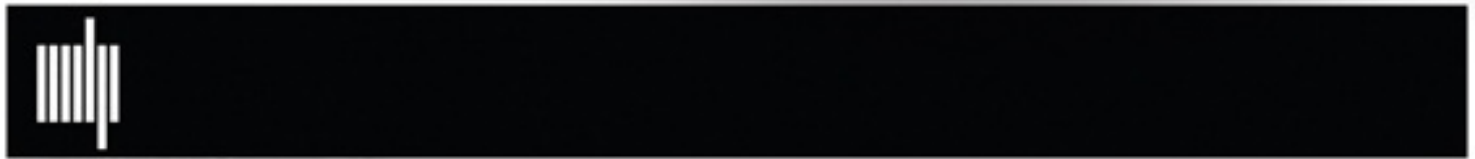
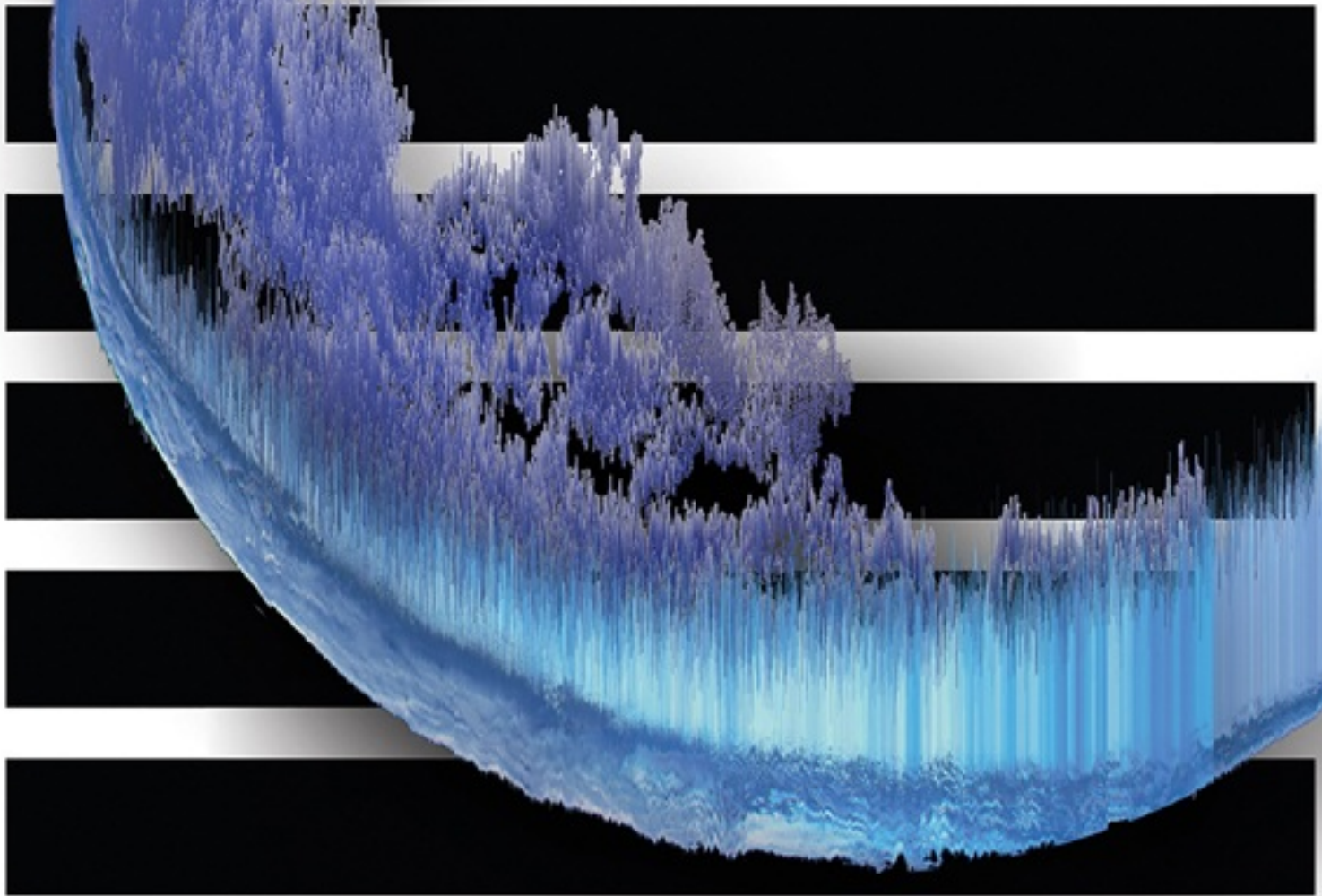


**The Stack
| On Software
and Sovereignty**

Benjamin H. Bratton

The Stack



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Benjamin H. Bratton, 2015

The Stack

On Software and Sovereignty

Benjamin H. Bratton

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For Lucien, and his world.

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Series Foreword

Software is deeply woven into contemporary life—economically, culturally, creatively, politically—in manners both obvious and nearly invisible. Yet while much is written about how software is used and the activities that it supports and shapes, thinking about software itself has remained largely technical for much of its history. Increasingly, however, artists, scientists, engineers, hacker designers, and scholars in the humanities and social sciences are finding that for the questions they face, and the things they need to build, an expanded understanding of software is necessary. For such understanding they can call upon a strand of texts in the history of computing and new media, they can take part in the rich implicit culture of software, and they also can take part in the development of an emerging, fundamentally transdisciplinary, computational literacy. These provide the foundation for software studies.

