

Time and the Biological Consequences of Globalization

by Kevin Birth

Discussions of globalization and time-space compression have not acknowledged the implications of the relationship of time and place on a rotating globe where each locale has its own cycles of day and night. When these cycles are recognized, several contradictions in contemporary capitalism emerge, most notably temporal conflicts between locations on the globe, desynchronization of biological cycles, and lack of correspondence between those cycles and social life. These contradictions are increasingly being addressed but not resolved through the power of the media to determine the timing of social activity and pharmacological interventions to ameliorate the bodily suffering caused by desynchronization.

The flattening of space defies Einsteinian curvature or quantum expansion but reflects the triumph of a populist and mechanical vocabulary of progress. Travel around the so-called village of the globe is made easy, swift and accommodating. Yet there lingers an unspoken apprehension of an incalculable price to be paid in pollution, in the extinction of species, and in other elemental implosive cycles which leave their shadow upon the psyche of nature.

—Wilson Harris

Poor Copernicus! Despite his idea that the Earth is a rotating globe that revolves around the sun, ideologies of modern capitalism, reinforced by scientific and social scientific theories, treat it as if it were flat (Friedman 2005). Treating the world as if it were flat is a consequence of time-space compression. Since the time of Copernicus, chronologists have created a global standardized time reference consisting of hours of equal duration, days of exactly 24 of those standardized hours, time zones, and a “prime” meridian that runs through the Greenwich Royal Observatory. Labor has become increasingly structured according to clock time rather than the solar day, and since the advent of artificial light and then global telecommunications work schedules are no longer tied to daylight. Both night-shift work and flexible schedules that transcend day and night are increasingly common. Techniques that allow the measurement of biological circadian cycles have

provided insight into both the way the body’s processes work together and the way these cycles can be disrupted. People have been placed in caves or bunkers to isolate them from time cues with the purpose of finding their “natural” free-running biological cycles of activity, rectal temperature, and hormonal levels (Aschoff 1965; Siffre 1975). Many species of animals have been subjected to observation, blood tests, urine tests, and saliva tests to evaluate their responses to timed noises, timed lights, absence of time cues, movement across multiple time zones, changes in the timing of cues, and cycles much shorter or much longer than 24 hours (Aschoff 1981; Dunlap, Loros, and Decoursey 2004; Moore-Ede, Sulzman, and Fuller 1982; Pittendrigh 1993). These studies have contributed greatly to the understanding of the relationship between the environment and biological processes, particularly in the study of the stimuli that synchronize biological rhythms. Known as *zeitgebers*, these stimuli include cycles of light and darkness and seasons. The study of the interaction of *zeitgebers* with circadian rhythms during night shifts reveals dissonance and desynchronization between human biological cycles and labor demands. Yet the relationship between the time-space compression associated with global capitalism and the diurnal cycles tied to day and night of the human body receives little attention. In chronobiological studies of humans, the standardized 24-hour length of the day overshadows the local and seasonal variability in the distribution of daylight across those 24 hours. The globe has come to be treated as if the experience of time were the same everywhere—as if the Earth were flat.

Ethnographic work with cocoa farmers in Trinidad made me sensitive to the collision between the multiple temporal cycles that farmers must negotiate and the homogenizing character of the calendar and the clock (Birth 1999). Fur-

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thermore, many Caribbean thinkers express unease at treating the Earth as if it were flat, because doing so is a denial of rhythms tied to the landscape. In the epigraph above, the Guyanese writer Wilson Harris notes the price to be paid for this flattening of space. Writing about another Caribbean thinker, Dash (1995, 12) notes that in much of Édouard Glissant's writing there is an "unease" with "the orderliness of the European landscape, the rhythmic measure of changing seasons." Glissant's (1956) Caribbean landscape is turbulent and explosive—a place of hurricanes and volcanoes and a place removed rhythmically and temporally from Europe. Benítez-Rojo (1996, 75) refers to the Caribbean as a "rhythmical area" rather than defining it in terms of space. Finally, and coincidentally, it was in Trinidad, including the village in which I worked, that Colin S. Pittendrigh, the pioneering chronobiologist, first noted and studied circadian cycles (Pittendrigh 1993, 22–23; Birth 1999, 38–39). West Indian thinkers and those who have studied West Indian thought are sensitive to the experience of local temporalities and the Earth as a globe.

