Journal of Literature and Science
Volume 10, No. 2 (2017)
ISSN 1754-646X
Otter, "Encapsulation: Inner Worlds and their Discontents": 55-66

Encapsulation: Inner Worlds and their Discontents[1]

Chris Otter

In 1896, the Portuguese writer Joaquim Oliveira Martins reflected on a fogbound stay in an English country house. The English "gather themselves up within themselves," he noted, "they contract themselves, they roll themselves up like snails in their shells" (76). Their "civilization," he continued, "consist[s] in" an "artificial structure," involving "kitchens like laboratories," "cupboards full of boots of different kinds for each moment of existence," and "sticks for every kind of walk" (76). Like contemporaneous fictional characters such as Verne's Captain Nemo and Huysmans's Des Esseintes, these individuals seemed to have withdrawn into encapsulated, cluttered worlds. Walter Benjamin would later elaborate on private shells, in which one "secluded oneself within a spider's web" (216). "From this cavern," he concluded, "one does not like to stir" (216). Peter Sloterdijk has recently argued that "on the threshold of advanced civilization . . . the artificial, sealed inner world can, under certain circumstances, become the only possible environment for its inhabitants" (*Globes* 237).

This retreat into capsules has had significant technological, sociological, ecological and phenomenological consequences. Capsules have become the ubiquitous life-space for billions of humans in the developed and developing world. Human living-space has become a giant apparatus within which encapsulated beings are fed, watered, mobilized, entertained, and maintained in states of historically-unprecedented bodily comfort. This apparatus is often called the technosphere (Haff; Zalasiewicz et al., "Scale and Diversity"). Conceptually grasping the technosphere necessitates the adoption of a multi-scalar analytical framework which operates at several spatial levels from the intimate worlds of humans to the unfolding planetary wreckage wrought by mass encapsulated existence. It also requires the analytic capacity to shift back and forth between scales and to appreciate the material effects of scale in complex systems (Coen, West).

In this essay, I outline a fivefold scalar structure: *equipment*, *capsules*, *networks*, *anthromes* and *anthropogenic sinks*. This essay predominantly focuses on the second scale: capsules. It argues that multidisciplinary analysis is essential to bring out the historical, material, cultural and existential complexity of the process of encapsulation. Brief as it is, the analysis draws on literature, history and philosophy as well as evolutionary biology, geology, environmental science and cognitive archaeology. The essay begins with a historical account of capsules and their climates, before sketching the larger scales of the technosphere: networks, anthromes, and anthropogenic sinks. It then provides an account of the material transition unfolding alongside the development of encapsulation, and concludes by situating these various phenomena within a deep historical and evolutionary context.

Capsules

Humans are becoming indoor creatures. Northern European studies suggest that people spend over ninety percent of their time inside (Duarte-Davidson et al. 7). As Michelle Murphy argues, "you are inside most of the time. Inside at work, at home, at the mall, even when you are on the move inside a car, bus, or plane. The inside, brought about by the built environments of late capitalism, provides your habitat, the milieu for your embodiment" (151). Even controlled outdoor interludes, like school recess, appear to be waning, at least in the United States. A 2009 survey showed that around 30 percent of American 8 and 9 year-olds have no recess, or at least seriously restricted playground time (Cox 67). In urban settings, the "outside" is often depicted as a fearfully open space, suffused with exhaust fumes and traversed by threatening strangers (Monbiot 167). Enclosure allows safe monitoring, controlled interaction, regulation, and various forms of oversight, inspection or surveillance.

Encapsulation took, and continues to take, two basic social forms: familial or domestic and extra-familial or public. The basic unit of domestic encapsulation is the house, whose long, deep history is integral to the history of human beings and the technosphere (Allen, Moore). One critical phenomenon of the relatively recent past is the process of physical reconstruction whereby the home became a much more materially private, insulated world, something seen in Western housing from at least the mid-nineteenth century (Daunton 215, Marcus 138-139). The house was itself internally differentiated into multiple subcapsular spaces for various functions, a process beginning in the nineteenth century and gathering pace after 1918. Public encapsulation involves a more eclectic range of structures, or "collectors," in which larger groups of humans are assembled, from the Crystal Palace and early Olympic stadia to today's chaotic landscape of offices, astrodomes, shopping malls and entertainment complexes (Sloterdijk, *Foams* 584). The world's first enclosed shopping mall, Southdale Shopping Centre in Minnesota, completed in 1956, was designed to replicate a European high street under controlled, indoor conditions. Such spatial differentiation exploded across the workplace, from factories to offices. Cubicular office spaces – *Generation X*'s "veal fattening pens" – partition larger enclosed spaces into cellular, synthetic cubes (Copeland 19-20).