Software Studies uses and develops cultural, theoretical, and practice-oriented approaches to make critical, historical, and experimental accounts of (and interventions via) the objects and processes of software. The field engages and contributes to the research of computer scientists, the work of software designers and engineers, and the creations of software artists. It tracks how software is substantially integrated into the processes of contemporary culture and society, reformulating those processes, ideas, institutions, and cultural objects around their closeness to algorithmic and formal description and action. Software studies proposes histories of computational cultures and works with the intellectual resources of computing to develop reflexive thinking about its entanglements and possibilities. It does this both in the scholarly modes of the humanities and social sciences and in the software creation/research modes of computer science, the arts, and design.

The Software Studies book series, published by the MIT Press, aims to publish the best new work in a critical and experimental field that is at once culturally and technically literate, reflecting the realities of today's software culture.

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The material in the book is previously unpublished, save for a few passages drawn from articles and book chapters I have published over the past few years. In most cases, I have reworked these here, but the cores of the ideas are in the original versions, and I acknowledge them with thanks. Sections of the “Earth” chapter appeared in *New Geographies 7: Geographies of Information*, ed. Ali Fard and Taraneh Meshkani (Cambridge, MA: Harvard Graduate School of Design, 2015). Sections of the “Cloud” and “Interface” chapters draw from “On Geoscapes and the Google Caliphate: Excess #Mumbai,” *Theory, Culture and Society Annual Review* 26 (2009): 329–342. This original article in many ways was the seed material around which this book evolved. My thanks to Ryan Bishop for his invitation to contribute, and also for setting *The Stack* in motion. Sections of the “City” chapter draw from “Ambivalence and/or Utopia,” in *Bracket 2: Goes Soft*, ed. Neeraj Bhatia and Lola Sheppard (Barcelona: Actar, 2013), from “Megastructures,” in *Entr’acte*, ed. Jordan Geiger (London: Palgrave Macmillan, 2015), and from “Parametricist Architecture (Would Be a Good Idea)” in *The Politics of Parametricism*, ed. Matthew Poole and Manuel Shvartzberg (London: Bloomsbury, 2015). Sections of the “Interface” chapter draw from “iPhone City (v.2008),” *Digital Cities AD: Architectural Design*, ed. Neal Leach, volume 79, no. 4 (2009): 90–97 (London: Wiley, 2009), and from “On Apps and Elementary Forms of Interfacial Life,” in *The Imaginary App*, ed. Paul D. Miller and Svetlana Matviyenko, 3–16 (Cambridge, MA: MIT Press, 2014). Sections of the “Earth” and “User” chapters draw from “What We Do Is Secrete: On Virilio, Planetarity and Data Visualization,” in *Virilio and Visual Culture*, ed. Ryan Bishop and John Armitage, 180–206 (Edinburgh: Edinburgh University Press, 2014). Parts of the concluding chapter draw from “The Black Stack” *e-flux journal*, no. 5 (March 2014), with special thanks to Julieta Aranda. This *e-flux* piece was a reworked version of a keynote at Transmediale 2014 with Metahaven; thanks to Ryan Bishop (again), Jussi Parikka, and Sean Cubitt for the invitation to Berlin. Finally, special thanks to Daniel van der Velden and Vinc Kruk of Metahaven for their ongoing friendship and collaboration (and for the excellent book cover). Many of the key ideas of this book developed in relation to our dialogues, some published and others not.

Preface

This book is both technical and theoretical. It is unapologetically interdisciplinary in its perspective and its project; it is a work of political philosophy, and architectural theory, and software studies, and even science fiction. It draws links between technologies, places, processes, and cultures that may exist at different scales but which are also deeply interrelated. In this crisscross, we observe that “computation” does not just denote machinery; it is planetary-scale infrastructure that is changing not only how governments govern, but also what governance even is in the first place. Computation is a logic of culture, and so also a logic of design. It is both how our culture designs and is itself the thing which we need to design better, but to do that we need to take a step back and view an emerging big picture that is different from what has been predicted. We may glimpse that another model of political geography is cohering before our eyes. What can we do with it? What does it want from us? The answers depend on our theories and tools, on our models and codes.

For design, theory and computation have been intertwined for decades. One might even suspect a direct correlation between the end of theory and the rise of software (software being a form of technology that is linguistic as well as a form of language that is technological). Sometime from 1990 to 1997 or so, especially in academic design programs, software seemed to displace theory as a tool for thought. Many students interested in asking essential questions about how things work turned to software, not just to describe those things but also to make them, and not just to make them, but also to think through them. This shift came with trade-offs. Thinking with tools, and in this case, working with the fixed capital of advanced technologies, is a good thing. It is part of the genesis of our species. It is how we mediate the world and are mediated by it; we become what we are by making that which in turn makes us. This is no less true (or less complex) as software becomes a more ubiquitous feature of the whole world: in your hand, in the building, part of every supply chain, every image, every archive, every query. I am of the opinion, however, that as we quickly learn more precise and higher resolution processes, it becomes correspondingly harder to see the whole at once. Accomplishments of analysis are paid for with a dissipation of synthesis. As such, software may need theory at least as much as theory needs software.

