



Anthropocene Fiction and World-Systems Analysis

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Abstract

*As developed by Immanuel Wallerstein and various co-thinkers, world-systems analysis is essentially an approach to economic history and historical sociology that has been largely indifferent to literary studies. This indifference is perhaps surprising given that the Annales school, which clearly influenced Wallerstein's work, produced a foundational account of the emergence of modern western literature in Lucien Febvre and Henri-Jean Martin's *L'apparition du livre* (1958). More recently, literary scholars have attempted to apply this kind of analysis directly to their own field. The best-known instances are probably Pascale Casanova's *La republique mondiale des lettres* (1999), Franco Moretti's *Distant Reading* (2013) and the Warwick Research Collective's *Combined and Uneven Development* (2015). More recently still, Andrew Milner in Australia and Jerry Määttä in Sweden have sought to apply "distant reading" more specifically to the genre of science fiction. Milner's model of the "global SF field" identifies an original Anglo-French core, supplemented by more recent American and Japanese cores, longstanding Russian, German, Polish and Czech semi-peripheries, an emergent Chinese semi-periphery, and a periphery comprising the rest of the world. This essay attempts to apply that model to what Adam Trexler has termed "Anthropocene fictions" and Daniel Bloom "cli-fi", which we treat here as a significant sub-genre of contemporary science fiction.*

Keywords: Climate fiction, climate change, world-systems



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In memory of Alan Swingewood (1938-2020)

As developed by Immanuel Wallerstein and various co-thinkers, world-systems analysis is essentially an approach to economic history and historical sociology largely indifferent to literary studies. Wallerstein's enduring concern has been with how historical capitalism has functioned as a world system, comprising a "core," "periphery," and "semi-periphery" defined in relation to three main variables: the degree of profitability, the degree of monopolization and the degree of state patronage. Core-like processes tend to constitute the bulk of production in comparatively few states, peripheral in a much larger number, semi-peripheral in an intermediate zone containing a near-even mix of core-like and peripheral production (Wallerstein 2004: 28). Historically, the core economies have included the Netherlands, Britain, France (and eventually Western and Central Europe more generally), the United States, and Japan; semi-peripheral economies Argentina, Brazil, Russia, India, Israel, China, South Korea, South Africa, Australia, and Canada; peripheral economies the remainders of Eastern Europe, the Middle East, Latin America, and sub-Saharan Africa. Wallerstein sees the world system as having its origins in the development of capitalist agriculture in Western Europe during the "long sixteenth century" 1450-1650, proceeding through the age of mercantilist consolidation 1600-1750 and an era of renewed expansion 1730-1850, into the creation of a "geoculture" of "centrist liberalism" during the period 1789-1914 (Wallerstein 1974-2011). The first four volumes of Wallerstein's *The Modern World-System* also chart the trajectory of Dutch and then British hegemony over the world-system, with projected fifth and sixth volumes intended to cover the period of US American hegemony during the twentieth and early twenty-first centuries. For Wallerstein himself, climate change is essentially incidental to the long-run accumulative dynamics of the world system. But Jason Moore, deploying a similar world-systems approach, has persuasively argued that these three successive "world hegemonies" can be understood as "socio-ecological projects;" the Dutch based on timber, the British on coal, and the American on oil (Moore 2015: 163). Like Wallerstein, Moore is comparatively uninterested in literary phenomena. We might surmise, however, that although specifically cultural aspects of the world-system might diverge slightly from the overall pattern of the economic world-system, perhaps in the direction of more greatly concentrated cores, there will nonetheless be very strong homologies between the economic and cultural systems.

World-Systems Analysis and Literary Studies

The indifference to literary studies in world-systems theory is perhaps surprising given that the *Annales* school, which clearly influenced Wallerstein's work, produced a foundational account of the economic infrastructure of modern western literature in Lucien Febvre and Henri-Jean Martin's *L'apparition du livre* (1958). More recently, however, some literary scholars have themselves attempted to apply this kind of socio-historical structural analysis directly to their own field. The best-known instances are probably Pascale Casanova's *La republique mondiale des lettres* (1999), Franco Moretti's *Distant Reading* (2013) and the Warwick Research Collective's *Combined and Uneven Development* (Deckard et al. 2015). Casanova's work is more obviously indebted to the

cultural sociology of Pierre Bourdieu than to world-systems theory, but Moretti's is self-confessedly inspired by Wallerstein.

World-systems theory first surfaced in Moretti as a way to understand how a relatively small number of exceptional works—Goethe's *Faust*, Melville's *Moby-Dick*, Wagner's *Der Ring des Nibelungen*, Joyce's *Ulysses*, Pound's *The Cantos*, Eliot's *The Waste Land*, Musil's *Der Mann ohne Eigenschaften*, García Márquez's *Cien años de soledad*—might belong to a single field he termed the “modern epic” (Moretti 1996: 1-2). He argued that, unlike their canonical equivalents in French or British literature, these were “all *world* texts, whose geographical frame of reference is no longer the nation-state, but a broader entity - a continent, or the world-system as a whole”. They were also each products of the system's semi-periphery, sites of “combined development,” where “historically non-homogeneous social and symbolic forms, often originating in quite disparate places, coexist in a confined space” (Moretti 1996: 50). Here the analysis is primarily textual, its purposes at times oddly reminiscent of more traditional variants of canonical literary studies. Nonetheless, this canon is relocated geographically and culturally away from the core and towards the periphery. In the *Atlas of the European Novel* the argument resurfaces, but now in quantitative and sociological guise, where Moretti's empirical indicators are the volume of translations recorded in the various national bibliographies. He describes the nineteenth-century literary economy as comprising “three Europes. With France and Britain always in the core; most other countries always in the periphery; and in between a variable group, that changes from case to case” (Moretti 1998: 174). French novelists were more successful in the catholic south, British in the protestant north, but the whole continent read Scott, Bulwer-Lytton and Dickens, Dumas, Sue and Hugo (Moretti 1998: 178-179). Moretti's *Atlas* thus becomes a map of how Franco-British cultural hegemony pre-empted the development of other literatures. This “most European of forms,” he writes, “proceeds to deprive most of Europe of all creative autonomy: two cities, London and Paris, rule the entire continent for over a century, publishing half (if not more) of all European novels” (Moretti 1998: 186). But, whereas the British clearly triumphed in Wallerstein's account of Franco-British economic rivalry, Moretti shows that, in the specific case of the world literary system, the “long and bitter rivalry between the continent's two narrative superpowers” was eventually won by France, “making Paris...the Hollywood of the nineteenth century” (Moretti, 1998: 184). By the mid-nineteenth century translations of French novels into Italian outnumbered British by a ratio of eight to one, whilst those into Danish were running roughly even. But Moretti also stresses the simultaneously disabling and enabling consequences of peripheral cultural location. Citing Roberto Schwarz on Brazil, he observes that “peripheral” literatures can in fact be “sustained” by “historical backwardness”. And, if this occurs, “the horizon does indeed open up...The outcome of a new geographical space, these forms then produce *a new fictional space*...A new space that gives rise to a new form—gives rise to a new space. Literary geography” (Moretti 1998: 195-197).

