instantiated in relation to our experience of the world—can shape broader political and ethical commitments. While formal metaphysical debates on the nature of abstractions have typically focused on their inaccessibility to direct experience, their lack of spatiotemporal location, and their causal inefficacy in the world (Hale 1988; Lewis 2001; Loux 2006, 17), careful ethnographic attention can shed light on the paradoxical ontologies through which abstractions appear simultaneously non-spatiotemporal, emerging as speculative specters that orient practice while remaining elusive to the senses, and yet deeply consequential for the relations that people establish with one another and with the environments that surround them. Seen from this perspective, the question of whether a given object is recognized as a volume or merely representable as one is no longer a stylistic issue. Rather, each of these

metaphysical figurations introduces distinctive political and ethical orientations. The former might evoke, for instance, a realist ontology structured by abstract homogeneous spacetime, a vision that today authorizes technocratic ambitions to measure, aggregate, and monitor the cumulative volumetric magnitudes of various objects of environmental concern, from methane and timber to carbon and water. The latter, by contrast, might suggest a nominalist world devoid of immanent abstract structures, where objects are ontologically irreducible to abstract magnitudes ingrained in broader spatiotemporal extensions and are instead brought into relation to each other through the contingent force of human convention.

Importantly, I want to emphasize that these contentions are not merely the product of academic theorists or armchair philosophers. Rather, orientations toward abstraction emerge in the wild, informing distinctive forms of what Bruno Latour has aptly called practical metaphysics (Latour 2005, 50). Speculations about the nature of abstractions thus erupt organically from ontological orientations ingrained in mundane practices of industry, trading, and bureaucratic regulation. Appreciating the nexus between metaphysical abstractions, on the one hand, and politics and ethics, on the other, is important because it reveals that our world is constituted by more than the more-than-human entanglements recently emphasized by anthropologists, geographers, philosophers, and science and technology scholars (Barad 2007; Bennett 2010; Latour 1999; Nail 2024). Alongside a world of speculations about distributed agency and material entanglement, we also encounter practical disputes about the nature of abstract entities, including, of course, volumes themselves.

As Eduardo Kohn has suggested from a strongly realist perspective, generality grows in the world itself, extending well beyond the exclusive purview of human minds and cultural conventions (Kohn 2013, 10). Yet this does not mean that abstractions develop independently of our political commitments and sociotechnical infrastructures. Rather, the kinds of abstractions toward which we metaphysically orient ourselves carry ethical commitments with relevant political consequences.

In this article, I bring these questions to bear on contemporary conversations about the politics of vertical and volumetric ecologies. I ground these concerns in my ethnographic work on Peru's tropical timber supply chains, a realm of industrial activity and environmental governance in which volumes have figured prominently as a means of organizing various conflicting projects, including recent attempts at technocratic reform, the pursuit of regional productivity, and the persistence of longstanding forms of labor exploitation (Romero Dianderas 2024b). In the context of Peru's tropical logging industry and its regulation, volumes mediate a wide range of everyday practices and bring together a multifarious set of human and more-than-human actors. They are the privileged means by which heterogeneous trees and pieces of lumber are regularly recast as commodities subject to pricing, circulation, and exchange (Çalışkan and Callon 2010; Marx 1977). Yet volumes also become the central stakes in multiple spaces of negotiation and dispute, from state inspectors determining the legality of specific logging operations to the exploitative exchanges through which small-scale riverine holders sell their logs to timber industrialists. This plurality of interconnected and often contrasting constellations of motivations and practices turns tropical timber supply chains into an ideal site for examining the multifarious lives of abstraction. By taking stock of the vast more-than-human

networks that bind together tropical timber supply chains, networks connecting hundreds of small-scale loggers, sawmills, timber traders, warehouses, trees, and riverine landscapes, I show how even within what appears to be an integrated set of supply chain relations we can discern different coexisting metaphysical orientations toward volume. As volumes become increasingly prominent within projects that seek to render tropical timber harvesting a technocratic domain of fine-grained calculational surveillance, the question of which metaphysical orientations we cultivate, and what forms of generality we allow to grow within our social worlds, becomes politically consequential at various scales.