As for the geopolitics of computation, we can point to another shift, around 2008 or so. Before this break, the growth of planetary-scale computing systems was seen more generally as a beneficent blossoming. The old order would be swept away and a new day illuminated with the power of networks, iStuff, Twitter revolutions, “Internet freedom,” and smart cities. After this break, however, the sky darkened, and now the Cloud portends instead state surveillance, tax evasion, structural unemployment, troll culture, and flash crashes. Reality, however, is actually more radical in both directions. The thesis of this book holds that the official utopia and the official dystopia are not particularly useful frames of reference, and that neither provide a robust and intelligent program for art, design, economics, or engineering. In fact, the messianic effervescence of the former and the apocalyptic panic of the latter are part of the problem. Today we lack adequate vocabularies to properly engage the operations of planetary-scale computation, and we make use of those at hand regardless of how poorly they serve us. After the cycles of positive and negative hype run their course we discover that computation holds both more potential and more risk than we foresaw. Going forward, we really do need new and better models, because computation already operates in ways that have surpassed and overflowed the regular cartographies.

This book starts with the technologies themselves, abstracting from them a formal model that is general and comprehensive, but not complete or fixed. The model does not put technology “inside”

“society,” but sees a technological totality as the armature of the social itself. It does not focus on computation in the service of governance, or in resistance to governance, but rather on computation as governance. In the first chapter, I propose that we view the various types of planetary-scale computation (e.g., smart grids, cloud computing, mobile and urban-scale software, universal addressing systems, ubiquitous computing, and robotics, and so on) not as isolated, unrelated types of computation but as forming a larger, coherent whole. They form an accidental megastructure called The Stack that is not only a kind of planetary-scale computing system; it is also a new architecture for how we divide up the world into sovereign spaces. More specifically, this model is informed by the multilayered structure of software protocol stacks in which network technologies operate within a modular and interdependent vertical order. The model allegorizes the logic of stacks into a general principle of systems, and uses it to describe both the geometry by which a political geography is subdivided as well as the aggregate shape of the technologies that occupy those spaces. The Stack model is global but it is not immutable. To the contrary, it is intrinsically modular and so the megastructure is also a platform, and an interface even, for the redesign and replacement of the Stack we have with a Stack-we-want (or perhaps with the Stack-we-want-the-least).

Accordingly, *The Stack: On Software and Sovereignty* is a book of design theory. Its interests are as speculative and projective as well as analytical; it is about sketching things in advance of their arrival as much as mapping things as they are. It describes a consolidation of cultural, institutional, and technical systems through the exponential logics of planetary-scale computation and considers how we might recognize and engineer alternative effects. The design horizon for each layer of The Stack is understood both by what it accomplishes as an ideal technology and, perhaps more important, by what accidents it brings that also define its real impact. My interest is in how design—designating things according to program—can work through these schema, across their disparate scales and toward different futures. What new forms can we compose for this computational and geopolitical condition? First to map it, then to interpret it, then to redesign it?

More precisely, then, this book is a design brief; it outlines a design problem and invites new interventions. It articulates a project of “geodesign” to be taken up as a collaborative megaproject. Problems inevitably arise that cannot be defined in isolation, but also cannot be engaged other than by specific technical practice, so opportunistic approaches and experiments are necessary. The argument of this design brief is neither simply pro-Stack or anti-Stack. Any infrastructure of this scale inevitably gathers and binds power into itself, and so is either remedy or poison or both. The system we have now is both what makes these extraordinary technologies possible, but is also what ultimately retards their real potential. In response, we need a geopolitics of design that is comfortable not only with computation but also with vertical systems of designation and decision. The Stack model is a diagram that works only when it is put to use. Perhaps by drawing the whole, we stand a better chance of designing a better architecture of globalization. Perhaps we are not lacking ideas but a platform to situate, deploy, and enforce them.

Because *The Stack: On Software and Sovereignty* draws on many disciplinary discourses, it is inevitable that some passages may seem opaque and others obvious, and differently so for different readers. Most important are the lines of connection between ideas and their illustrations. I chose the examples for how they clarify a point made, but I claim no definitive treatments of any of them. I tried to choose examples that are not too of-the-moment. Given the subject matter's pace of change, referring to events that are richly elucidative even though slightly untimely, may help ensure that the narrative stands the test of time. Similarly, many books about design rely heavily on images to make their point, and my editor and I decided early on that the text should stand on its own. Let the book be a book. There are (almost) no pictures to be found, but the companion website (thestack.org bratton.info/thestack) includes many images and illustrations accompanying each chapter, and (if you

choose) you may refer to these as you read and approach the book in a way that is a bit more like my visually elaborate public talks. Like any other project that tries to draw wholes, *The Stack* produces its own vocabulary (e.g., *platform sovereignty*, *loop topology*, *Cloud feudalism*) that becomes clear as the argument accumulates. To aid readability, I have included a glossary to consult, or perhaps even to read first.

We are still very early in the historical trajectory of planetary-scale computation. How intelligent algorithmic species will evolve and how our cultural systems will train them and be trained by them is anyone's guess. Writing from inside the research university, I hope that we will look back on this moment—when you could go to medical school and not take basic data structures or JAVA, or get a computer science degree and not be fluent in any of the basic issues in the philosophy of technology, the essential ideas of contemporary art, or train in a design program without working on any substantive political science problems—as one curtailed by bizarre intellectual paranoia. Our shared design project will require both different relationships to machines (carbon-based machines and otherwise) and a more promiscuous figurative imagination. Toward that, this book is my drawing on our cave wall, one that invites response, revision, and even replacement.