More recently, Moretti has expanded on these analyses to advance an ambitious map of how comparative literature might be refigured as a discipline. He argues that the study of *Weltliteratur* can no longer be conceived simply as national literature writ large—“literature, bigger,”—but must

rather be reorganised around entirely different categories and conceptual problems. It “is not an object,” he continues, “it’s a *problem*, and a problem that asks for a new critical method: and no one has ever found a method by just reading more texts” (Moretti 2013: 46). The model he proposes, again adapted from Wallerstein, is that of a “world literary system,” simultaneously “*one*, and *unequal*: with a core, and a periphery (and a semi-periphery) bound together in a relationship of growing inequality” (Moretti 2013: 46). If this is how the system itself functions, then the appropriate mode of analysis will become “distant reading,” where distance “*is a condition of knowledge*,” permitting the analyst “to focus on units...much smaller or much larger than the text: devices, themes, tropes—or genres and systems” (Moretti 2013: 48-49). This combination of distant reading and world literature allows him to treat the history of the modern novel as a “system of variations,” in which pressure from the Franco-British core tended towards uniformity, but variable local realities in the periphery and semi-periphery tended towards difference (Moretti 2013:56). The result is a series of localized structural “compromises” between foreign plot, local characters and local narrative voice, in which the “one-and-unequal literary system” becomes embedded in the form itself (Moretti 2013: 58-59). Moretti offers this analysis as an example, rather than a model, of how comparative literature might proceed; but clearly believes in the wider applicability of sociological analyses of this kind. Hence, the concluding insistence that literary comparatists

have always been too shy in the presence of national literatures, too diplomatic...you become a comparatist for a very simple reason: *because you are convinced that...viewpoint is better*...“Don’t delude yourself”, writes Stendhal of his favourite character: “for you, there is no middle road.” The same is true for us (Moretti 2013: 61-62).

The Warwick Research Collective has astutely observed that Moretti’s understanding of the world literary system echoes, not only Wallerstein, but also Leon Trotsky’s notion of capitalist development as a process of “combined and uneven development” necessarily entailing the combination of archaic and contemporary forms. This, they argue, is “a central—perhaps *the* central—arc or trajectory of modern(ist) production in literature” (Deckard et al. 2015: 6). Hence, their title, but also their insistence that “world literature” is “*the literature of the world-system* – of the modern capitalist world-system” (Deckard et al. 2015: 8). Capitalism, they continue, is “the substrate of world-literature” and “modernity is both what world-literature indexes or is ‘about’ and what gives world-literature its distinguishing formal characteristics” (Deckard et al. 2015: 15). Whilst Wallerstein and Moore trace the origins of the modern world-system back to the sixteenth century, Moretti and the Warwick Collective focus on the much shorter period since the late eighteenth century. This is by no means a breach with Wallerstein, merely a deliberate focus on the geoculture of centrist liberalism, which they see as producing the *Weltliteratur* Goethe had only dreamt of. As the Collective explains: “it is only in the ‘long nineteenth century’, and then as the direct result of British and European colonialism, that we can speak both of the *capitalisation* of the world and of the full *worlding* of capital” (Deckard et al. 2015: 15). This is also, however,

the historical occasion for the initial emergence of modern science fiction (henceforth SF), from precisely Moretti's Franco-British core, as represented paradigmatically by Mary Shelley, Jules Verne and H.G. Wells; and that of the "Anthropocene," at least in Crutzen and Stoermer's original formulation (Crutzen and Stoermer 2000). Neither Moretti nor the Warwick Collective have applied world-systems theory to SF, but Andrew Milner in Australia and Jerry Määttä in Sweden have both begun to do so. Milner's model of the "global SF field," and the "SF selective tradition" which sustains it, identifies an original Franco-British core, supplemented by more recent American and Japanese cores, longstanding Russian, German, Polish and Czech semi-peripheries, and a periphery comprising the rest of the world (Milner 2014), to which we have subsequently added an emergent Chinese semi-periphery (Milner 2014; Milner and Burgmann 2018: 24-25). Määttä's study of disaster narratives concludes that they seem to function "as pressure valves during periods of build-up to expected conflicts or crises...as a way of mentally preparing for an even bleaker reality which...will soon be imminent" (Määttä 2015: 429).