Philosophers, anthropologists, architects and urbanists have followed Benjamin and used capsular living as the basis for theoretical reflection on the psychosocial relationship between physical space and human being. For Marc Augé, the world of car parks, airport lounges and hotels forms an endless, comfortable, monotonous sequence of non-places: "frequentation of non-places today provides an experience – without real historical precedent – of solitary individuality combined with non-human mediation (all it takes is a notice or a screen) between the individual and the public authority" (Augé 117-118). Keller Easterling uses the term zones to refer to such modular accumulations, whose forms can be reassembled, in limitless permutations, across the globe: "the zone offers a clean, relaxed, air-conditioned, infrastructure-rich urbanism that is more familiar to the world than the context of its host country. . . . not yet a site of intensified urbanity, the zone is often a place of secrets, hyper-control, and segregation" (Easterling 67). For Sloterdijk, we inhabit a world of monadological foams, "an aggregate of microspheres (couples, households, businesses, associations) of different formats that, like the individual bubbles in a mountain of foam, border on one another and are layered over and under one another, yet without truly being accessible or effectively separable from one another" (*Foams* 56). Foam-worlds are stacked with capsules, honeycombed, air-conditioned, centreless, and oligoptic: they form an "anthropogenic island" gradually distending across the earth's surface (Sloterdijk *Foams* 334).

Within technospheric zones, human being becomes increasingly oriented towards devices, or equipment. Such equipment (clocks, ovens, refrigerators, computers) allows humans to become what the American sociologist William Catton called "prosthetic animals," with technologies functioning as "detachable parts of *extended* human beings" (147). Human capacity has become modified and extended via individualized portfolios of equipment. Within their spatially-circumscribed worlds, humans cooked, bathed, slept, cleaned, wrote, fixed things and developed a limitless number of pastimes, hobbies or interests. Physically close to others, yet spatially partitioned from them, humans oriented themselves towards their close family, themselves, or, increasingly, objects. Firmer physical boundaries between inside and outside, and increasing subdivision of the inside itself, could then encourage and shape particular patterns of social interaction. The British interwar semi-detached house, for example, delimited and minimized intimate communication with outsiders while maintaining social norms of courtesy and propriety (Scott 195). The inner world of the house increasingly became a type of "refuge from the non-place," a capsular milieu for affective, meaningful relationships (Moran 2004, 608). An immense number of subcultures thrive within encapsulated, device-oriented worlds, including myriad practices of collecting, model-making, game-playing and outdoor pursuits undertaken with particular technological prostheses (parachutes, skis, rackets, trowels, crampons, apiaries). Digital interconnection has only further intensified and differentiated this process, allowing the virtual aggregation of spatially distant collectors, enthusiasts, monomaniacs and hobbyists.

Animals did not escape this rage for encapsulation and enfolding. Early forms of enclosing included the construction of walls and fences, which allowed the command of agricultural resources, and made property claims easier to establish and enforce. A particularly important innovation was barbed wire, which allowed the silent control of disorderly livestock across large tracts of agrarian space (Netz). Livestock, meanwhile, were gradually moved into rudimentary capsules, where they could be closely monitored and their growth controlled. Purpose-built bullock sheds grew greatly in number from 1840 (Holderness 160). This phenomenon accelerated after 1950, particularly for pigs and chickens, culminating in vast chicken plants, battery farms and "pig penthouses," which housed, fed and processed animals experiencing accelerated, telescoped existence ("Farmers" 290). By the 1970s, "the totally-enclosed piggery where the environment was under complete control" was common, with rigorous control of insulation, ventilation and lighting (Sainsbury 139). Sows inhabited cramped cubicles or farrowing crates: porcine life developed in an artificialized world of cement, asbestos, plastic, foam insulation and corrugated steel. By 2000, the earth supported around 620 million tonnes of live domesticated zoomass, ten times that of wild terrestrial animals, most of whom inhabited capsules (Smil, "Eating Meat" 618).

The process of encapsulation extends to nonliving entities. During the twentieth century, commodities were increasingly transported and sold inside containers, cans, packets, cartons and boxes. The first container ship, *Gateway City*, sailed from Newark to Houston in 1957 (Rees 87; Smil *Transforming the Twentieth Century* 222). During the Vietnam War, over 100,000 containers were used for military supplies (ibid. 223). Containers became the basic capsular form through which commodities move around the globe, their movements orchestrated by remote tracking and tracing systems (ibid. 198). The folding carton was developed between 1850 and 1870 (Twede 246). Cartons were essential to the development of the breakfast cereal industry (Twede 248). Such object-capsules enabled the delicate control of microspaces: they formed commodity envelopes. Containers' temperature, humidity, gas levels and ventilation are all controllable (Rees 88). Cartons, sachets and wrappers increasingly create specific milieux and insulated atmospheres. Tupperware and Saran wrap provide airtightness; Tyvek, which cloaks housing during construction, is easy to cut yet very strong, and allows water vapour to escape while preventing the ingress of water (Fenichell 233, 237; Smil *Making the Modern World* 41).