November 2014
La Jolla, California

I The Models

The Maelstrom, a mad spiral, the terror of hardened sailors, the Maelstrom is a circle of circle
Which circle leads one by chance to escape? Or perhaps to be sucked down to the bottom?

—Michel Serres, “Jules Verne's Strange Journeys”¹

Centralization is vulnerability—and yet the world is not content to build its biomass on such
fragile template, it forces the same model onto its metasystems as well.

—Peter Watts, “The Things”²

The cybernetics of men. ... As you, Socrates, often call politics.

—Stafford Beer, “Cybernetic Praxis in Government”³

Introduction

1. A New Architecture?

In an address to the Council on Foreign Relations on the need for a new geopolitical architecture, the outgoing secretary of state, Hillary Clinton, made a rather striking recommendation: “We need a new architecture for this new world, more Frank Gehry than formal Greek.”⁴ She described the system dominated by the United Nations, the North Atlantic Treaty Organization, and several other large organizations as the equivalent of the classical Parthenon in Athens. “By contrast, there’s Gehry. Modern architecture [sic]. ... Some of his work at first might appear haphazard, but in fact, it’s highly intentional and sophisticated,” Clinton continued. “Where once a few strong columns could hold up the weight of the world, today we need a dynamic mix of materials and structures.” Looking to contemporary design for new models of geopolitical architecture, both literal structures and figurative systems, may be a good idea (regardless of whether Gehry’s singular and floral morphologies are necessarily the best option), but what drives this demand for new armatures and diagrams of global power and sovereignty? Clinton went on to identify global information systems as perhaps the single most important powerful engine of the new world that would demand new organizing architecture. The continuing emergence of planetary-scale computation as meta-infrastructure and of information as a historical agent of economic and geographic command together suggest that something fundamental has shifted off-center. But global transformations of hard and soft systems brought by computation have disturbed neat arrangements in ways that Clinton struggles to articulate and we struggle to describe and design for. While trade and migration perforate borders, state sovereignty and supervision over information flows are also dramatically reinscribed and reinforced. The possible architectures at work now and in the future seem twisted and torqued in the extreme.

In this context, this book proposes a specific model for the design of political geography tuned to this era of planetary-scale computation. It works from the inside out, from technology to governing systems. As we link infrastructure at the continental scale, pervasive computing at the urban scale, and ambient interfaces at the perceptual scale, we will explore how these interweave and how we might build, dwell within, communicate between, and govern our worlds. To do this, it draws on the multilayered structure of software, hardware, and network “stacks” that arrange different technologies vertically within a modular, interdependent order. From this and from other non-computational structures, the model abstracts a general logic of platforms, now a fundamental principle for the design and coordination of complex systems. In practice this includes outlining an alternative subdivision of political geographies at work now and in the future, some of which may be familiar and others less so. In doing so, the chapters pull on threads from different intellectual fabrics and knit them together by following their crisscrossing patterns. These lead from the long-foretold and long-postponed eclipse of the nation-state to the ascendance of political theology as an existential transnationalism, from the billowing depths of cloud computing and ubiquitous addressability to the logistical modernity of the endlessly itinerant object, and from the return of the city-state in the guise of a multipolar network of megacities and walled megagardens to the permanent emergency of ecological collapse and back again.

My conclusions are speculative and meant to inform and support further design of these systems.

Like any other good theoretical design research, it handles slippery problems in ways that are provisional, prototypical, and provocative—not necessarily policy (yet). The story arc begins by tracing the political division of earthly territories—land, sea, and air among them. Throughout history, each arrangement of those divisions expresses a particular and evolving geometry of sovereign space and a specific topology of segmentation and jurisdiction, and because these orders are unfixed, they are also redesignable.⁵ It becomes clear, for example, that the stability of geopolitical architecture based on the land-bounded nation-state as the indispensable unit of sovereignty is continually undermined by its own successes and exceptions (and with them, many political identities are as well). I argue that in order to account for the real effects of planetary-scale computation and to make it accountable as a designable platform, a decentering of some conventional ideas about political geographic norms is necessary. Maps of horizontal global space can't account for all the overlapping layers that create a thickened vertical jurisdictional complexity, or for how we already use them to design and govern our worlds. Instead of lamenting all the exceptions to the norm, hoping that they will get back in the box where they belong, perhaps it is time to map a new normal. Toward conceiving an alternative geometry of political geography, looking forward more than backward, this book considers the model of The Stack.