Before turning to SF let us say something about the "Anthropocene." Eugene Stoermer, who coined the term, was Professor of Biology at the University of Michigan and an expert on microalgae; Paul Crutzen was Research Professor of Atmospheric Chemistry at the University of Stockholm and winner of the 1995 Nobel Prize for Chemistry; the body to which they formally proposed the term in 2000, the International Geosphere-Biosphere Programme, or IGBP, had been established by the International Council of Scientific Unions in 1987 to study changes in the total Earth system; it oversaw an enormous body of sustained research between then and 2015, when it was succeeded by the Future Earth project. The geological time scale conventionally used by Earth scientists distinguishes between eons, eras, periods and epochs. Measured thus, the last 11,700 years—the period in which human civilizations have existed—comprises the Holocene epoch of the Quaternary period of the Cenozoic era of the Phanerozoic eon. The epoch which immediately preceded it, the Pleistocene, lasted from roughly 2,588,000 to 11,700 years ago and was much colder than the Holocene. The epoch which in turn preceded it, the Pliocene, lasted from about 5,333,000 years ago, and was significantly warmer than now, but progressively cooled, leading to the glaciations of the Pleistocene. The GTS classificatory system is based on the evidence of geological residue and thus tends to register the effects of geology on life, but not those of life on geology. The theoretical novelty of Crutzen and Stoermer's proposal was precisely to assert the obverse, that human life is now significantly transforming the geology of the planet. This met with some initial skepticism, much of which has subsequently dissipated. The Working Group on the Anthropocene of the International Geological Congress formally recommended adoption of the term to the 2016 Congress in Cape Town, giving as its preferred date for the beginning of the new epoch not the Industrial Revolution as it had been for Crutzen and Stoermer, but rather 1950. This later dating arises from the empirical observation that the lead indicators of anthropogenic disturbance to the earth system—not simply atmospheric carbon dioxide, but also ozone depletion, species extinction, deforestation, and so on—all increased very sharply from the middle of the twentieth century. As Crutzen observed in 2003, in an article co-authored with then-executive director of the IGBP Will Steffen, "the Earth System has recently moved well outside the range of

natural variability exhibited over at least the last half million years. The...changes now occurring...are unprecedented and unsustainable” (Crutzen and Steffen 2003: 253).

What Crutzen, Stoermer, and Steffen call the Anthropocene is for Jason Moore the Capitalocene, “the historical era shaped by relations privileging the endless accumulation of capital” (Moore 2015: 173); and it dates not from the mid-eighteenth century as Crutzen and Stoermer originally understood the Anthropocene, nor from the mid-twentieth century as the Working Group on the Anthropocene has, but rather from the origins of capitalism in the fifteenth century. As a long history of capitalism Moore’s account is both loyal to Wallerstein and in itself very persuasive; but it nonetheless speaks over, rather than to, the concerns that prompted Crutzen and Stoermer’s original interventions into the earth sciences. For, although capitalism might date from the fifteenth century, the key indicators of environmental despoliation clearly date from the nineteenth century. This is precisely the point of Andreas Malm’s *Fossil Capital* (2016), a text which also uses the term Capitalocene, but which identifies the crucial eco-historical shift as occurring around the British cotton industry’s transition from water power to steam power—that is, coal power—during the late eighteenth and early nineteenth centuries (Malm 2016). Detached from the question of historical periodisation, which is crucial for Moore but not for Malm, the Anthropocene/Capitalocene distinction becomes merely one of terminology. And, of course, here both Moore and Malm are formally correct: it was capitalism as a particular mode of production, rather than humankind in general, that produced what we’re now calling anthropogenic climate change. But whatever world-systems theorists might prefer, the term chosen by the more “radical” scientists—meaning those whose work was the most disruptive of the pre-existing scientific consensus—is the Anthropocene. And this is where Ian Angus’s point holds: “leftist academics are resisting efforts to bridge the two cultures gap,” he writes: “This is an academic equivalent of the *political sectarianism* that has long plagued the left” (Angus 2017: 83). Indeed it is, even if Angus’s treatment of Moore often betrays its own similarly sectarian bent.

World-Systems Analysis and Science Fiction

Before proceeding to a world-systems approach to SF we should be clear what exactly we mean by the latter. For Darko Suvin, the doyen of academic SF studies, it is a “*genre whose necessary and sufficient conditions are the presence and interaction of estrangement and cognition*” (Suvin 2016: 20) and its most characteristic formal device is “*the narrative dominance or hegemony of a fictional ‘novum’ (novelty, innovation) validated by cognitive logic*” (Suvin 2016: 79). The great strengths of this conceptual framework are essentially twofold: first, that it deconstructs the false opposition between “literary” and “genre” (or “popular”) texts; and second, that it firmly establishes the necessary opposition between SF and fantasy. So, in Suvin’s terms, Barbara Kingsolver’s *Flight Behavior* (2012) can be considered SF insofar as its narrative is dominated by the fictional but cognitively logical novum that monarch butterflies settle in Tennessee, which in reality they don’t (yet). And Ian McEwan’s *Solar* (2010) is similarly science fictional because its novum of artificial photosynthesis is similarly fictional but nonetheless cognitively logical. Conversely, fantasy texts, even those by politically radical writers like China Miéville, will not work effectively as climate fiction insofar as they remain dependent on magical thinking. This

isn't an argument against enjoying the pleasures of fantasy, but only against taking fantasy seriously as climate fiction. In fantasy magic can always save the day; in real life it never does. For that, we have science, politics, and SF.

Milner's model of the global SF field is built around three main vectors: the size of national book publishing industries; the volume of translations between different languages; and the global history of SF as registered in comparatively authoritative sources like the on-line *Encyclopedia of Science Fiction* (Clute, Langford and Nicholls 2011-2019). The six largest national book trades for most of the twentieth century were the British and American, French and German, Russian and Chinese. By the 1960s only these possessed national industries producing over 20,000 titles per annum (Laurenson and Swingewood 1972:140). By the mid-1990s the UK annual output of books had reached 107,263 titles, China 100,951 titles, Germany 75,515, the US 68,175, Russia 36,237, and France 34,766 (UNESCO 1999: IV-82-89; IV-83-86-88). Other things being equal, then, we would expect these six national literary economies to contribute disproportionately to SF book publishing, and thence to SF film and television production. Translation rates obviously differ from total publication rates, but there is nonetheless a considerable correlation between the two. Excluding Latin and Ancient Greek, which are unlikely to include much SF, UNESCO's *Index Translationum* calculates that, over the period 1979-2018, the top twelve source languages for translation were, in rank order, English, French, German, Russian, Italian, Spanish, Swedish, Japanese, Danish, Dutch, Czech, and Polish. English, French and German were by far the largest source languages; English with 1,266,110 titles, French 226,123 titles and German 208,240 titles; all other source languages produced well under 200,000 titles (UNESCO 2019). We should note that Spanish translations were more likely to be Latin American than European; and that translations from English were more likely to be British in the earlier period, more likely to be U.S. American in the later, but that both were major national publishers throughout. This means that, of our six largest national publishers, all but China were in the top twelve producers of source translations. And Chinese—the 14th largest modern source language (the 13th was Norwegian)—was itself still quantitatively significant. Other things being equal, we would expect SF world texts—that is, those that acquired a significant audience beyond their immediate national context—to be exported disproportionately from these twelve language zones.