In what follows, I unpack a series of ethnographic vignettes emerging from three different nodes of Peru's tropical timber supply chains: the technocratic office, the industrial sawmill, and the logging campsite. Across these scenes, I examine how volumes become speculative abstractions that different actors recruit to address practical matters of concern, including efforts to render tropical timber traceable, attempts to maximize industrial productivity, and critiques of stringent regulatory requirements. I then show how the ways people approach these matters are premised on distinct metaphysics of abstraction, that is, on distinctive ways in which volumes are imagined in relation to tangible wooden objects such as trees, logs, and sawn lumber, whose distributions and circulations are expected to become legible (or not) through their supposed volumetric homogeneity. In this context, even industries often imagined to be far removed from philosophical speculation become practical testing grounds for exploring the unsettled nature of metaphysical abstractions such as volumes. As volumetric imaginaries increasingly saturate the politics of environmental governance, reviving the nexus between metaphysics and politics becomes crucial for advancing efforts to gain more self-reflective collective control over how we orient ourselves toward abstractions in the articulation of shared environmental futures.

A Continuum of Magnitudes

When it comes to tropical logging regulation, the year 2009 can hardly be overstated as a critical inflection point in Peru's recent history. In the early months of that year, the governments of Peru and the United States signed a Free Trade Agreement (FTA), a decision that liberalized bilateral trade across the board and set the stage for significant regulatory reforms in several of Peru's most prominent economic sectors. One of the most consequential by-products of this agreement was the introduction of a Forestry Addendum, through which the Peruvian government committed to ensuring that all tropical timber exports leaving the country were sourced legally and sustainably. The inclusion of this Addendum in the FTA was quite unprecedented, since it was the result of a successful transnational campaign seeking to raise awareness about the rise of species depletion, corruption and labor exploitation in tropical rainforests, tropes that had been associated with Peru's tropical logging industry for generations (Bedoya Garland and Bedoya Silva-Santisteban 2005; Global Witness 2017; Urrunaga et al. 2012). Up to that point, state regulations upon tropical logging had been underfunded and largely decorative, with on-site field inspections practically nonexistent and barely any mechanism to sanction the legality of tropical timber being traded domestically or internationally (Romero Dianderas 2024a). In this context, the Forestry Addendum crystallized a set

of financial and diplomatic conditions through which Peru's tropical rainforest products —especially tropical timber—were to enter the imagined orbit of global sustainable trade. For U.S. policymakers and the more liberal sectors of Peru's environmental movement, this project depended on the development of novel technocratic infrastructures capable of rendering traceable the opaque and complex sourcing networks that have historically structured the country's tropical timber supply chains.

It is important to note that this spirit of reform resonated with broader trends emerging in global environmental governance in the early twenty-first century. While private third-party certification schemes and corporate green labeling had dominated sustainability initiatives in the 1990s and early 2000s (European Commission, Directorate-General for Environment 2021; Rico-Straffon et al. 2023), the turn of the century witnessed the gradual emergence of state-enforced traceability infrastructures in the regulation of environmentally sensitive commodity supply chains (FAO 2016; Fripp et al. 2023). Within this framework, the antidote to illegality and unsustainable sourcing was imagined as the deployment of new data infrastructures through which the movements and circulations of timber—from harvest and stacking to transport, transformation, and trade—could be registered, verified at multiple points, and aggregated across local, regional, and national scales.

In Peru, these traceability infrastructures took the form of the *Módulo de Control* [Control Module], a data system housed within the country's Forestry Agency and supported by technical experts funded through U.S. foreign aid programs. In essence, the goal of the *Módulo de Control* was to transform tropical timber supply chains into a smooth informational panopticon, within which wooden objects could be rendered legible as measurable magnitudes of timber volume. If a tree was felled in a remote logging site deep in the rainforest, an identification code would be assigned to each resulting log. This code would then be paired with a timber volume and a species identification within a cloud-based database.

As we sit in his office in Lima's business district, Jorge, a Peruvian-born, U.S.-trained expert supporting the development of the *Módulo de Control*, explains the intricacies of the system. 'When we started to assemble the *Módulo de Control*, we did not even have a map of processes that allowed us to understand what was going on' ,he says, pulling a report from one of his shelves. The first step, in Jorge's vision, was to render Peru's complex and historically intractable network of supply relations into a formal flow of tractable processes. 'After many months, we finally agreed that the entire supply chain could be reduced to about eight hundred discrete procedures'. For Jorge, ensuring that the flow of information could reliably track these hundreds of processes required that even the most remote *oficinas desconcentradas* in the country—the local forestry agencies where loggers first report the volumes of timber they have felled—be enlisted into a larger cybernetic system spanning the entire country. These bits of quantified information—which logger felled how many cubic meters of timber, and from where—could then be aggregated at multiple scales. 'Think about it' ,Jorge continues. 'We barely knew how timber was moving just a few years ago. Now we can inspect the entire country, each region, and even each locality in a single online dashboard'. At sufficient scale, the dashboard could display precise figures from specific jurisdictions, allowing inspectors to detect abrupt changes in historical trends or anomalous yields per hectare across different sites. 'A typical rainforest hectare can yield about four to seven cubic meters

of timber. If you suddenly see a logging operation yielding forty cubic meters, you know something is wrong'.