I propose The Stack as a way that we might map political geography, but also for how we understand the technologies that are making that geography. Planetary-scale computation takes different forms at different scales—energy and mineral sourcing and grids; subterranean cloud infrastructure; urban software and public service privatization; massive universal addressing systems; interfaces drawn by the augmentation of the hand, of the eye, or dissolved into objects; users both over-outlined by self-quantification and also exploded by the arrival of legions of sensors, algorithms, and robots. Instead of seeing all of these as a hodgepodge of different species of computing, spinning out on their own at different scales and tempos, we should see them as forming a coherent and interdependent whole. These technologies align, layer by layer, into something like a vast, if also incomplete, pervasive if also irregular, software and hardware *Stack*. To be clear, this figure of The Stack both does and does not exist as such; it is both an idea and a thing; it is a machine that serves as a schema as much as it is a schema of machines. It lets us see that all of these different machines are parts of a greater machine, and perhaps the diagrammatic image of a totality that such a perspective provides would, as theories of totality have before, make the composition of alternatives—including new sovereignties and new forms of governance—both more legible and more effective. As the shape of political geography and the architecture of planetary-scale computation as a whole, The Stack is an accidental megastructure, one that we are building both deliberately and unwittingly and is in turn building us in its own image. While it names the organization of a planetary-scale computing infrastructure, my purpose is to leverage it toward a broader program for platform design. In the depiction of this incipient megastructure, we can see not just new machines but also still-embryonic geopolitical institutions and social systems as well. For these, The Stack is powerful and dangerous, both remedy and poison, a utopian and dystopian machine at once (it can go either way, and as Buckminster Fuller said, it will be touch and go until the last instant). As a model, The Stack is simultaneously a portrait of the system we have but perhaps do not recognize, and an antecedent of future territory, and with both at hand, we hope to prototype the alien cosmopolitanisms they engender for us and suggest to us.

Planetary-scale computation both distorts and reforms modern jurisdiction and political geography and produces new forms of these in its own image. It perforates and transcends some borders while introducing and re-thickening others at new scales and in greater quantity. While this inaugurates new design problems, it does not represent the introduction of design into political geography as such; design is always already there. The frame of the nation-state as the core jurisdiction is a design-

deliberate and otherwise—of a geopolitical architecture derived from the partitioning of plan geography, separating and containing sovereign domains as discrete, adjacent units among a linear and horizontal surface. That one particular modern model is a specific and durable composition of the lamination of territorial and governmental layers into one, but today as a design logic for political geography, it is less a monopoly platform than it once was. It leaned on a consensus that was always a bit tenuous and today demands attention and revisitation. We could trace this design back to, among other defining events, the 1648 Peace Treaty of Westphalia, which formalized this particular flattened political-cartographic diagram and set some terms for its subsequent normalization and partial universalization throughout the world. The effects of this design extended not just to how political space would be formally represented and enforced but also how the content of “the political” as a unique domain of human action and ethics would be known. Some decades after Westphalia, Immanuel Kant codified and expanded on the implications of its arrangements and gave it deep philosophical leverage. He articulated “cosmopolitanism” as the polity of those who share the surface of the earth's crust as their locale and as a moral and legal federation of the landed national units and of their citizens. The formal system of Westphalian states did not resolve once and for all conflicts over law, land, and identity into this global and self-encapsulated legal architecture, but instead invested in the state the standing of the legitimate instrument of those conflicts (and, as importantly, over exceptions to that legitimacy as well).

Today's political geographic conflicts are often defined as exceptions to that normal model, and many are driven, enabled, or enforced in significant measure by planetary computation: byzantine international and subnational bodies, a proliferation of enclaves and exclaves, noncontiguous states, diasporic nationalisms, global brand affiliations, wide-scale demographic mobilization and containment, free trade corridors and special economic zones, massive file-sharing networks both legal and illegal, material and manufacturing logistical vectors, polar and subpolar resource appropriations, panoptic satellite platforms, alternative currencies, atavistic and irredentist religious imaginaries, cloud data and social-graph identity platforms, big data biopolitics of population medicine, equities markets held in place by an algorithmic arms race of supercomputational trading, deep cold wars over data aggregation across state and party lines, and so on. In relation to the incommensurate demands of diverse protocols, these rewrite and redivide the spaces of geopolitics in ways that are inclusive of aerial volumes, atmospheric envelopes, and oceanic depths. In response, certain geopolitical modernities drift from the center of the frame, are obscured by the multiple exposure image of competing claims over the same place, and are sometimes even overcome by the effects.

Today the authority of states, drawn from the rough consensus of the Westphalian political geographic diagram, is simultaneously never more entrenched and ubiquitous and never more obsolete and brittle. In the emergence of The Stack, it is not that the state declines per se, but that our contemporary condition is qualified both by a debordering perforation and liquefaction of the system's ability to maintain a monopoly on political geography, and by an overbordering, manifested in an unaccountable proliferation of new lines, endogenous frames, anomalous segments, medieval returns, infomatic interiors, ecological externalities, megacity states, and more. These zones fold and flip-flop on top of one another, interweaving into abstract and violent spatial machines of uncanon jurisdictional intricacy. Borderlines are militarized as they are also punctured or ignored. However, the simultaneity of all this is only contradictory at first blush. Debordering and overbordering both testify to the crisis of the Westphalian geographic design, and indeed of the force of law that would predicate the state's ability to convene and constitute sovereignty only in relation to that particular image. The capacity of the state to enforce those same territorial claims is not simply undone; indeed, it is also reinforced by the same processes of delinking sovereignty and geography that state

themselves have innovated. The modern norm of political geography is fracturing through its own radicalization and by its own hand, not just by the accumulation of violations to its authority. At the same time, the future of its governance, and the designability of that future, is now, as it has been many times before, being decided through encounters with incommensurate external challenges to its claimed monopoly on geographic geometry. Such encounters sometimes produce genuinely new things, and sometimes they produce what is merely consistent with what can be enforced, and sometimes they produce things that are neither.