These people are not alone in recognizing the significance of globeness—living on a rotating, revolving globe. In an era of the ideological assertion of flatness, it seems that many have recognized the temporal advantages conveyed by this condition. For example, the president of Johns Hopkins University told Friedman (2005, 16): "I have just learned that in many small and some medium-size hospitals in the US, radiologists are outsourcing reading of CAT scans to doctors in India and Australia!!! Most of this evidently occurs at night (and maybe weekends) when the radiologists do not have sufficient staffing to provide in-hospital coverage." Night in the United States is day in India and Australia. Comparative economic advantage is normally thought of in terms of resources or the characteristics of the labor force, but globalization has made the strategic use of time differences between service providers and clients into another source of advantage.

Global and Local Times in Biological Perspective

Globeness ties space and time together. One's place on the globe positions one not only in space but also in multiple systems of time. These multiple times include clock time, defined according to one's time zone, solar time, defined by the cycle of day and night, and cycles of social activity. Human biology, sensitive as it is to both social and solar cycles, seems potentially caught between the clock, the sun, and social life. The clock defines some but not all social times (Birth 1999), although in the coordination of global relationships it structures relationships between multiple locations. In the nexus of the global and the local, the potential conflicts between biology, clock, sun, and sociality can become significant.

With regard to human biology, position on the globe is a critical variable. Longitudes indicate relationships of local solar times, and time zones define clock time for state-specified

ranges of longitude (Galison 2003). One's latitude, while not affecting local clock time, does affect one's relationship to the temporal markers of dawn and dusk and to seasonal changes. In many animals, humans included, the farther one is from the equator, the greater the seasonal variation in hormonal cycles, particularly melatonin (Schwartz et al. 2001; Wehr 2001). This was ethnographically documented in Condon's *Inuit Behavior and Seasonal Change in the Canadian Arctic* (1983), in which he found seasonal variations in physiology, social stress, activities, and birth rates. If place-bound identities are becoming more significant, as Harvey argues (1993, 4), then one wonders about the ways in which time and space are experienced both locally—as in the tie between landscape and its rhythm that is important in the Caribbean—and in relationships that span different time zones. This experience is full of potential conflicts between global and local schedules and between the timing of global relationships and the cycles of one's locally embedded biological rhythms.

The exploration of this topic involves relating space and time as well as sociality and biology. To explore the intersection of these issues involves theorizing time and timing, but this goes against inclinations in much recent scholarship. Discussions of postmodernity privilege the issue of space, often as a means to eschew temporality. Theories of capitalist production and exchange avoid the issue of timing in favor of the concept of "average time." Both biological and social science uncritically adopt clock time and the standardized 24-hour day. Chronobiology does so without recognizing that this standard is a cultural construction; social science does so without reflecting on the way in which this standard emerged to chart and measure natural temporal cycles that are still important even though they have become divorced from the clock. The organization of this article, then, must involve an excursion through postmodernism, economics, the history of contemporary time-reckoning, and the epistemological divide between natural and social science before looking for ways to reconcile social science and natural science approaches to social time and human chronobiology. In all of these cases, there is a common thread of the persistent neglect of the consequences of living on a globe. Once these consequences are considered, the contradictions and conflicts of time-space compression become apparent, and so does the need to appreciate these issues from a perspective that can integrate biology, geography, social systems, and culture.

The Postmodernist "Elimination" of Time

Theories of postmodernity often suggest that space has triumphed over time. According to Jameson, "The new spatial logic of the simulacrum can now be expected to have a momentous effect on what used to be historical time" (1984, 66), and the postmodern is "a culture increasingly dominated by space and spatial logic" (p. 71). Soja claims that "space and geography may be displacing the primacy of time and

history as the distinctively significant interpretive dimensions of the contemporary period” (1987, 289). Laclau asserts that “the ‘spatialization’ of an event consists of eliminating its temporality” (1990, 41).

Some argue that spatial logic does not completely capture temporality and that it remains important to develop a balanced treatment of time and space (Dodgshon 1999; Massey 1992). Massey points out that many uses of the concept of space define it in opposition to time. She cites Laclau’s *New Reflections on the Revolution of Our Time* (1990) as an important example of this tendency. Laclau asserts that “any repetition that is governed by a structural law of successions is space” (1990, 41). Space, then, is a closed system. Repetition is never simple duplication (Deleuze 1994), however; as Benítez-Rojo argues, “every repetition is a practice that necessarily entails a difference” (1996, 3). Consequently, time, even when cyclic and repetitive, implies some form of disjuncture if not disruption. Massey concludes that such disruption is necessary for the possibility of politics.