Jorge's dashboard was thus premised on a vision of the supply chain as a set of orderable processes, where the movement of hundreds of timber shipments could be treated as volumetric magnitudes belonging to the same abstract continuum. As hundreds of logging operators across Peru's Amazonian lowlands felled trees in the rainforest, measured them according to standardized methods, and registered their resulting volumes on cloud-based platforms, these timber volumes could be readily aggregated by *oficinas desconcentradas* in accordance with Jorge's formalized processes, and subsequently reported to regional bureaus and national statistical records in the *Módulo de Control*. From this perspective, the formalization of processes and the standardization of practices ensured that the flow of volumes-as-magnitudes corresponded to the flow of volumes-as-timber, rendering irregular wooden matter moving across rainforests, rivers, ports, and sawmills commensurable with numerical magnitudes stored in computer databases.

Let us pause for a moment and consider what is at stake when an expert like Jorge aspires to reorganize practices and relations across the Amazon lowlands so that he can be sure, for instance, that 1,521,746.34 cubic meters of tropical timber were harvested across the entire country in 2023 (SERFOR 2024). What sorts of metaphysical assumptions are ingrained in the technocratic ambition to produce a traceable world composed of commensurable objects with homogeneous volumetric magnitudes? One way to understand such orientations is to situate them within a longer genealogy of liberal thought in which abstract space and assumptions about the neutrality of observation come together. As authors such as Pablo Bustinduy have noted, the early modern rise of abstract space—the belief that the universe is structured as a single homogeneous and continuous extension—was arguably coterminous with the emergence of liberal political imaginaries premised on the idea that no natural hierarchies, discontinuities, or fundamental heterogeneities were embedded in the fabric of space itself (Bustinduy 2024, 8). Only once heterogeneous experiences of place that had long appeared radically discontinuous—the monastery and the street, the field and the forest—could be reconceived as structured by a single homogeneous extension did it become possible to measure and calculate bodies as expressions of the same kind of magnitude. Through this transformation, in the words of Emmanuele Lugli, people came to 'quantif[y] rolls of silk in the same way as [they] measured land and the distance between stars' (Lugli 2019, 6).

I want to suggest that such liberal assumptions about the existence of a single homogeneous extension subtly pervade the synoptic ambitions of Jorge's dashboard. When he ventures to claim that it is indeed possible to aggregate hundreds of thousands of cubic meters of tropical timber harvested across the country in a given year, he assumes that failures to know the country's aggregate volume of timber stem not from irreducible ontological conditions but from contingent technological limitations that he may eventually overcome. Consequently, he orients himself and his technological innovations toward an abstraction that resides nowhere in particular but emerges from the metaphysical aggregation of a manifold of discrete, homogeneous magnitudes. In this sense, he implicitly asserts that the hundreds of logs scattered across the country do indeed have volumes that exist independently of the vagaries and

distortions introduced by particular human observations. Such realist assertions are rooted in a longstanding technocratic aspiration to render human interested observation increasingly irrelevant to the flow of information through ever more sophisticated digital technologies (Day 2001, 3; Geoghegan 2016; Hayles 1999). As Bernard Dionysius Geoghegan has argued, the 'drive toward informatic disembodiment belongs to a liberal ideology that promises equality through the technological suspension of geographical, linguistic, ethnic, and class differences' (Geoghegan 2023, 10). In this light, Jorge's technocratic ambitions can be situated within a broader genealogy of thought in which disembodied information, spatiotemporal continuity, and liberal dispositions converge to foster distinctive kinds of metaphysical orientation (see Day 2001, 53).