Recognizing this paradox raises more questions and possibly provides some leads. What might account for its complexities and what topological imaginations might allow us to reform it? At stake is more than a new way for states to operate or a new set of technologies requiring governance; rather, it is a scale of technology that comes to absorb functions of the state and the work of governance. Toward an answer, The Stack model suggests both the means and ends of a specific kind of platform sovereignty. It demands that we understand the designability of geography in relation to the designability of computation and to see the state (and other sovereign institutions) in relation to both at once. This differs from how other political philosophies of technology have understood governance and machines. Max Weber's sociological theories of bureaucracy also described the state as a kind of machine, a vast apparatus for which the instrumental rationality of inputs and outputs should guarantee predetermined outcomes. Platforms, however, don't operate according to such guarantees; they feed on the indeterminacy of outcomes. Louis Althusser and other Western Marxists spoke of the "state machine," a more amorphously distributed ideological mechanism that interpolated its subjects through their internalization of the time of capital. Platforms, however, have much more varied relationships to nonstate forms of authority and noncapitalist economies. As we'll see, their totality is always adjacent to other totalities. Michel Foucault located "governmentality" more directly as the immanent discourses, techniques, and architectures that constitute the objectivity of the modern subject.⁶ For Foucault, the state, as such, is only one site of governance among many others and by no means the most central for understanding economies of power. Platforms are similar in this regard. Equally important for Foucault were scientific laboratories, daily routines in prisons, hospital quarantine protocols, psychiatric textbooks, the design of dormitories according to particular lines of sight, the shape of a surgical device according to an invented idea of a standard body, "the angle between two walls and its happy ending."⁷ Here governance itself is articulated and configured through the specific technologies and techniques with which it produces its own subjects and objects. It may justify enforcement according to the content of laws, but for Foucault, that governance is itself just as much invented by those techniques as the things that it governs. It is an effect as much as it is a cause of how certain machines and mechanics organize bodies over time.

One of the most important ways it does this is by seeing them in particular ways, and we might say that governance in general evolves in relation to what it is technically possible for it to see at any historical moment. If new means for perception and surveillance are made available (to see new spaces, new scales, new traces, new crimes), then governance—and the state in particular—will conform itself to the vacuum opened up by new vision machines and to the demands of whatever is now available to observe and control. What James Scott calls "seeing like a state" is then not just a way to imagine the world as something demanding state governance through the intervention of reason and interference of planning; it is also the ultimate effect of how increasingly powerful technologies of perception, sensing, detection, parsing, and processing all react together to enforce design and retrain governance in their own images.⁸ States and nonstate actors of all types compete directly not only over the invention of vision machines that produce new spaces to claim (air space, electromagnetic spectrum, exabytes of mass-intercept data), but also dominion over those spaces on

they are mapped. The emergence of The Stack may represent this historical logic taken to an extreme new maturity. It is not the “state as a machine” (Weber) or the “state machine” (Althusser) or really even (only) the technologies of governance (Foucault) as much as it is *the machine as the state*. In an agglomeration of computing machines into platform systems not only reflects, manages, and enforces forms of sovereignty; it also generates them in the first place. Just as for Foucault's technologies, its mechanics are not representative of governance; they *are* governance. But unlike for Foucault's archaeology, its primary means and interests are not human discourse and human bodies but, rather, the calculation of all the world's information and of the world itself *as* information. We, the human while included in this mix, are not necessarily its essential agents, and our well-being is not its primary goal. After billions of years of evolution, complicated heaps of carbon-based molecules (that includes us) have figured out some ways to subcontract intelligence to complicated heaps of silicon-based molecules (that includes our computers). In the long run, this may be for the better—and may or may not.

2. An Accidental Megastructure

This accidental megastructure, this machine that is also a “state,” is not the result of some master plan, revolutionary event, or constitutional order. It is the accumulative residue of contradictions and oppositions that arose to address other more local problems of computing systems design. In the success and failure of those attempts, The Stack congeals, but do we know where and how? Contemporary geopolitics, and the largely confused commentary on it with which we muddle along, are knotted through and through. We see it in a politics of radial transparency aligned with another politics of radical privacy, in journalists’ self-congratulation at the use of social media in the Arab Spring as supposedly outlining an anterior stratum of crowds and power (absent in their coverage of the shock economies of Haiti, Pakistan, Nigeria, and Louisiana, for example), in how Wikipedia formalizes taxonomic consensus from a heteroglossia of interests and how WikiLeaks inverted the ocular and occult body of the state, or in how Google cloud services both circumvent and circumscribe state authority in China and in how much of China's direct perception of computational supply chains is invisible to Californian search engines. Both events and pseudoevents are plentiful and it's hard to know what signals a new situation and what is trivial: the Google Earth stand-off between Costa Rica and Nicaragua, Prism and [Data.Gov](#), hyperbolic packet-routing topologies, Dot-P2P and OpenDNS, net neutrality and the golden shield, downloadable guns 3D printed out of synthetic biopolymers paid for with Bitcoins, the National Security Agency (NSA) versus Unit 6139, NSA versus Anonymous versus Anonymous versus Syrian Electronic Army, NSA versus Syrian Electronic Army versus ISIL versus FSB (Federal Security Service of the Russian Federation) versus North Korea versus Samsung versus Apple versus European Parliament, and on and on. Which of these situations scales well into a general lesson and which actually obscures the critical junctures? What will be the long-term ramifications of the privatization of the common intellect by search and social network platforms on our ability to self-govern, or toward what form of governance do they already serve us up? The tangle of these questions is not exclusive to what is historically new. Emergent secular geographies (such as cloud computing, ubiquitous computing, emergent ethnoscapes, minoritarian psychogeographies of user-interfaces) may appear in the guise of archaic sacred geographies (such as Dar al-Islam, Christendom, Greater Judea) against which the domain of secular states was formulated. These compete with states not only for claims over legitimate violence, but also claims over legitimate citizenship and the capacity to delineate borders. Sometimes the emergent defines the archaic by opposition, and sometimes it is a

essential collaborator.