Controlled Climates

Tyvek, like battery farms and shopping malls, creates the physical conditions of possibility of a controlled climate, designed to sustain, enhance and channel the material, biological and social development of the entities contained within. Encapsulation, in other words, generates innumerable climate bubbles proliferating across the earth. In his futurist work *1999: Our Hopeful Future* (1956), Victor Cohn rhapsodized about domestic envelopes with exquisite levels of microenvironmental control. Emily Future, for example, possesses a climate-controlled "garden bubble," with easily-adjustable air freshness (35). Cohn was inspired by the contemporaneous work of Buckminster Fuller and novel materials like fibreglass (40-41). "Before long, houses (and other structures) may be built out of low-cost, light-weight plastic bricks – square balloons really, hollow inside and inflated with air," he predicted (42). Encapsulation aspires towards "concrete atmotechnics" in which everything – humidity, temperature, dust, smell, sound and light – is meticulously regulated (Sloterdijk, *Foams*, 165).

"Concrete atmotechnics" remained an aspiration in 1881, when Glasgow's Medical Officer of Health, James Burn Russell, in a lecture on "The House," asserted that the basic physical aim of housing was "to provide for ourselves a special climate…shutting off a space around our bodies" of optimum temperature and atmospheric purity (157). The following century saw such desires realized, first in public buildings and later in housing, via the critical technologies of heating and, particularly, air-conditioning. In 1901, Alfred Wolff's New York Stock Exchange system used three 100-ton ammonia absorption chillers, which controlled both humidity and temperature. The waste water was collected in roof cisterns and utilized to flush toilets (Donaldson and Nagengast 271, 274). Wolff predicted controlled atmotechnics and "a new era in the comforts of habitation" (cited in Donaldson and Nagengast 275). He utilized three key elements of modern air conditioning: humidity control, temperature control, and filtering (Donaldson and Nagengast 276). In the first half of the twentieth century, air-conditioning systems were installed in department stores and transportation systems. The first reliable and vaguely affordable household system was marketed by Frigidaire in 1929. Domestic air-conditioning was thus practical by 1930 (Donaldson and Nagengast 301). By 1961, over 1 million American homes had centrally-installed air conditioning, while 4 to 5 million more had window conditioners (Thévenot 360).

Air-conditioning has spread into capsular spaces across the technosphere. Between 1997 and 2007, the number of Chinese households with air-conditioning units tripled, with annual numbers sold reaching 20 million (Cox 44). The amount of energy required to air-condition encapsulated space is enormous: in Mumbai, around 40% of the city's electricity is used to run air-conditioning (Cox 141). Over 150 billion square meters of the planet are now covered in air-conditioned structures (Zalasiewicz et al., "Scale and Diversity" 17). The relationship between climate change and pollution on the one hand, and air-conditioning on the other, produces a form of positive feedback, resulting in the creation and maintenance of globally-homogeneous, air-conditioned private environments, particularly in wealthy enclaves like Dubai (Cox 143). One Kuwait City architect was recently quoted saying that "it's almost as if the outdoors doesn't exist . . . that's the mindset of people here"" ("Hottest City"). This process seems to produce people less capable of tolerating cold and adjusting body heat according to conditions. Fishermen and farmers, for example, generally complain less about heat and cold than those living at constant temperatures (Pond 240).

The aim of climate control, of concrete atmotechnics, was not to replicate the atmospheric and perceptual environment of the outside world. Instead, the aim was to modify, improve, calibrate and control every molecular, thermodynamic and sensory aspect of the gaseous inner envelope: heat, humidity, sound, smell, light. This can be seen in multiple milieux, including factories, hospitals, warehouses, cold-stores and commercial kitchens: "it is not sufficient for the premises to be generally light. There should be no gloomy corners or passages to collect unseen dirt. In most establishments, therefore, artificial lighting will be required to supplement natural lighting even during the daytime, but careful planning will reduce the expense of this to a minimum" (Ministry of Health 15).