In this context, Jorge's dashboard entails that, with the right protocols and technological arrangements, the *Módulo de Control* can indeed register hundreds of homogeneous magnitudes and aggregate them with precision. In this realist vision, abstract volumes are not something imposed upon the flux of the world by our phenomenal minds, but rather real and quantifiable properties of extension that structure objects and space itself. Armed with such metaphysical premises, proponents of the *Módulo de Control* have been guided by the aspiration to make their traceability systems ever more precise, an emphasis justified as an antidote to the fraud, corruption, and unsustainable harvesting that 'bad measurement and reporting' have allegedly enabled in the past all across the Amazon lowlands. Yet, as I will explain later, this technocratic commitment to homogeneous and continuous extension—to logs having volumes and such volumes being potentially aggregable within a single continuum of magnitudes—has not escaped criticism. In the words of one irritated employee from Peru's Forestry Agency whom I met as I left Jorge's office, 'these *gringos* [U.S. foreign aid experts] want to account for even the splinters of logs … This is crazy'.

The Art of the Yield

Thousands of kilometers away from Lima's business center, on the outskirts of Iquitos, one of Peru's largest Amazonian cities, I walk along a muddy road by the banks of the Nanay River. On both sides of the road, piles of logs lie scattered everywhere, many of them still bearing the metal clamps used to drag them through the rainforest and later guide them along waterways until reaching their destination in the main patio of Silverio's sawmill, where I am currently headed. When I arrive at the yard, Silverio greets me from afar and walks over. He is a man in his mid-fifties, with a serene smile and a distracted gaze that suggests he has a lot on his plate. Judging by his modest attire, it would be difficult to guess that he is one of the most successful timber industrialists in the city, as well as one of the most knowledgeable figures in the tropical timber business. Later that day, Silverio tells me a bit of his story. He is an immigrant from the Peruvian Andes who arrived in Iquitos during his teenage years with his father, who had come to the Amazon lowlands in search of work in the many logging camps that populate the region. Over time, father and son accumulated enough capital to move upward in the industry, first establishing a small sawmill near the Brazilian border and later opening a larger one on the riverbanks of Iquitos, where his headquarters are now located.

Today, Silverio's sawmill processes timber into sawn lumber and other secondary wood products that he later sells to national and international buyers. To supply his mechanized blades with fresh timber, he relies on a network of formal logging operators who regularly bring floating log rafts down the river, replenishing the piles of logs stacked in the yard. These suppliers include a variety of groups and individuals: small companies operating formal concessions, crews of Indigenous workers harvesting timber in their traditional territories, and private landowners taking advantage of occasional clusters of hardwood trees near their homes. Before logs are delivered by these parties, however, Silverio's field crew typically travels to meet the sellers at the logging sites where the logs are first stacked. Once there, they bargain and ultimately settle on a price per log through a process commonly known as *cubicación*. By the time the whole business cycle is complete, Silverio has at his disposal numerous piles of logs with distinctive textures and shapes, many of them still covered with the moss and fungi they bore when they were part of living trees. For Silverio, organizing logs according to their species and ranked qualities is the first step in the careful art of transforming these lively-looking creatures, still smeared with traces of the forests from which they come, into fungible magnitudes of value that can circulate smoothly in the market (Tsing 2015, 62).

Silverio's entire operation is driven by the imperative to maximize the magnitude of timber volume he can extract from these piles of logs, a contingent ratio of value that he refers to as *rendimiento* (yield). This endeavor relies both on the technical prowess of his industrial operators in the sawmill and on the subtle arts of observation, negotiation, and persuasion practiced by his *cubicadores* across the region. As Silverio's *cubicadores* travel long distances to inspect the logs that may later be purchased and transported to the sawmill, they are guided by the anticipation of extracting as much usable volume as possible from the capricious morphology of the logs they evaluate. With this goal in mind, their business centers on paying as little as possible by pointing to the various malformations or signs of decay that may render a log less suitable for industrial processing (or, at least, that is what they argue to their counterparts). This cunning disposition has made *cubicadores* part of the regional lore of Peru's Amazonian lowlands, where they frequently appear as protagonists in local stories of exploitation, deprivation, and trickery (Romero Dianderas 2024b). When *cubicadores* meet, for instance, Indigenous workers who have spent weeks or even months felling trees and moving logs from deep within the rainforest to navigable waterways, they take advantage of imperfections in the materiality of logs and the desperation in the eyes of their interlocutors to minimize payments. Such reductions are performed by discounting their overall volume in board feet, the volumetric unit in which negotiations are typically conducted as *cubicadores* inspect logs still soaking wet, perhaps fractured along the sides, and covered with insects and vegetation. The maximization of yield on the part of Silverio's *cubicadores* thus takes the form of a speculative anticipation: an estimation of how much value, determined by a volumetric magnitude in board feet, might ultimately be extracted as the differential between what is paid to timber sellers and what may later be produced and sold through industrial processing.