We describe this by a consolidation of cultural and technical systems, a realignment of institutions and discourses, and attempts to recognize and engineer their effects and accidents. That is, the design horizon for each layer of this Stack must be considered in terms of both what it accomplishes as an ideal technology and, perhaps more important, how its *undesigned accidents* characterize its real outcomes. For example, in the slippery redefinitions of citizenship and sovereignty in a cloud computing era, what referent of last resort can we rely on? Human rights? End-user agreements? Are we obligated to every service embedded in every software-enabled object or surface we might encounter? Is there a hierarchy of these? What if effective citizenship in a polity were granted not according to categorical juridical identity, but as a shifting status derived from any user's general relationship to the machinic systems that bind that polity to itself? In other words, if the interfaces of the city itself address everyone as a "user," then perhaps one's status as a user is what really counts. The right to address and be addressed by the polity would be understood as some shared and portable relationship to common infrastructure. Properly scaled and codified, this by itself would be a significant (if also accidental) accomplishment of ubiquitous computing. From this perhaps we see less the articulation of citizenship for any one city, enclosed behind its walls, but of a "citizen" (Is this even still the right word?) of the global aggregate urban condition, a "citizen-user" of the vast discontinuous city that striates Earth, built not only of buildings and roads but also of perplexing grids and dense, fast data archipelagos. Could this aggregate "city" wrapping the planet serve as the condition, the grounded legitimate referent, from which another, more plasmic, universal suffrage could be derived and designed? Could this composite city-machine, based on the terms of mobility and immobility, a public ethics of energy and electrons, and unforeseeable manifestations of data sovereignty (various parts looking like *chora*, *demos*, *agora*, *polis*, *dromos*, and *technics*) provide for some kind of ambient homeland? If so, for whom and for what? If it could, or if it already is in some way, then our regular categories and criteria are not describing it very well for us. This is perhaps because it is not planned but an accident of the process. Adding processing power to legacy models of political sovereignty first inflates them grotesquely and then, in time, as the generative infrastructure of another geography fills up different frames and replaces them with irregular new forms and formats, all those legacy models start to look Greek to us.

These "accidents" form the basis of many of our current geopolitical conflicts and conundrums. The first Sino-Google conflict of 2009, during which Google "pulled out" of the world's largest Internet market in response to demands for state monitoring and control of search results as well as the hacking of its servers by Chinese state-sponsored teams, may well be the opening crack in a new kind of war over who or what governs society in the first place. That war is less between two superpowers (or proxies for them) than between two irreconcilable logics of how polities and publics are conceived according to what sovereign spaces. One of these sees "the Internet" as an extension of the body of the state (or subservient to it) and another sees "the Internet" as a living, quasi-autonomous (if privately controlled and profited) transterritorial civil society that produces, defends, and demands rights on its own. For this, Google is a nonstate actor operating with the force of a state, but unlike modern states it is not defined by a single specific territorial contiguity. It is a US-headquartered corporation but also a transnational actor that has taken on many traditional functions of nation-states. While Google is as reliant on real physical infrastructure—its data centers are by no means virtual—that physicality is more dispersed and distributed than partitioned and circumscribed. But this opposition is not simply states versus markets, or West versus East. The implication is not another prophecy of the declining state withering away into the realm of pure network, but to the contrary: the state's ongoing redefinition is now undertaken in relation to network geographies that it can neither contain nor be contained by. From here, the practical geopolitical design issues only get more, not less, complex.

What, really, are to be the national rights of mobile subjects in a cloud-based society? Can you be bound to the data laws of your passport country no matter where you go? Or can your cloud platform follow you, and you follow it such that your platform constitutes your primary sovereign “territory” no matter where you go? Should it? Or should individual servers fly the flag of a certain state and disseminate data according to those laws, even if the server may be across the world? Or, instead, should the particular data laws of any one particular geographic site try to construct and contain the laws of flow on one particular spot, regardless of the sovereign origins of sender or receiver? The local mile trumps all? All of these options are counterintuitive, so what are the alternatives? What if the server farms are outside territorial waters altogether, like Google's patented offshore data centers, which for sensible energy-conservation reasons would also put the physical infrastructure of the global cloud outside regular territorial jurisdiction (discussed in more detail in the *Cloud* chapter). It is not my hypothesis that planetary computation will bring the accidental of alien political geography because it already has. The design problems require speculation but are not hypothetical. They demand that we engage a response that is as inventive as it is ineluctable.