Optimized climate bubbles, however, formed a major axis of contention about the impact of inhabiting a technosphere increasingly at odds with a putatively natural, unencapsulated outside. Crusaders for the outdoor life fulminated about the seemingly inexorable march of encapsulation, often recommending sleeping outside or opening windows to avoid the atmospheric perils of physical disconnection from the earth's atmosphere (Kellermann 254-255). Indoor climate control perpetually failed to secure a perfect "special climate," instead being silently permeated by imperceptible streams of dangerous compounds and pollutants, including byproducts of combustion (nitrous oxide, carbon monoxide), tobacco smoke, formaldehyde, acetone, asbestos and radon (Spengler and Sexton, 10-13). Additionally, indoor climates foster an array of microorganisms and allergens from pets, insects and disinfectants (Spengler and Sexton, 12). Unwanted life – bedbugs, body lice, SARS, *Legionella pneumophila* – emerges, evolves, and thrives in strange capsular niches: comfortable folds of clothing, hypercontrolled hospital spaces, cooling towers, evaporative condensers, and hot tubs.

In-Betweens and Outsides

Climate engineering, then, aspires to create spaces which are atmospherically sealed from a dirty, noisy, turbulent outside. This disconnection is, however, phenomenological rather than technological or material. The giant capsular islands are threaded to their outsides in three distinct material ways. First, urban and exurban agglomerations are linked together by infrastructural networks. Second, anthromically-reconfigured territory – farms, forests and so forth – provide the raw materials for encapsulated life. Third, wider geospheric and biospheric envelopes function as distant repositories, or anthropogenic sinks, into which human waste drifts, dissipates, percolates, settles, accumulates, and returns to haunt humans in the form of pollution (Mitman, Murphy and Sellers 2004). These are the three larger scales of the technosphere: networks, anthromes, anthropogenic planetary sinks. The outside may be less thoroughly artificialized than capsules themselves, but its naturalness has become increasingly rhetorical, symbolic or relative.

Immense systems of infrastructure provide the energy, water, food, commodities and information necessary for encapsulated life. There is insufficient space here to develop this argument in any detail, but three points will suffice. First, transportation technologies, a key infrastructural network, became increasingly encapsulated. Le Corbusier's cellular architecture, for example, was inspired by inhabiting a fifteen square-metre room on a liner from Europe to South America (Klose 264). The same phenomena was apparent with train compartments, and is evident with motorization, where early open vehicles were soon englobed with roofs and windshields, producing mobile, insulated, modularized and ultimately climate-controlled cocoons (Mom 373-374). The space-station becomes the definitive capsule. Second, the development of key electronic technologies, notably transformers, transistors, and microchips, facilitated the development of electricity grids and high-speed information networks which have allowed physically-distant capsules to become informationally proximate. Networks have thus contributed to hyper-sedentariness, machinic interaction, domestic non-placelessness, and digital sociality, producing what Jonathan Crary has called "states of neutralization and inactivation" (88). Third, the particular topologies of multiple infrastructures embed and reinforce tremendous asymmetries of access and agency, particularly through the creation of enclaves and premium network spaces (Graham and Marvin 2001).

Encapsulated life and its equipment required water, food and energy to be permanently and immediately available and seemingly perpetually abundant. Such material resources necessitated "ghost acreage," the distant tracts of farmland, mines, and forests, the products of which insouciant capsule-dwellers devoured through their daily rituals of equipment use (Catton 123). Such areas remain part of the technosphere despite their nonurban nature. Fences and barbed wire demarcate land, trees are organized into planned forests, while soil itself becomes so reworked as to become anthropogenic, like Northwest Europe's plaggen soils or the *terra prata* of the Amazon basin: "the structure of European soils…is artificial," wrote Edward Hyams in *Soil and Civilization* (1976), adding that it was "as much a work of man as *Hamlet*, or Durham Cathedral, or the Rockefeller Centre" (86). Consequently, enormous swathes of agrarian landscape "may also be placed in the functional technosphere" (Zalasiewicz et al. "Scale and Diversity" 15). Here we see the reworking of planetary biomes into *anthromes*: landscapes transformed by humans and their technological and economic systems, from forests to croplands to cities. Eighteen anthromes have been identified, including the urban anthrome (500,000 square miles), the irrigated cropland anthrome (a million square miles), and the populated forest anthrome (4.5 million square miles): collectively, they cover thirty-nine million square miles (Kolbert 176), most of which is non-urban, with a scattered sprinkling, rather than dense agglomeration, of capsules.

The technosphere, however, extends, in more diffuse form, beyond anthromic forest-field systems, through its dispersal of waste and pollution into wider anthropogenic sinks. Such detritus leaks out of capsular complexes, infrastructures and anthromes into truly global envelopes. First, it leaches into and accumulates within oceans, already modified by artificial islands, reconfigured coastlines and oil rigs. The seafloor is, in many places, heavily bottom-trawled, making it "the submarine equivalent of terrestrial agricultural soils" (Zalasiewicz et al. "Scale and Diversity" 16). Sunken freighters and oil tankers are "mastodons of the industrial age" (Harris 32). Second, human waste permeates the earth's atmosphere, already traversed by waves, satellites and spacestations, in the form of pollution, gaseous emissions and fragments of broken technology. Billions of pieces of human debris are in now constantly orbiting the earth (Gärdebo, Marzecova and Knowles 46).