This labor of maximization continues when logs encounter Silverio's mechanized blades. Once they have been piled, sorted by species, graded by quality and made ready for processing, Silverio and his workers are intent on ensuring that as little

timber as possible is lost as the logs are transformed into usable lumber products. In this stage, they seek to maximize what they call the *factor de rendimiento*, or lumber recovery factor. The primary result of this process can be seen in one corner of Silverio's main patio. There, dozens of lumber blocks, each sharing the same rectangular shape and bearing no remaining trace of the rainforest, are stacked into a stable pile, forming a striking visual representation of the volumetric magnitudes that Silverio can now bring to the market. As a literal materialization of Silverio's effort to maximize yield, they represent the end result of Silverio's profit-oriented volumetric speculations.

If Jorge's dashboard evokes a metaphysical orientation in which volumes are imagined as spatial extensions residing in objects themselves, magnitudes independent of the distortions introduced by human judgment and interpretation, Silverio's treatment of volumes involves a different kind of orientation, one closer to industrial processing and commercial maximization. For him, volumes are not independent of human effort and intention. Rather, they must be extracted with skill and patience through the careful and organized labor of *cubicadores* and mechanized blade operators. This purpose-oriented volume emerges from the encounter between human industrial ambitions and the accidental morphologies of logs. Abstract spatial extension, here, neither precedes nor contains tangible objects. Instead, volume itself becomes the outcome of an ex post process of industrial transformation. As Silverio and his crew carefully calibrate their blades to minimize timber losses and strive to maximize the number of lumber blocks despite the presence of rot or cracks in the logs, a specific kind of homogeneous volumetric magnitude is crafted out of the irregular wooden matter of a pile of logs.

Importantly, Silverio's metaphysical orientation differs from Jorge's in another crucial sense. While Jorge relies on a universalist vision of space, one in which the absence of structural discontinuity or hierarchy grounds technocratic aspirations for equality, neutrality, and rationality, Silverio's volumes are not entities that stand apart from power, inequality, or interest. Quite the contrary: they are born of contingent calculation and interested labor. More importantly, they are magnitudes that can only be provisionally stabilized, not because they reflect the intrinsic dimensional structure of an object, but because they prove useful to the most powerful party in an exchange (that is, Silverio and his cunning *cubicadores*). Volumes, therefore, remain abstract, but they are far from impervious to the broader political and economic relations that bring them into being. Rather, they are vessels for the reproduction of longer historical relations of unequal exchange and exploitation that have shaped Peru's tropical timber supply chains for generations, processes through which industrialists like Silverio seek to extract as much value as possible from the precarious labor of small-scale riverine loggers (Romero Dianderas 2024b).

In this sense, Silverio's engagement with abstract volumetric magnitudes echoes broader economic and political genealogies in which measurement and calculation do not primarily revolve around aspirations to grasp the dimensional structure of the world, but instead become indexes of contingent class struggles and social hierarchies. From this perspective, the ways people measure and calculate are themselves shaped by fraught power relations within society, rather than simply serving as neutral means of apprehending the world's extensional structure (Kula 1986; Lugli 2019; Scott 1998). In Silverio's sawmill, therefore, volumes are not discovered, but laboriously and

exploitatively extracted. The lumber blocks stacked in the corner of his patio thus mark the provisional triumph of a particular metaphysical orientation, one that transforms the irregular morphology of logs, the craftsmanship of *cubicadores* and industrial operators, and the harnessing of the precarious labor of riverine loggers into maximized magnitudes ready to circulate in the market.

Voluminous Critiques

About three days of navigation from the shores of Iquitos, I spend the week with Aldair, a young forest engineer recently hired by a wealthy timber industrialist to oversee one of his logging operations and survey the area for harvestable trees. Aldair is young and still making a name for himself in the industry, but despite his age, he is already deeply familiar with the ups and downs of a sector recently thrust into the spotlight by an intense wave of regulatory reform. As the day ends, we sit in silence beside a small fire lit before sunset, while clouds of mosquitoes gather around us in the growing dark and the sound of crickets fills the surrounding forest. As Aldair prepares dinner in a small cauldron over the fire, he begins to recapitulate everything he will need to do over the next few weeks to secure state authorization to mobilize timber from the operation under his management. 'About a month ago, my crew and I surveyed that entire sector over there', he says, pointing toward a vast hilly expanse across a nearby stream. 'Before we harvest a single tree, we need to report their locations, species, and volumes. Otherwise, we risk having the operation sanctioned by state authorities'.