Quite apart from these aggregate statistics, something needs to be said about the relative significance of different languages within the global cultural economy. Alexander Beecroft distinguishes between two “global languages,” English and French, a number of “regional world languages” such as Spanish, Portuguese, and Arabic, “major national languages” such as German, Polish and Japanese, “minor national languages” such as Norwegian and Cambodian, and “minority languages” such as Pomeranian and Maori (Beecroft 2015: 259-277). Other things being equal—which they very often manifestly are not—one would expect SF world texts to be exported disproportionately from the first three kinds of language. Beecroft's reasons for treating French as a global language are interesting:

One of the features making French a genuinely global language is the large number of second-language speakers (perhaps 200 million)...Further, it is an official language in twenty-nine nations...on every continent except Asia...and...a working language of nearly every international organization in the world (Beecroft 2015: 264-265).

So, although there are more German than French first-language speakers (90 million as opposed to 70 million), French is a world literature, a *littérature-monde*, in a way that German is not. This might explain why France is more significant than Germany as a source of translations, despite its having a smaller total publishing industry. We should, then, expect both French and English to contribute disproportionately to the world SF field.

Before leaving the question of language and publishing, more needs to be said about Germany, Russia, and China. German might not be a world language, but Germany is nonetheless the home of the third largest book trade in the world. Perhaps the most unusual feature of German publishing is that, unlike British, American, and French, it is a massive net importer of translations. According to the *Index Translationum*, English was the source language for 1,266,110 titles during the period 1979-2018, but the target language for only 164,509 titles; a net surplus of 1,101,601 titles. By contrast, German was the source language for 208,240 titles, but the target language for 301,935 titles, a net deficit of 93,695 titles. Other things being equal, we should expect to find Germany much more responsive to Anglo-French SF than vice versa. Something similar can be observed of China, where the net deficit was 49,052 titles. Russian, by contrast, was a net exporter of translations, albeit with only a very small surplus of 2,818 titles (UNESCO 1990; 2016). Other things being equal, we should expect these different translation rates to affect the relative locations of these national literatures within the world SF system.

This leads us to the essentially “ethnographic” question of the qualitative significance of various national SF sub-cultures. We might begin by taking as a key indicator SF World Conventions, events that require an enormous amount of voluntary effort on the part of local fan communities, and which must therefore attest to the presence of a sizeable local fan base. To date, these have been hosted by cities in the United States, Canada, Britain (both England and Scotland), Germany, Australia, the Netherlands, Japan, Finland, Ireland, and New Zealand (scheduled for 2020). These world conventions are responsible for the annual Hugo Awards, which can be taken as indirect indicators of fan preferences. To date, Hugo Award winning novelists have been drawn from the United States, Britain, Canada, and China; Hugo winning film and television directors from the United States, Britain, Australia, China, New Zealand, Mexico, and Canada (World Science Fiction Society 2019). There is an obvious bias here towards anglophone and North or Central American SF producers, which is unsurprising given that the World Science Fiction Society is based in the United States despite its misleadingly universalizing title. A few less obvious observations are also in order, however. First, the presence of the Netherlands and Finland amongst world convention host nations reminds us that, although Dutch and Finnish are relatively minor languages, they are each significant modern source languages for published translations; which in turn suggests the possibility that one or both might contribute at least peripherally to

world SF. Second, the presence of Canada, Australia, Ireland, and New Zealand amongst host nations—Canada in both lists of Hugo Award winners, and Australia and New Zealand in the second list—suggests that peripheral anglophone nations have readier access to the world SF system by way of British and U.S. intermediaries than do minor non-anglophone nations. Third, the presence of China in both lists of Hugo Award winners, during the twenty-first century but not during the twentieth, suggests that China might be a newly emergent force within the genre.

Turning to the history of SF, it is clear that it was conceived in Britain and France, at the core of the nineteenth century world literary system (Shelley, Verne, and Wells) and continued in both countries throughout the twentieth century and into the twenty-first (through Aldous Huxley, George Orwell, C.S. Lewis, John Wyndham, Fred Hoyle, Arthur C. Clarke, Michael Moorcock, J.G. Ballard, Iain M. Banks, Ken Macleod, and China Miéville in Britain; J.-H. Rosny aîné, Anatole France, Maurice Renard, Jacques Spitz, Pierre Boulle, Robert Merle, Daniel Walther, Serge Brussolo, G.-J. Arnaud, Maurice Dantec, Jean-Marc Ligny, Alain Damasio, and Michel Houellebecq in France). Verne and Wells are clearly crucial. In 1990, the last year in which the *UNESCO Statistical Yearbook* published figures for the most frequently translated authors, Verne was the fourth most translated author in the world, Wells the 68th (UNESCO 1990: 7-110, 7-111). In 2019, the *Index Translationum* had Verne in second place, with 4751 new translations recorded between 1979 and 2018. The University of Illinois holds translations of Wells's work in nineteen different European languages, including 53 titles in French, 47 in Spanish, and 32 in German (Parrinder 2005: 2). First published in England in 1895, *The Time Machine* was translated into French and Brazilian Portuguese as early as 1899, into Hungarian in 1900, Russian in 1901, Italian in 1902, German in 1904, and Czech in 1905. *War of the Worlds*, published in England in 1898, was translated into Dutch, Hungarian, and Norwegian in 1899; into French in 1900, German and Italian in 1901; Spanish in 1902; and Czech in 1903 (Parrinder and Barnaby 2005:xxiii-xxv).