Materials

Much of this detritus is historically-novel. Although traditional materials (bricks, wood, iron) continue to be used in vast quantities, the technosphere is also composed of the new materials of the second industrial revolution (steel, plastics, reinforced concrete). Steel production skyrocketed in the twentieth century following the development of open hearth and electric arc furnaces. Light metals have become indispensable, with Rosin and Eastman's cornucopian tract *The Road to Abundance* (1953) celebrating the transition to "the Age of the Light Metals, or the "Magal Age" (magnesium-aluminum) as it is sometimes called" (84). The demand for aluminium soared after 1950, with uses ranging from cars to space vehicles (Smil, *Transforming the Twentieth Century* 121).

Equally significant was the rising utilization of metalloids, particularly silicon, and concrete, which is "by far the most important manmade material in terms of global annual production and cumulatively emplaced mass:" some have even suggested designating it an "anthropic" rock (Smil, *Making the Modern World* 55). Our landscape is covered with concrete, which is often reinforced, (dams, roads, bridges, car parks, tower blocks, pipes), but it is not a particularly durable substance and we face a future of serious concrete deterioration (Smil, *Making the Modern World*, 56).

An enormous variety of plastics have been created, the most important of which are polyethylene, polypropylene and PVC (Smil, *Making the Modern World* 62). The phenomenon of plasticity has allowed the deliberate creation of many specific material properties designed for particular functions: low density, resistance to mold, durability, cheapness, ductility, and thermal resistance, for example. Plastics have become the ubiquitous capsules, cloaks and conduits of encapsulated, networked life: bags, films, wrappers, sheets, foils, bottles, pipes. They marked the triumph of synthetic chemistry: "nowadays it is possible to make a complete suit of clothes, from hat to shoes, of any desirable texture, form and color, and not include any substance to be found in nature" (Slosson 5). Nylon, for example, was lauded as an almost magically artificial substance: the *New York Times* boasted that it "has no chemical counterpart in nature" (cited in Fenichell 150). We should also note how increasingly materially variegated consumer items have become: in 1980, information technology needed eleven elements, but by 2000 this figure was sixty, making recent technology reliant upon small amounts of rare elements, and hence threaded to many dispersed and distant anthromic mining zones (Baccini and Brunner 55).

The result has been a vast, if nationally and economically variable, rise in material consumption levels and physical throughputs of packaged, disposable commodities: plastic bottles, paper handkerchiefs and cartons, and, increasingly, devices whose obsolescence was planned. The combination of synthetic materials, accumulation of equipment, disposability and planned obsolescence has accelerated the movement of waste synthetic products flowing back into landfills and dumps, and earth's terrestrial, aquatic, and atmospheric sinks. The phenomenon of litter, an accumulation of wrappers and packets, is a localized example of this process. Less initially perceptible was the accretion of microplastics across the geosphere and biosphere. Fragments of plastic whose densities exceed 1gm/cm^3 sink in seawater, and are eventually deposited after indeterminate subsurface peregrinations (Zalasiewicz et al. "Geological Cycle of Plastics" 6, 8). Machine-washed synthetic fabrics – our body-wrappings of choice – generate large quantities of microplastics which, following leisurely movement via sewage sludge, arrives in rivers and seas to provide "a near-ubiquitous signature of the Anthropocene in coastal settings" (Zalasiewicz et al., "Geological Cycle of Plastics" 7). Most fragments collected from marine water come from polyethylene and polypropylene; such debris, colonized by microbes, has been called the "Plastisphere" (Zalasiewicz et al., "Geological Cycle of Plastics" 7). Many other forms of waste form planetary risks, including small particulate matter in the atmosphere and manifold forms of dangerous waste, from radioactive materials to the tumuli of discarded and hazardous electronic equipment accumulating across the developing world.