The architecture of this model treats these overlapping layers, claims, and networks not as exceptions to the normal rule but as the basis of an emergent order. The Stack, as examined here, comprises six interdependent layers: *Earth, Cloud, City, Address, Interface, User*. Each is considered on its own terms and as a dependent layer within a larger architecture, and each is drafted from the superimposed image of the geographic and computational machines we now inhabit and the ones we might yet make. Each layer is understood as a unique technology capable of generating its own kind of integral accidents, which, perhaps counterintuitively, may ultimately bind that larger architecture into a more stable order. These layers are not just computational. As much as it is made from computational forms (multiplexed fiber-optic cables, data centers, databases, systems standards and protocols, urban-scale networks, embedded systems, universal addressing tables), The Stack is also composed of social, human, and concrete forces (energy sources, gestures, effects, self-interested maneuvers, dashboards, cities and streets, rooms and buildings, physical and virtual envelopes, empathies and enemies). These hard and soft systems intermingle and swap roles, some becoming relatively “harder” or “softer” according to seemingly arcane conditions.⁹ The Stack comes from both equilibrium and emergence, one oscillating into the other in undeciphered and unaccounted-for rhythms, stabilizing and destabilizing the same component for sometimes mismatched purposes. What is its state condition, and, literally for governance, what kind of machine that is a state does it provide for?

The scenario described in the chapters to follow, and appearing before us in the real world, can be summarized as one in which *Users*,¹⁰ human or nonhuman, are cohered in relation to *Interfaces*, which provide synthetic total images of the *Addressed* landscapes and networks of the whole, from the physical and virtual envelopes of the *City*, to the geographic archipelagos of the *Cloud* and the autophagic consumption of *Earth's* minerals, electrons, and climates that power all of the above. The most complex paths through these layers may displace well-established forms of human-machine infrastructure interaction, perhaps so well established that entire cities were designed to accommodate them. This may insert machine control at almost any point, amplifying or diverting human control over any machine in which the *User* happens to be installed, or even of the whole infrastructure landscape in which those machines swarm together. For example, the integrated design of driverless cars includes navigation interfaces, computationally intensive and environmentally aware rolling hardware, and street systems that can stage the network effects of hundreds of thousands speeding robots at once. The next stable form of the “automobile” (a description that will become perhaps more and more accurate) may be as a mobile *Cloud* platform inside of which *Users* navigate the *City* layer of a larger Stack according to augmented scenery *Interfacial* overlays and powered by grids

electrons as well as bits. Planetary-scale computation involves the whole *Earth* from which silicon, steel, and all manner of conflict minerals are drawn. Computation is not virtual; it is deeply physical event, and The Stack has an enormous appetite for molecules of interest and distributing them into our pockets, our laps, and our landfills. The chemistries and the terawatts that will feed The Stack, and the frictions through it, force us to reckon that the ponderous heaviness of *Cloud* computing will be a key driver of geopolitical frictions to come. We are taking a high-stakes risk with the development of smart grids and the energy appetites per terminus they will enable. Will the platform efficiencies of The Stack provide the lightness necessary for a new subtractive modernity, an engine of a sustainable counterindustrialization, or will its appetite finally suck everything into its collapsing cores of data centers buried under mountains: the last race, the climate itself the last enemy?

In the figure of The Stack, we see not one totality but the production of multiple and incongruous totalities, some of which are “interfacial regimes,” some are superimposed landscapes of *Addressed* and others are interwoven *Cloud* and state geometries. These geometries both draw and draw on the vertical platform of The Stack, and in doing so may also displace existing geographies with several alternatives at once. Perhaps these culminate in the apotheosis of Anthropocenic industrialism and perhaps they provide larval scripts for a post-Anthropocenic alternative, or both, or perhaps something much less decisive and dramatic. Our sights are not trained on how The Stack might hasten the messianic arrival of some seamless full-spectrum computational end of history, but how its gnashing and grating juxtapositions generate peculiar new spaces, normal enclaves, and how those exceptions are instructive as ways of deliberately reorganizing the world. Put differently, treatments of each of these six layers work with a particular caveat, that is Paul Virilio's axiom that the invention of a new kind of technology is also simultaneously the invention of a new kind of accident.¹¹ This holds true for the emergence of planetary computation and its Stack, as much as it does for the forging of aluminum and airplane crashes, set theory and stock market crashes, and incandescent light bulbs and climate change. Each individual layer promises its own range of possible accidents as it abuts its neighbors, and in some way each of the six layers is presented as a technology *for* accidents. Each is described in terms of both how it resolves the emergent accidental megastructure of The Stack in one and how the essential accident of each layer, and of the combined whole, points toward very different kinds of geosocial relations and geopolitical systems, perhaps especially those determined not by today's technology but by whatever technological regime will come after planetary-scale computation.

3. Blur and Accident

We start with questions that are as slippery as what they interrogate. In an age of planetary-scale computation, what is “sovereignty” and what is the future political geography, especially as the former is separated from the latter? How would the answers influence how we draw and divide up what and what goes where, and what shape the maps are that could do this? When geography becomes geolocation, who or what truly occupies any given place? Its owner, its user, the platform that makes it useful to either? Again, how is one person governed when platforms of governance see her as a *User* at a particular layer of a whole more than as a formal citizen? What freedoms of movement and freedoms from movement can she claim? What constitutes a constitution when the terms of engagement with other publics, near and far, both human and nonhuman, are codified into visual *interfaces*—images that are also tools? How can these platforms be redesigned to organize alternative economics, geopolitics, ecologies, philosophies, and even models of historical time? As it

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