For Moretti, the distinction between periphery and semi-periphery is essentially that between simple cultural reception and imitation on the one hand, and creative cultural innovation on the other. The semi-peripheral SF societies are therefore those that can be seen, retrospectively, as having substantially contributed to the global SF field and to the evolving global SF selective tradition. Measured in these terms, the most significant semi-peripheral SF cultures are almost certainly: Germany during the Weimar Republic (Otto Willi Gail, Thea von Harbou, Fritz Lang, Otfried von Hanstein) and again in the post-Cold War Federal Republic (Wolfgang Jeschke, Frank Schätzing, Dirk C. Fleck); Russia during the early Soviet period (Alexander Belyaev, Alexander Bogdanov, Mikhail Bulgakov, Vladimir Mayakovsky, Andrei Platonov, Alexei Tolstoy, Yevgeny Zamyatin), the late Communist period (Genrikh Altov, Dmitri Bilenkin, Kir Bulychev, Mikhail Emtsev, Eremey Parnov, Arkady and Boris Strugatsky, Alexei Tarkovsky), and in the post-Cold War Russian Federation (Vladimir Sorokin, Dimitri Glukhovsky); inter-war Czechoslovakia (Karel Čapek, J.M. Troska); Communist Poland (Konrad Fialkowski, Stanisław Lem, Adam Wisniewski-Snerg); inter-war North America; and post-Second World War Japan. Each of these generated work that became influential on the Franco-British core and, through it, on the more general world system.

The periphery, by contrast, included both late nineteenth century Japan and early twentieth century Poland. Verne's *Le Tour du monde en 80 jours* was translated into Japanese as early as 1879, six more of his *Voyages extraordinaires* in the early 1880s. These prompted a series of Japanese imitations, the best known of which is probably Oshikawa Shunrō's *Kaitai gunkan*, a reworking of *Vingt mille lieues sous les mers*. Wells's *The Time Machine* and *The War of the Worlds* were translated into Polish in 1899, prompting a series of Polish imitations, so that the earliest "Polish writers of science fiction...worked more or less consciously under Wells's spell" (Juszczuk 2005:126). None of these acquired any lasting international significance, however; that is, they did not enter into the global SF selective tradition. These are unusually interesting cases precisely because both subsequently emerged from peripheral into semi-peripheral status (and Japan eventually into near-core status). But the periphery also included a whole range of other national cultures similarly prone to import, but not significantly export, SF texts—for example China, South Korea, Argentina, Brazil, Italy, the Netherlands, Finland, Norway, Hungary, Canada, Australia, and New Zealand.

Two of the semi-peripheral SF cultures, the US and Japan, eventually emerged as new cores of the system. The so-called "Golden Age" of American SF, which many U.S. Americans mistakenly identify with the origin of the genre itself, was the product of a moment when the United States still remained an essentially semi-peripheral literary economy. But between the 1930s and the 1950s the United States very rapidly became near-hegemonic within the genre (Hugo Gernsback, John W. Campbell, Isaac Asimov, Robert Heinlein), a situation which continued through the New Wave (Philip K. Dick, Harlan Ellison, Norman Spinrad, James Tiptree Jr., Roger Zelazny), feminism (Ursula K. Le Guin, Joanna Russ, Marge Piercy), Afrofuturism (Samuel R. Delany, Octavia Butler), cyberpunk (William Gibson, Bruce Sterling), and the new humanisms of writers like Kim Stanley Robinson and Paolo Bacigalupi. Moreover, North American hegemony extended from print to film (James Whale, Stanley Kubrick, George Lucas, Stephen Spielberg, Ridley Scott, James Cameron, Tim Burton, and Paul Verhoeven all worked in Hollywood, even though some were of European extraction) and television (Gene Roddenberry, J. Michael Straczynski, Chris Carter, and Joss Whedon).

This Americanized SF was exported into Japan during the immediate post-Second World War period, in part as a result of the American military occupation. The genre's new Japanese semi-periphery responded to its new (British-) American core much as America had responded to European SF, by productively reworking inherited forms in ways that registered local Japanese peculiarities. The key Japanese SF writers (Kōbō Abe, Shinichi Hoshi, Sakyō Komatsu, Haruki Murakami) all achieved this kind of effect. But the decisive breakthrough came in the way Japanese writers, directors, and animators appropriated the products of the American audio-visual media to produce contemporary manga and anime SF (Osamu Tezuka, Katsuhiro Otomo, Mamoru Oshii, Hideaki Anno). Japanese SF has, then, moved from the genre's periphery to its semi-periphery and, in some respects, threatens to rival American SF at the core.

Canada is, by most standards, a peripheral or, at best, semi-peripheral literary economy; but it also enjoys peculiarly close relationships with the US, which has been the primary core of the

post-Second World War SF system. For better or for worse—and sometimes both—U.S. Americans often treat anglophone Canada as if it were part of the United States. And this is perhaps especially true of the SF subculture. So, the first SF world convention to be held outside the United States was in Toronto in 1948. So American SF magazines, comics, graphic novels, and paperbacks are readily on sale in Canada and, conversely, Canadians readily contribute to them. So leading Canadian SF writers, such as A.E. van Vogt and Margaret Atwood, and film and television directors, such as David Cronenberg, and John Fawcett, have enjoyed unusually easy access to American audiences and honors. This is not to suggest that Canada is in itself a core SF culture, but rather that its status is genuinely anomalous, oscillating between core and peripheral characteristics, to the extent that the wider core oscillates between constructing itself as U.S. American or as North American.