Once he finishes his surveying work, Aldair plans to travel to the nearest *oficina desconcentrada* [local forestry agency] in the small city of Requena. There, he will submit a management plan detailing the dozens of trees he intends to harvest in the name of his employer. As soon as he does so, the volumetric magnitudes he reports will begin to circulate within a broader statewide data ecosystem. Agents at the *oficina desconcentrada* will likely record these figures in a spreadsheet. From there, the data will travel, either through cloud-based servers supported by local telecommunications infrastructure or via physical flash drives transported by boat, to Iquitos, where they will be aggregated in official servers at the Regional Forestry Bureau. Eventually, his numbers will enter national data systems, accumulating alongside hundreds of other reports into ever-larger datasets, where they may one day be visualized in Jorge's dashboard. Once there, these figures will allow different constituencies to see how much timber is scheduled to be harvested from Aldair's operation, laying the groundwork for tracking and monitoring the flows and distribution of timber according to international standards of transparency and sustainability.

The next day, we begin our surveying work in earnest. Quite aware that the submission of his volumetric reports may enroll his operation into a larger infrastructure of tracking and monitoring, Aldair appears visibly anxious about getting his measurements right. Back in the day, he says, such figures were little more than floating numerical signifiers that loggers could adjust almost at will. If what was at stake was the payment of onerous taxes, the reported volumes might decrease, reducing the amount owed to local authorities. Yet just a few days later, as floating log rafts crossed a surveillance post along the river, those same volumes might suddenly increase, accounting for a portion of the shipment that ostensibly exceeded what

had been declared in official documents. The discontinuity of volumetric magnitudes across these situations, Aldair suggests, belonged to a world in which abstract magnitudes were not believed to reside in things themselves, nor carefully extracted as exchange value from a pre-valuable materiality. Rather, such magnitudes were understood as strategic sites of maneuver, precisely because they were ultimately less about the things they purported to measure than about tactical communication with various publics and interlocutors.

Then, Aldair tells me, things began to change. Following regulatory reforms introduced after the 2009 Free Trade Agreement with the United States, as well as growing diplomatic pressure from other economic partners such as the European Union, the relationship between volumetric magnitudes and the trees and logs they purported to describe became the object of intensive, multi-party verification. If in the early 2000s such magnitudes were little more than strategic inscriptions on paper, by the early 2010s what was reported to the state had become subject to verification before, during, and after the timber harvesting process. For Aldair, this transformation materializes in the form of regular on-site inspections carried out by multiple institutions responsible for supervising different stages of the sourcing process. 'Once I submit my report, someone from the *oficina desconcentrada* might come to verify my measurements', he says, as we walk near the hills full of trees that his crew will soon cut down. 'If I were harvesting mahogany or cedar, a certified auditor might also come to verify my reports. Then there are agents stationed at surveillance posts along the river. And finally, there are national inspectors who can visit your operation at any point in the process'. As trees are surveyed, cut down, severed into logs, and dragged across hills and waterways, this regime of recursive verification operates under the assumption that volumetric magnitudes should remain consistent across time and space, persisting through multiple measurements despite the shifting forms taken by tropical timber.

For Aldair, this proliferation of volumetric verification practices is a matter that calls for caution. And he is not alone, he tells me. Throughout the 2010s, loggers across the region were confronted with the question of whether their measurements could produce volumetric magnitudes that remained consistent across multiple measuring events. Thinking aloud, Aldair begins to trace the many interruptions that may jeopardize the attainment of such elusive consistency. 'Trees are not perfectly cylindrical, right? When you press your *wincha* (measuring tape) against a log, which diameter will you take?' he wonders. 'What about measuring a log as it lies on a steep hill, or when it is immersed in mud, or floating on water? And what happens when the logs are no longer even there, but an inspector arrives and says that the distance between the remaining canopy and the stump of a harvested tree does not match what you reported?' By dwelling on these experiences of interruption and fragmentation, where saturated soils, water, mud, and undulating terrains shape the irregular rhythms and conditions of work that characterize tropical logging in Peru's Amazonian lowlands, Aldair advances an empiricist critique of contemporary technocratic aspirations to stabilize volumes as discrete magnitudes within a single homogeneous extension.