Part of the postmodernist suppression of time in favor of space is related to the problem of thinking about the local in relationship to globalization. Robertson hints at this when he writes, “Interest in the theme of postmodernity has involved much attention to the supposed weaknesses of mainstream concern with ‘universal time’ and advancement of the claim the ‘particularistic space’ be given much greater attention” (1995, 26). The postmodernist tendency to use universal time as a foil against which the particular can be represented is premised on the centuries-long process of representing time as homogeneous and divorced from place—clocks, calendars, and time zones have all been efforts at erasing place in the service of temporal standardization. Adam points out that “standard time and world time are essential material conditions for the global network of communication in both information and transport” (1995, 114). The contrast between universal, global time and locality is an unbalanced parallelism, however—there is no concept of time linked to the local. Even from the postmodernist perspective, there is a need for understanding of the interaction of universal time and local temporalities, and this interaction has not received much attention.

One reason for this is the elision of “nature.” Local times are matters of cycles of day and night that involve incongruence of solar time and clock time according to one’s position on the globe. In suppressing nature, local solar time is a conceptual casualty. Jameson, describing postmodernism, notes that it “is what you have when the modernization process is complete and nature is gone for good” (1991, ix). Have the globe and solar cycles really been eliminated, or is Jameson referring to suppression? Furthermore, if human biological circadian cycles are cued to the sun, then making solar time irrelevant also makes those biological rhythms irrelevant. It is a rejection of the human species’s status as a diurnal mammal that follows from the rejection of the shape and astronomical orientation of our planet.

Does such rejection compromise the ability to understand the embodied experiences and material dimensions of globalization and to explore specific instances of the interaction of global power relations with human biological processes? Adam criticizes globalization theory from the perspective of a feminist perspective on time, pointing out that the emergence of contemporary concepts of time has “lessened some of the human dependence on, but not overcome our rootedness in, the rhythmicity of the cosmos, the seasons and the times of the body” (2002, 15). While much of postmodernist theory acts as if nature and time had been eliminated, it does not feel as if it had. I have found Caribbean writers turning to the local rhythms of the landscape to resist this ideology, cocoa farmers who also work for the government or in factories developing strategies to minimize conflicts between these two different types of cycles, and Trinidadians learning quickly to calculate the time differences between themselves and family members in New York, California, or England before making telephone calls. Because of the global distribution of family and friends, Trinidadians even learn to adjust to daylight saving time despite its absence in Trinidad and Tobago. In the Caribbean, a region hailed as among the most postmodern of all regions (Benítez-Rojo 1996), nature’s temporal influences are present and culturally asserted in the face of globalization.

Adam argues that “clock time, world time, standard time and time zones have become naturalized as the norm vastly increases the difficulty of recognizing the role this created time plays in everyday life. Other temporal principles fade into the background. They become invisible” (2002, 17). Despite this invisibility, they continue to be felt. Time has not disappeared, but there is a conflict between a logic of temporal flexibility that seeks to make lived time and the experiences of duration, sequence, and daily cycles irrelevant. This conflict includes the contradictions between culturally created times and biological circadian cycles. LeFebvre describes it as the “bitter and dark struggle around time and the use of time” (2004, 74)—a struggle over how “so-called natural rhythms change for multiple, technological, socio-economic reasons.” Globeness links these biological cycles to global social processes. The language of Adam and LeFebvre suggests that time conflicts have been pushed into the dark recesses of theory and globalizing power relations, by implication making people such as Caribbean intellectuals, Trinidadian cocoa farmers, and global technology companies the inhabitants of these recesses. The suppression of embodied temporal conflicts is part of the postmodern condition.

The Timing of Capitalist Circulation

Time-space compression is an idea associated with the rapid flow of information in contemporary capitalism (Harvey 1989). In grappling with the complex interactions of production, labor, and exchange found in Marx’s political economy, the concept of time-space compression shifts theoretical

emphasis away from the production process and toward the complex interaction of production, labor, and exchange in relationship to processes of circulation. When discussing capitalist circulation, Marx equivocates between the concept of “average time” and the recognition of variation in the speed of circulation. On the one hand, he wants to treat time in the same fashion as production, in which he postulates “average labor time.” His effort to use the concept of “average circulation time” (1978, 236) seems repeatedly undermined by his desire to acknowledge the myriad ways in which the pace of circulation can vary: the effect of the seasons on production (1981, 369), the time of production (p. 388), the rate of consumption (p. 418), and the effects of credit and commercial capital (1978, 267; 1981, 418). In Marx’s thought, the more the circulation process is accelerated, the greater the surplus the capitalist obtains. In this formulation, increasing productivity and maintaining extracted surplus value reduce the time of exchange, including the time of transport and storage (Marx 1978, 203; Adam 2002, 20). Under such conditions, there is pressure to reduce the duration of circulation to zero—thereby eliminating time entirely. This is the economic foundation for time-space compression and the ideological inclination to eliminate time.