China is an altogether different matter: Chinese is the world's most widely read language, it is home to one of the world's six largest publishing industries, and it is both an important source and target language for translations. And yet it was not even peripheral to the world SF system until the late 1970s. There had been a brief flourishing of utopian fictions during the first years of the twentieth century, many involving quasi-science fictional flying machines, some also distinctly futuristic gender relations (Chen 2016); one isolated Chinese translation of the Japanese translation of Verne's *De la terre à la lune* in 1902; a plethora of didactic children's SF stories on the official Russian model during the brief alliance between the Soviet Union and the infant People's Republic; and virtually nothing at all during the Cultural Revolution. The genre only emerged as reading for adults, and then often only fitfully, after 1978 (Liu 2016: 363-364). Thereafter, it has been continuously associated with the magazine 科幻世界 *Kehuan Shijie/Science Fiction World* founded in 1979, which reached a peak circulation of 400,000 in 1999 and still claims a regular circulation of about 300,000. This is, no doubt, negligible by Chinese standards, but nonetheless very significant by the standards of SF magazines elsewhere. The three leading contemporary Chinese SF writers, Liu Cixin, Wang Jinkang, and Han Sung, are all veterans of 科幻世界 *Kehuan Shijie* and all have been multiple winners of the 银河奖 *Yinhe/Galaxy* prize for best Chinese SF, which it administers. All three have been translated into English and, famously, Liu won the 2015 Hugo Award for best SF novel with the English translation of 三体 *Santi/Three-Body*. This doesn't yet make China a new core, but it very probably does mean that it has finally entered into the semi-periphery of the system.

World-Systems Analysis and Climate Fiction

Thus far, we have directed our attention towards SF in general rather than climate fiction in particular. But in this third and final part of the essay we attempt to apply world-systems analysis to what Adam Trexler has termed "Anthropocene fictions" and Daniel Bloom "cli-fi" (Trexler 2015; Merchant 2013), which we treat here as a significant sub-genre of contemporary SF. Climate fiction in the most general of senses is at least as old as the story of Noah in *Genesis* VI-VIII. But these older climate stories are mainly concerned with flood and ice rather than warming, and typically owe very little to any kind of intellectually plausible climate science. Contemporary climate fiction, by contrast, is deeply indebted to climate science and therefore overwhelmingly

concerned with anthropogenic warming. This is true even of texts like Michael Crichton's *State of Fear* (2004) which set out to refute the science. Climate fiction in this sense is thus a very recent development, dating back no further than the late 1970s: the earliest examples seem to be *Heat* (1977) by the American Arthur Herzog and *The Sea and Summer* (1987) by the Australian George Turner. Interestingly, both Herzog and Turner were professional writers and journalists with relatively well-established careers in SF, both of whom seem to have been drawn to the global warming *topos* as an extension from their earlier SF, occasioned by their interest in current scientific debates. This leads us to conclude that climate fiction is not in itself a new genre, as both Bloom and Trexler seem to suppose, but rather a sub-genre of SF. If this is so, then, other things being equal, one would expect the geo-political literary economy of climate fiction to run roughly parallel to that of SF as a whole.

Here, we need to distinguish between structural and conjunctural determinants of the evolution of the sub-genre. The main structural determinant will indeed be the world SF system. But its effects may be either countered or reinforced by one or more of three main conjunctural factors: the degree of perceived vulnerability to extreme climate change of any particular national political economy, the salience of Green politics within any particular national polity, and the salience of climate change within broader environmentalist discussions in any particular national culture. All three of these pertain in part to the cultural sphere, even the first; for if the actual degree of climate vulnerability can be measured with some degree of objective accuracy—it is clear, for example, that poorer countries are generally more vulnerable than wealthier—the extent to which this is collectively perceived and understood remains culturally constructed. Media representations of the threat of climate change, especially commentary by climate scientists, economists, and ecologists, are likely to be central here. At the strictly political level, the local visibility of Green politics will depend on such factors as the electoral system and the availability or non-availability of public funding for minor parties. But it will also depend on the local balance between old and new media, the extent to which advertising revenues are dependent on carbon polluters, and so on. Our three conjunctural determinants can thus be understood as different aspects of the “greening” of the public sphere. They are not “merely” cultural, however, not even the third, since the contours of local environmentalist debates will themselves be shaped in response to wider political and economic developments. The local incidence of cli-fi will thus be determined by the interaction between the world SF system and the (loosely defined) local green public sphere.

The effects of the world SF system are most clearly apparent in three of the four core SF cultures, the US, Britain and France, all of which have been productive of an extensive body of climate fiction. Instances of U.S. climate fiction include: in written literature, Herzog's *Heat*, Bruce Sterling's *Heavy Weather* (1994) and *The Caryatids* (2009), T.C. Boyle's *A Friend of the Earth* (2000), Crichton's *State of Fear*, Kim Stanley Robinson's *Science in the Capital* trilogy (2004-2007), *Aurora* (2015), *Green Earth* (2015) and *New York 2140* (2017), Cormac McCarthy's *The Road* (2006), Paolo Bacigalupi's *The Windup Girl* (2009) and *The Water Knife* (2015), Barbara Kingsolver's *Flight Behavior* (2012), Nathaniel Rich's *Odds Against Tomorrow* (2013),

William Gibson's *The Peripheral* (2014), Chang-Rae Lee's *On Such a Full Sea* (2014), Ben Lerner's *10:04* (2014), Claire Vaye Watkins's *Gold Fame Citrus* (2015), Meg Little Reilly's *We Are Unprepared* (2016), John Feffer's *Splinterlands* (2016), and David H. Spielberg's self-published *On Vestige Way* (2017); in the graphic novel, Josh Neufeld's *AD: New Orleans after the Deluge* (2010), Grant Calof and Eric Eisner's *H2O* (2011), and Brian Wood's *The Massive* (2012-15); and in film, Kevin Reynolds's *Waterworld* (1995), Steven Spielberg's *AI: Artificial Intelligence* (2001), Roland Emmerich's *The Day After Tomorrow* (2004), Andrew Stanton's *Wall-E* (2008), Jake Paltrow's *Young Ones* (2014), Darren Aronofsky's *Noah* (2014), Christopher Nolan's *Interstellar* (2014), and Dean Devlin's *Geostorm* (2017); and in television, some episodes of Bruce Miller and Reed Morano's *The Handmaid's Tale* (2017-2019).