Evolutionary and Ontological Reflections

The study of encapsulation, and the technosphere more generally, is an excellent way to do the ScienceHumanities: a genuinely pluralistic research endeavour involving many disciplines, none of which are given epistemological priority. The fivefold structure of the technosphere, for example, invites wider speculation on deeper human history, which in turn necessitates truly multidisciplinary work combining the sciences and the humanities. It is now widely acknowledged that traditional evolutionary theory failed to pay sufficient attention to the phenomenon of niche construction. All life-forms modify their surroundings in some way, sometimes actively, sometimes reactively, sometimes by perturbing local environments, and sometimes by relocating to new ones (Odling-Smee et al. 47). Some creatures clearly construct extraordinarily elaborate niches. Termites build air-conditioning systems with ducts, chimneys and other structures, without which their colonies would perish (Odling-Smee et al. 92). Niche construction theorists argue that modified environments, in addition to genes, provide pathways of inheritance by modifying selection pressures and providing an ecological or territorial legacy for future generations (Odling-Smee et al. 13, 68, 377). Evolutionary models thus require feedback loops complicating notions of pure genetic inheritance. Artifacts like wasps' nests or beavers' dams are not exactly geological entities. Odling-Smee et al. argue that the artifactual is sufficiently ontologically consequential to merit its own ontological category between the biotic and the geological. Instead, they propose a threefold model: biotic-abiotic-artifactual. The artifactual, by creating ordered niches for organisms, generates disorder elsewhere in the environment and thus has entropic tendencies (Odling-Smee et al. 191). The basic point here is that the technosphere is the largest physical artifact built by a single species. It is not a geological phenomenon, but an artifactual one. It is a "superconstruction" erupting from and between the biosphere and the geosphere, whose morphology, scale and materiality are entirely unlike anything previously created on earth (Odling-Smee et al. 335). The scale of the technosphere envelops and reorders the niches of countless other forms of planetary life, which have been domesticated, translocated, modified and extinguished during recent millennia (Boivin et al. 6389).

However, the implication here – that humans created the technosphere – itself overlooks the feedback at the heart of niche construction theory. It is more appropriate to regard *homo sapiens* and its planet-spanning superconstruction as co-evolutionary products. As Lambros Malefouris notes in his explication of material engagement theory, early humans did not simply visualize tools and then go about inventing or materializing them. Instead, tools – or equipment – were the "enactive cognitive prostheses" through which humans underwent forms of cognitive evolution (154). By making sequences of clay objects, for example, they created "a new numerical "habitus"," a material, embodied field within which number could be grasped (116). Tool-use, the control of fire, cognitive evolution and the technosphere all have a common if non-singular origin around 2.6 million years ago (Williams et al., 15). Human-technospheric co-evolution is a "change in the entire spectrum of available developmental resources, and in the many causal pathways by which resources come to be deployed in development" (Malefouris 40). The technosphere has a deep, rich history reaching back into the Pleistocene.

Conclusion

In *The Biosphere* (1926), Vladmir Vernadsky described a complex, layered series of envelopes within which the films of life formed, distended and thrived, such as the thermodynamic, the chemical, and the paragenetic (101). Long before Sloterdijk, he elaborated a complex theory of planetary spheres. The biosphere was, however, juxtaposed solely with the geosphere. Although Vernadsky acknowledged that humans were "a new phenomenon in geological history," the massive, artifactual technosphere remained conceptually invisible (143). Its visibility was perhaps more evident to those, like Verne and Benjamin, whose focus was on the microworlds of novel technologies and urban spaces. The technosphere, it might be suggested, was articulated first in literature (particularly science fiction) and philosophy, and only later conceptualized and named in more scientific disciplines.

The Great Acceleration has made the technosphere stunningly and inescapably palpable (McNeill 2014). The structure elaborated here renders the technosphere conceptually tangible at five increasing scales, from keys, pens and computers to the changing climate and the plastic ocean. At each scale, a corresponding series of unintended consequences, problematics and disasters are unfolding. Climate change is often portrayed as the ultimate anthropogenic-technospheric calamity. Indeed, we read and worry about it, and sometimes deny it, from within our comfortable capsules, not least because of the huge infrastructures producing climate information (Edwards). But encapsulation brings in its wake another set of issues: a diffuse tangle of emergent physiological, psychological and sociological problems, from allergies and metabolic disorders to anomie and autism. Since such problems cannot be neatly viewed as cultural or biological, they require a similar tangle of disciplines to comprehend and, perhaps, treat. The emergent field of neurohistory is instructive here (Smail). Capsular life is a place of almost pathological immobility, comfort and cleanliness (Lieberman 349). Scarcely-perceptible shifts in comfort, tolerance, sensitivity, mood, empathy, immunity and interactivity are radically different in modality and scale to climate change. But they are equally side-effects of living inside our planet’s largest artifact.

Notes

1. I would like to thank Keir Waddington, James Castell, and Martin Willis for their enormously helpful, detailed, and perceptive comments on various early drafts of this article.

Works Cited

Allen, John. *Home: How Habitat Made Us Human*. Basic Books, 2015.

Augé, Marc. *Non-Places: Introduction to an Anthropology of Supermodernity*. Translated by John Howe. Verso, 1995.