During the 2010s, Aldair explains, the problem of idiosyncratic measurement became a serious obstacle to the implementation of volumetric verification mechanisms, one that ultimately pushed several public and private institutions across the

country to come together in an effort to standardize their measuring practices. State forestry agencies, forest auditors, conservationists, and loggers all participated in these attempts. These efforts eventually materialized in what came to be known as the *Protocolo de Convergencia* [Convergence Protocol], a state-sponsored document that, through specific casuistry, detailed procedures, and narrowly defined margins of error, sought to prevent volumetric magnitudes from once again being destabilized by the partial and strategic interests of different actors (SERFOR 2017). Against the possibility of the strategic inflation and contraction of volumes on the part of workers like Aldair and their employers, the *Protocolo de Convergencia* sought to tame empiricist objections by standardizing the conditions under which volumetric calculations should take place across Peru's Amazon lowlands.

If Jorge's dashboard approaches volumes as homogeneous spatial extensions that reside in things themselves, Aldair's critical reservations about ongoing regulatory reform refuse such a realist communion between abstract magnitudes and the physical entities they purport to describe. From this perspective, the sheer multiplicity of the world—trees that are conical, parabolic, or cylindrical in different ways; the capricious morphologies of sinuous trunks; logs rolling down a hill or floating along a river—stands in the way of the kind of foundational stability that would allow us to experience homogeneous and regular extensions as independent of our contingent conditions, interests, and ambitions. One way to understand Aldair's relation to volumetric magnitudes is through the distinction between the volumetric and the voluminous (Billé 2020, 5–6). If the volumetric evokes an experience of space in which a regular form is successfully imposed onto matter—imagine a measuring tape pressed against the bark of a tree—the voluminous emerges precisely when our experience of space fails to reduce matter to such regular form. In this sense, the voluminous corresponds to an experience of extension that is immersive and irreducible, one in which the orderly continuity of homogeneous space repeatedly slips away from the flow of perception.

The Uses of Volumetric Abstraction

As our foray across Peru's tropical timber supply chains draws to a close, we may take a step back and consider how the ambitions, interests, and values of Jorge, Silverio, and Aldair become intertwined through industrial and technocratic rhythms spanning hundreds of kilometers. At one level, their lives are ostensibly connected first and foremost by the material circulation of tropical timber, a process that, in recent years, has brought together a diverse set of constituencies: environmentalists eager to tighten regulatory control over an industry long associated with unsustainable harvesting, and industrialists and loggers seeking to revive a sector in regional decline.

Telling the story from this angle resonates with a broad literature examining the social lives of commodities as they move across sites of production, distribution, and consumption (Appadurai 1988; Tsing 2005). Similarly, placing the material circulation of tropical timber at the analytical center brings into focus questions of distributed agency and more-than-human entanglement, concerns that animate recent conversations in several strands of new materialist thinking (Boysen 2023; Nail 2024).

By contrast, throughout this article I have sought to decenter material circulation in order to shed light on something else: how the relationship between volumetric abstractions and the shifting sociotechnical configurations that instantiate them allow us to envision volumes in different ways across Peru's tropical timber supply chain. In metaphysics, abstractions like volumes are traditionally defined as general objects that are neither spatiotemporally present to our experience nor causally effective in the world. My argument has been that, qua abstractions, volumes are indeed not spatiotemporally present. They are general entities that can only be encountered through provisional instantiations, such as a number on a spreadsheet or the shape of a pile of logs. Yet this ontological elusiveness does not render them inconsequential for economic and political life. Rather, I have shown ethnographically that abstractions are entangled in wider fields of practices, interests and ambitions. Seen from this perspective, abstractions play an important role in the organization of social life, and their interventions in the fabric of our experience become a terrain of ethical and political engagement, one that looks quite different depending on the vantage point from which it is approached.

Importantly, my approach to the tangled nature of abstraction avoids culturalist biases that reduce divergent metaphysical premises to stable models of social difference. Taking inspiration from Helen Verran's work on numbers in Yorubaland, I do not interpret disparate ways of imagining abstraction as the result of different 'cognitive models' or 'cultural frameworks' that might explain away difference (Verran 2001). Just as Verran approached numbers as they manifested in the goings-on of Yoruba social life, an endeavor in which she learned to follow the ritualized practices through which numbers practically emerge in mundane situations, I subscribe to a mode of explanation that focuses not on discrete frameworks, but on shifting practices and sociotechnical arrangements. My notion of metaphysical orientation is relevant in this respect, as it draws attention to the ways distinctive understandings of volumes may emerge organically from people's engagement with practices and ambitions surrounding regulation, productivity, and critique. Indeed, we might even (and probably should) acknowledge the possibility that the same person might envision volumes in different ways as they move across distinct situations and sites of encounter. From the perspective of metaphysical orientations, questions of judgment—truth and falsity, honesty and insincerity, accuracy and imprecision—become less relevant than attending to how particular premises about abstraction are enabled by practical and situated ways of engaging the world.