Well-known instances of British climate fiction include: in written literature, Maggie Gee's *Where are the Snows* (1990), *The Ice People* (1998), and *The Flood* (2004), Will Self's *The Book of Dave* (2006), Ian McDonald's *River of Gods* (2006), Jeanette Winterson's *The Stone Gods* (2007), Marcel Theroux's *Far North* (2010), Ian McEwan's *Solar* (2010), David Mitchell's *Cloud Atlas* (2004) and *The Bone Clocks* (2014), Ben Elton's *Time and Time Again* (2014), Michel Faber's *The Book of Strange New Things* (2014), Laurie Penny's *Everything Belongs to the Future* (2016), Megan Hunter's *The End We Start From* (2017), Paul McAuley's *Austral* (2017), and Chris Beckett's *America City* (2017); in the graphic novel, John Hicklenton's *100 Months* (2012); and in film, Matthew Vaughn's *Kingsman: The Secret Service* (2015); of French climate fiction, in written literature, Michel Houellebecq's *La Possibilité d'une île* (2005) and arguably also his *La Carte et le territoire* (2010), Yann Quero's *Le Procès de l'Homme Blanc* (2005) and *L'Avenir ne sera plus ce qu'il était* (2010) as well as his edited collection *Le Réchauffement climatique et après...* (2014), Jean-Marc Ligny's *Aqua™* (2006), *Exodes* (2012), and *Semences* (2015), Pierre-Yves Touzot's *Terre lointaine* (2008), and Bernard Besson's *Groenland* (2011); and in the graphic novel, Jacques Lob and Jean-Marc Rochette's *Le Transperceneige* (1982) and its three sequels by Rochette, Benjamin Legrand and Olivier Bocquet (1999-2015). The most important Japanese examples are probably Hayao Miyazaki's graphic novel *風の谷のナウシカ/Kaze no Tani no Naushika* (1982-1994), its 1984 adaptation for anime, and his 1997 anime *もののけ姫/Mononoke-hime*, although these are not so much cli-fi as "cli-fantasy". The comparative underproduction of Japanese cli-fi texts seems to be an effect of the low salience of anthropogenic climate change within environmentalist discussions in Japan, where nuclear radiation has been a much more central issue, at least since the 2011 Fukushima disaster and arguably ever since the long-term effects became apparent of the 1945 American nuclear attacks.

The most striking feature of the SF semi-periphery is almost certainly the sheer volume of German climate fiction. Important examples include: Anton-Andreas Guha's *Der Planet schlägt zurück* (1993), Dirk C. Fleck's *GO! Die Ökodiktatur* (1993), *Das Tahiti-Projekt* (2008), *MAEVA!* (2011) and *Feuer am Fuss* (2015), Karl-Heinz Tuschel's *Der Mann von IDEA* (1995), Till Bastian's *Tödliches Klima* (2000), Sybil Berg's *Ende gut* (2004), Frank Schätzing's *Der Schwarm* (2004), Wolfgang Jeschke's *Das Cusanus Spiel* (2005), Liane Dirks's *Falsche Himmel* (2006), Manfred Boeckl's *Die Einöder* (2007), Ulrich Hefner's *Die dritte Ebene* (2008), Dieter

Oesterwind's *Steinerne Glut* (2008), Klaus Peter Lehner's *Natürlich grausam* (2008), Juli Zeh's *Corpus Delicti* (2009), Nele Neuhaus's *Wer Wind sät* (2011), Sven Böttcher's *Prophezeiung* (2011), Ilija Trojanow's *Eis Tau* (2011), and Margret Boysen's *Alice, der Klimawandel und die Katze Zeta* (2016). Fleck, Schätzing and Jeschke are all winners of the Deutscher Science Fiction Preis for best novel, Fleck twice for *GO! Die Ökodiktatur* and *Das Tahiti-Projekt*, Schätzing for *Der Schwarm*, Jeschke twice, including one for *Das Cusanus Spiel*. Schätzing and Jeschke have been translated into English and French, Fleck into Spanish, Turkish and Vietnamese, but not yet into either English or French.

In sharp contrast to Germany, there is comparatively little mention of climate change in SF from the Eastern European semi-periphery. The politics of de-Stalinization, including the cultural politics of state-produced environmental pollution, seem to figure much more largely. Interestingly, there is a passing reference to Western misconceptions about climate change in Victor Sorokin's influential *Den' oprichnika*: "Аж целых минуе 32. Вот вам и глобальное потепление, о котором чужеземцы талльчат" (*It's a good 32 below. That's the global warming foreigners are always wittering about*) (Sorokin 2006: 129-130). Sorokin's Andrei Danilovich Komiaga is no doubt an unreliable narrator, but his Russian readers are nonetheless no doubt familiar with this particular sentiment. Sorokin's joke is on his readers, but it seems significant nevertheless that it actually works.

This comparative indifference to climate fiction recurs in China. Chinese SF has been concerned with environmental issues such as pollution, but global warming does not figure largely amongst these. Indeed, Liu Cixin specifically warns his American readers that, whereas "climate change and ecological disasters...have...built-in adjustment periods...contact between humankind and aliens can occur at any time," hence; his (in our view improbable) insistence that "extraterrestrial intelligence will be the greatest source of uncertainty for humanity's future" (Liu 2014:394). There is an irony here in that Liu's *三体Santi* (literally *Three-Body*), in English translation *The Three-Body Problem*, is itself predicated on the absolute priority of climate change not on Earth, but on his fictional Trisolaris. The eponymous "three-body problem" is an apparently insoluble problem in classical mechanics. But in the novel it is also both an apparently insoluble virtual reality game of alien origin and, more fundamentally, the relation of the planet Trisolaris to its three-sun system in Alpha Centauri. The effects of this trisolar interaction have been precisely to subject the planet to extremes of heat and cold, which radically impede the development of Trisolaran culture and ultimately threaten to destroy the planet. Hence, their invasion fleet's 450-year journey towards Earth. Hence, too, the computer game and the ETO, the Earth-Trisolaris Movement, both of which are alien-inspired and designed to slow down Earth's technological development. Mike Evans, co-founder of the ETO, is unsurprisingly a radical environmentalist. The novel is thus a thinly disguised polemic against environmentalism, which ironically performs that which it aims to refute. It is difficult to avoid the conclusion that the text mirrors a wider Chinese indifference to global warming registered in the PRC Government's lack of commitment to the 1997 Kyoto Protocol: *三体Santi* was first serialised in *科幻世界Kehuan Shijie* during 2006; that is, well before China's apparent change of position in the 2015 Paris Agreement.