Baccini, Peter, and Paul Brunner. *Metabolism of the Anthroposphere: Analysis, Evaluation, Design*, 2nd ed., MIT Press, 2012.

Benjamin, Walter. *The Arcades Project*. Translated by Howard Eiland and Kevin McLaughlin, Belknap, 1999.

Boivin, Nicole, et al. "Ecological Consequences of Human Niche Construction: Examining Long-Term Anthropogenic Shaping of Global Species Distribution." *PNAS*, vol. 113, no. 23, 7 June 2016, pp. 6388-96.

Catton, William. *Overshoot: The Ecological Basis of Revolutionary Change*. U of Illinois P, 1980.

Coen, Deborah. "Big is a Thing of the Past: Climate Change and Methodology in the History of Ideas." *Journal of the History of Ideas*, vol. 77 no. 2, April 2016, pp. 305-21.

Cohn, Victor. *1999: Our Hopeful Future*. Bobbs-Merrill, 1956.

Copeland, Douglas. *Generation X. Tales for an Accelerated Culture*. St. Martin's Press, 1991.

Cox, Stan. *Losing Our Cool: Uncomfortable Truths About Our Air-Conditioned World (and Finding New Ways to Get Through the Summer)*. New Press, 2010.

Crary, Jonathan. *24/7: Late Capitalism and the Ends of Sleep*. Verso, 2013.

Daunton, Martin. "Public Place and Private Space: The Victorian City and the Working-Class Household," *The Pursuit of Urban History*, edited by D. Fraser and A. Sutcliffe, Edward Arnold, 1983, pp. 212-33.

Donaldson, Barry, and Bernard Nagengast. *Heat and Cold: Mastering the Great Indoors: A Selective History of Heating, Ventilation, Air-conditioning and Refrigeration from the Ancients to the 1930s*. American Society of Heating, Refrigerating and Air-Conditioning Engineers, 1994.

Duarte-Davidson, R., et al. "Benzene in the Environment: An Assessment of the Potential Risks to the Health of the Population." *Occupational and Environmental Medicine*, vol. 58, no. 1, 2001, pp. 2-13.

Easterling, Keller. *Extrastatecraft: The Power of Infrastructure Space*. Verso, 2014.

Edwards, Paul. *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming*. MIT Press, 2010.

"Farmers Using Electricity to Operate 'Pig Penthouses', 'Baby St' with Cattle," *Edison Electric Institute Bulletin*, September 1968.

Fenichell, Stephen. *Plastic: The Making of a Synthetic Century*. HarperCollins, 1996.

Gärdebo, Johan, Agata Marzecova and Scott Knowles. "The Orbital Technosphere: The Provision of Meaning and Matter by Satellites." *Anthropocene Review*, vol. 4, no. 1, 2017, pp. 44-52.

Graham, S and Marvin, S. *Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Condition*. Routledge, 2001.

Haff, P. "Technology as a Geological Phenomenon: Implications for Human Well-Being." *Geological Society of London Special Publications*, vol. 395, 2014, pp. 301-309

Harris, Edward. *Principles of Archaeological Stratigraphy*. Academic P, 1979.

Holderness, B. "The Origins of High Farming." *Land, Labour and Agriculture, 1700-1920*, edited by B. Holderness and Michael Turner. Hambledon Press, 1991.