Furthermore, thinking through metaphysical orientations draws attention to the fact that engagements with volumes are not singular or isolated events, but emerge from larger, intersecting genealogies of thought that extend well beyond the Amazonian landscapes where we encounter them. In this article, I have offered three ethnographic vignettes drawn from different nodes of Peru's tropical timber supply chains, and I have argued that each provides a distinct vantage point from which to understand how volumes might relate to concrete wooden objects such as trees, logs, and sawn lumber. Importantly, I have suggested that each of these moments carries echoes of broader traditions of thinking about the metaphysics of volumetric magnitudes. As Jorge aspires to determine how many cubic meters of tropical timber were harvested across the country last year, we may discern elements of a realist vision of space as homogeneous and continuous, one in which volumes reside in and contain things independently of external observers. As Silverio strives to extract as much yield as possible from the capricious

materiality of the logs he piles in his patio, we glimpse longstanding practices of interested extraction and exploitation through which nature is industrially metabolized into exchange value. Finally, as Aldair worries about his measurements not coinciding with those of state inspectors, his reflections align with a broader genealogy of empiricist critique concerning the ultimate difficulty of reducing the flux of matter to regular form. Whether as a realist belief in homogeneous extension, a pragmatic engagement with extractive optimization, or a critical reflection on the limits of standardization, volumetric magnitudes remain rooted in speculative metaphysical orientations toward the structure of the world.

Such questions are key to understanding the role of the volumetric in contemporary environmental politics. As scholars increasingly explore the diverse ways in which corporate, scientific, governmental, military, and civilian actors conceptualize and engage with complex spatial objects, interrogating how abstractions such as volumes are thought to relate to tangible entities—rock formations, atmospheric circulations, or peatlands—may offer important insights into the politics of space in an era of increasingly entangled environmental relations. What sorts of metaphysical orientations, for instance, might guide the actions of scientists, policymakers, or rural villagers as they relate carbon dioxide to *tons*, deforestation processes to *areas*, or water reserves to *cubic meters*? While the shared invocation of tons, areas, or cubic meters might suggest the existence of a common object grounded in a shared metaphysical orientation, critical reflections on the politics of volumetric space benefit from suspending such assumptions and slowing down thought as we ethnographically grapple with these abstractions (De la Cadena 2015; Stengers 2005, 994). Paying attention to the metaphysical unsettledness of volumes (and of abstraction more generally) thus becomes a productive step toward expanding the analytical potential of the notion of the volumetric in the analysis of global environmental politics.

Finally, the notion of metaphysical orientation brings into focus the often-blurred relationship between metaphysics and ethics. As Benjamin Brandom has argued, making a judgment and settling on a belief entails embracing responsibility, insofar as commitments to particular visions of the world lay the groundwork for practice (Brandom 2009, 10). In other words, how we orient ourselves toward specific metaphysical presumptions about the world conditions how we authorize ourselves to imagine it and act upon it. As Jorge, Silverio, and Aldair practically reflect on the nature of volumetric magnitudes, they are simultaneously grappling with the mundane yet consequential concerns that shape their everyday worlds: the optimistic promise of technocratically imagined sustainable futures, the historically entrenched extractive ethics of industrial productivity, and the hard empirical limits encountered by new projects of environmental surveillance and standardization. Being attentive to the kinds of metaphysical orientations we cultivate therefore opens opportunities to reflect more carefully on the kinds of worlds we seek to bring into being, fields of metaphysical engagement where new possibilities may emerge even in the most unexpected places.

As we contend with planetary questions that demand an ever more intensive recruitment of abstractions in the organization of social life, these sprouts of metaphysical engagement are worth attending to. As Matteo Pasquinelli has argued, the geopraxis demanded by paradigms such as the Anthropocene calls for a new metrology capable of 'staying with the trouble', that is, of keeping our engagements with measurement

and calculation open to political experimentation (Pasquinelli 2022; see also Haraway 2016). In doing so, we need not rely solely on academic debate. Mundane scenes of everyday life, far removed from philosophical argument and theoretical speculation, already teem with forms of metaphysical experimentation.

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