Almost as striking as the differences between the German and Chinese semi-peripheries is the substantial number of climate fiction texts emanating from the periphery proper. The obvious starting point here is Canada with Atwood's *MaddAddam* trilogy, comprised of *Oryx and Crake* (2003), *The Year of the Flood* (2009), and *MaddAddam* (2013). But other examples of Canadian cli-fi include Élisabeth Vonarburg's *Chroniques du Pays des Mères* (1992), Jean-Louis Trudel's *Les Marées à venir* (2009), Craig Russell's *Fragment* (2016), and Omar El Akkad's *American War* (2017). In an early review of *The Year of the Flood*, Fredric Jameson observed that Atwood "is a Canadian, and no little of her imaginative power comes from her privileged position above the border of the lower 48" (Jameson 2009:8). Much of Atwood's "literary" fiction is in fact set in her native Canada, but all five of her SF novels, *The Handmaid's Tale*, the *MaddAddam* trilogy itself, and *The Heart Goes Last*, are set in the United States or in what was once the United States. In other words, her SF is quite deliberately North American as distinct from Canadian. Moreover, as Jameson also observes, "at least 300 million English-speakers generally need to be reminded" that she is Canadian. Her fiction thus performs exactly that oscillation between core and periphery we found to be characteristically Canadian.

Other significant, more fully peripheral instances of climate fiction include: from Australia, Turner's *The Sea and Summer*, Steven Amsterdam's *Things We Didn't See Coming* (2009), Alexis Wright's *The Swan Book* (2013), Peter Carey's *Amnesia* (2014), Jane Rawson's *A Wrong Turn at the Office of Unmade Lists* (2014), Ellen van Neerven's *Heat and Light* (2014), Alice Robinson's *Anchor Point* (2015), James Bradley's *Clade* (2015), George Miller's *Mad Max: Fury Road* (2015), Jane Abbott's *Watershed* (2016), Briohny Doyle's *The Island Will Sink* (2016), Sally Abbott's *Closing Down* (2017), Cat Sparks's *Lotus Blue* (2017), Jennifer Mills's *Dyschronia* (2018), and Tom Faunce's *Split by Sun* (2018); from Sweden, Jesper Weithz's *Det som inte växer är döende* (2012); from Norway, Jostein Gaarder's *Anna. En fabel om klodens klima og miljø* (2013), and Jo Nesbø and Erik Skjoldbjærg's *Okkupert* (2015-17); from Finland, Risto Isomäki's *Sarasvatin hiekka* (2005), Antti Tuomainen's *Parantaja* (2010), and Emmi Itäranta's *Teemestarin kirja* (2013); from Spain, Jordi de Manuel's *L'olor de la pluja* (2006); from Latin America, Homero Aridjis's *Le leyenda de lose soles* (1993) and *¿En quién piensas haces el amor?* (1996), and Gioconda Belli's *Waslala* (1996); from South Africa, Alastair Bruce's *Wall of Days* (2010), Umoya Lister's *Planetquake* (2010), and Neill Blomkamp's *Elysium* (2013); from Switzerland, Ivan Engler and Ralph Etter's *Cargo* (2009); from Korea, Bong Joon-Ho's *Seolgunnyeolcha* (2013); and from India, Amitav Ghosh's *Gun Island* (2019).

The large number of Australian climate fictions might owe something to the legacy of Turner's *The Sea and Summer*; something to the country's extreme vulnerability to the likely effects of global warming; and something to the, by anglophone standards, large Green presence in Australian (and New Zealand) party politics: in 2019 there were 10 elected Green members in the Australian parliament (out of 227) and 8 in the New Zealand (out of 120), as compared to none in the U.S. Congress; 1 (out of 338) in the Canadian parliament, and 1 (out of 650) in the UK. The large number of Finnish texts must owe something to the disproportionate strength of the SF community, especially fandom, in Finland as evident in Helsinki's successful bid to host the 2017

SF World Convention. And the large number of South African texts might owe something to the extraordinary critical and commercial success of Blomkamp's *District 9* (2009), which apparently prompted "an unprecedented boom in local science fiction" (Steenkamp 2014: 143).

We might conclude this discussion by asking why it is that so many climate fiction texts appear to originate from the periphery of the global SF field. Thus far, we have pointed to conjunctural determinants such as the local salience of Green politics or the local degree of climate vulnerability. But we might also find more general answers available in Moretti's own theoretical framework. For, of course, he has argued that peripheral or semi-peripheral status can itself be conducive to new cultural possibilities. And we can observe that the truly innovative moments in the global history of SF—the emergence of pulp fiction and the B feature movie in the United States, or of manga and anime in Japan—are located not in the system's core, but in its periphery becoming semi-periphery. The development of contemporary climate fiction might be a similar such moment, similarly located disproportionately in newly emergent semi-peripheral SF cultures. Our conclusion, then, is that the cultural geography of climate fiction exhibits significant, albeit minor, variations from the more general structure of the global SF field. At the core, there appears to be a comparative underproduction of cli-fi in Japan; in the semi-periphery, a comparative overproduction in Germany; in the periphery, an interestingly creative comparative overproduction in Canada, Finland, Australia, and South Africa. The repeated eruption of new peripheral sources of literary creativity partly contradicts Moretti's claim that the world literary system is characterized by relations of growing inequality. But so too does his own stress on how new geographical spaces can produce new fictional spaces. We might conclude, then, that the tendency towards growing inequality within the world literary system is, like Marx's own law of the falling rate of profit, precisely a law of tendency; which can necessarily be offset by countervailing tendencies such as that towards cultural creativity at the periphery.

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