Hyams, Edward. *Soil and Civilization*. Harper, 1976.
Kellermann, Annette. *Physical Beauty: How to Keep It*. George H. Doran, 1918.
Klose, Alexander. *The Container Principle: How a Box Changes the Way We Think*. Translated by Charles Marcrum II, MIT Press, 2015.
Kolbert, Elizabeth. *The Sixth Extinction; An Unnatural History*. Holt, 2014.
Lieberman, Daniel. *The Story of the Human Body: Evolution, Health, and Disease*. Pantheon, 2013.
Malafouris, Lambros. *How Things Shape the Mind: A Theory of Material Engagement*. MIT Press, 2013.
Marcus, Sharon. *Apartment Stories: City and Home in Nineteenth-Century Paris and London*. U of California P, 1999.
McNeill, John. *The Great Acceleration: An Environmental History of the Anthropocene since 1945*. Belknap, 2014.
Ministry of Health. *Clean Catering: A Handbook on Premises, Equipment and Practices for the Promotion of Hygiene in Food Establishments*. Her Majesty's Stationery Office, 1963.
Mitman, Gregg, Michelle Murphy and Christopher Sellers. "Introduction: A Cloud over History." *Osiris*, 2nd series, vol. 19, *Landscapes of Exposure: Knowledge and Illness in Modern Environments*, 2004, pp. 1-17.
Mom, Gijs. *Atlantic Automobilism: Emergence and Persistence of the Car 1895-1940*. Berghahn, 2015.
Monbiot, George. *Feral: Rewilding the Land, the Sea, and Human Life*. Chicago UP, 2014.
Moore, Jerry. *The Prehistory of Home*. U of California P, 2012.
Moran, Joe. "Housing, Memory and Everyday Life in Contemporary Britain." *Cultural Studies*, vol. 18, no. 4, July 2004, pp. 607-27.
Murphy, Michelle. *Sick Building Syndrome and the Problem of Uncertainty: Environmental Politics, Technoscience, and Women Workers*. Duke UP, 2006.
Netz, Reviel. *Barbed Wire: An Ecology of Modernity*. Middletown. Wesleyan UP, 2009.
Odling-Smee, F., Kevin Laland and Marcus Feldman. *Niche Construction: The Neglected Process in Evolution*. Princeton UP, 2003.
Oliveira Martins, Joachim. *The England of To-Day*. Translated by C. Willdey. George Allen, 1896.
Pond, Caroline. *The Fats of Life*. Cambridge UP, 1998.
Rees, Jonathan. *Refrigeration Nation: A History of Ice, Appliances, and Enterprise in America.* Johns Hopkins UP, 2013.
Rosin, Jacob, and Max Eastman. *The Road to Abundance*. McGraw-Hill, 1953.
Russell, James. "The House." *Public Health Administration in Glasgow: A Memorial Volume of the Writings of James Burn Russell*, edited by A.K. Chalmers, James Maclehose, 1905.
Sainsbury, David. *Pig Housing*, 4th ed., Farming Press, 1976.
Scott, Peter. *The Making of the Modern British Home: The Suburban Semi and Family Life between the Wars*. Oxford UP, 2013.
Slosson, Edwin. *Creative Chemistry. Descriptive of Recent Achievements in the Chemical Industries*. The Century Company, 1920.
Sloterdijk, Peter. *Globes: Macrospherology*. Translated by Wieland Hoban, Semiotext(e), 2014.
---. *Foams: Plural Spherology*. Translated by Wieland Hoban, Semiotext(e), 2016.

Smail, Daniel. "Neurohistory in Action: Hoarding and the Human Past." *Isis*, vol. 105, no.1, 2014, pp. 110-22.

Smil, Vaclav. "Eating Meat: Evolution, Patterns, and Consequences." *Population and Development Review*, vol. 28, no. 4, December 2002, pp. 599-639.

Smil, Vaclav. *Making the Modern World: Materials and Dematerialization*. Wiley and Sons, 2014.

Smil, Vaclav. *Transforming the Twentieth Century: Technical Innovations and their Consequences*. Oxford UP, 2006.

Spengler, John, and Ken Sexton. "Indoor Air Pollution: A Public Health Perspective." *Science*, vol. 221, no. 4605, 1 July 1983, pp. 9-17.

Thévenot, Roger. *A History of Refrigeration throughout the World*. Translated by J. Fidler, International Institute of Refrigeration, 1979.

Twede, Diana. "The Birth of Modern Packaging: Cartons, Cans and Bottles." *Journal of Historical Research in Marketing*, vol. 4, no. 2, 2012, pp. 245-72.

Vernadsky, Vladimir. *The Biosphere*. Foreword by Lynn Margulis et al., introduction by Jacques Grinevald, translated by David Langmuir, revised and annotated by Mark McMenamin, Copernicus, 1998.

West, Geoffrey. *Scale: The Universal Laws of Life and Death in Organisms, Cities and Companies*. Weidenfeld and Nicholson, 2017.

"Where is the World's Hottest City." *Guardian*, 22 July 2015. www.theguardian.com/cities/2015/jul/22/where-world-hottest-city-kuwait-karachi-ahvaz. Accesssed 13 Dec. 2017.

Williams, Mark, et al. "The Anthropocene Biosphere." *Anthropocene Review*, vol. 2, no. 3, 2015, pp. 196-219.

Zalasiewicz, Jan, et al. "The Geological Cycle of Plastics and Their Use as a Stratigraphic Indicator of the Anthropocene." *Anthropocene*, vol. 13, 2016, pp. 4-17.

Zalasiewicz, Jan, et al. "Scale and Diversity of the Physical Technosphere: A Geological Perspective," *Anthropocene Review*, vol. 4, no. 1, 2017, pp. 9-22.

Zalasiewicz, Jan., Mark Williams, Colin Waters, Anthony Barnosky and Peter Haff, "The Technofossil Record of Humans." *Anthropocene Review*, vol. 1, no. 1, 2014, pp. 34-43.