The trading of commodities can take place separately from their movement. As a result, reduction of circulation’s duration is not directly tied to the rate of movement of the commodity. This creates a type of temporal discipline different from that of the factory. The temporal discipline of industrial labor is the connection of sustained work over specified durations. The temporal discipline of instantaneous exchange and time-space compression involves the ability to work at any time—an emphasis on working at the right time rather than working for a specific quantity of time. The result is a focus on round-the-clock readiness linked to rhythms of exchange.

While Castells’s representation of the network society points to “capital’s freedom from time and culture’s escape from the clock” (2000, 464), most discussions of time-space compression do not escape the clock but instead point out the ways in which time and particularly timing are crucial in time-space compression. In contrast to Castells, Harvey emphasizes the “annihilation” of space as the motivation and consequence of time-space compression (1989, 258; 1990, 425). Adam describes time as having become “thoroughly relativized: nighttime in Wales is daytime in Hong Kong and evening in California. This knowledge forms part of the daily interactions of a global community of airline staff, financiers, business people and politicians,” and she adds that “space, it seems, is no longer an obstacle to communication; in such instances, at least, it has been rendered almost irrelevant” (1992, 177). The politics of defining time zones supports Harvey’s and Adam’s perspectives more than Castells’s. Hongladarom describes a debate in Thailand over advancing its time zone to be in the same zone as Singapore, Malaysia, and Hong Kong. Hongladarom says, “A reason for the move was that the country’s time zone would then be the same as those

of Hong Kong and Singapore, making financial interactions between Thailand and these two powerhouses easier” (2002, 345).

Labor practices also indicate the growing importance of time and timing over location. Presser (1999) points out that the so-called standard work schedule of 35–40 daytime hours per week is becoming less common in the United States and night and weekend work more common. This trend is global (Fischer, Rotenberg, and Moreno 2004). The reasons for this include an increase in the service sector and technology developments that generate a need for 24-hour service. Epstein and Kalleberg (2001, 7) argue that the time of day during which people work might be more important than the number of hours they work. They add that it is those at the top and bottom of the labor market that are most affected by the increase in work hours during nonstandard times (p. 10).

Finally, in economics one finds a concern with “time-specific” analysis that has emerged only since the mid-twentieth century (Winston 1982). This form of analysis attempts to uncover temporal variations, both rhythmic and arrhythmic, in production, exchange, and consumption and makes the point that economic theory tends to use units of time that are too large to allow analysis of the timing of economic processes. This form of economic analysis shifts the question of time away from issues of quantity per unit of time to issues of how timing influences quantity.

Both Winston and Marx raise the important issue of the timing of consumption. Much of the emphasis on the expansion of night work has focused on the service industry, which implies not only that nighttime work has expanded but that nighttime consumption has expanded as well. Chatterton and Hollands suggest that the number of “nightlife consumption spaces” in Britain’s cities has increased and that this is the result of increasing corporate interests in providing such venues (2002, 101). The timing of consumption is particularly important with regard to witnessing live events. Among the West Indian community in New York City, the webcast of West Indian test cricket attracts audiences regardless of the time of day, and sports bars open early in the morning for groups of cricket fans. When the West Indies team visits India, Sri Lanka, Pakistan, or Australia, avid cricket fans forgo sleep to support their team.

Participation in global processes of commodity circulation is a major dimension of the experience of globalization, and such participation has its own rhythms and cycles that are not homologous to local biological rhythms. This does not make biology and local solar cycles irrelevant, however. Instead, it makes human social activity a site of embodied encounter between local times and global desires.

The Embodied Experience of Time-Space Compression

The time-space compression associated with postmodernity and globalization creates a paradox of locations, with different

times with regard to local clocks being linked to the same clock time with regard to exchange and the movement of information, such as the new temporal commonality that Hongladorum describes for Thailand and Hong Kong or the fact that all of China is within a single time zone or the policy that places the space shuttle in the same time zone as Greenwich regardless of where it is in its orbit.

The emphasis on the instantaneous flow of information in time-space compression has not only obscured the features of living on a rotating globe but also led to an emphasis on information over material flows and the experience of one's body and its immediate surroundings. The disembodiment of time-space compression from the physical and psychological temporal experience of the body affirms the denial of physiology that is crucial for the global functioning of capitalism. When the destruction of the physical becomes transformed into the purging of the physical from theory, theory falls prey to the criticisms Marx and Engels (1976) had long ago of Hegelianism—its emphasis on conceptual abstraction results in an inability to come to grips with the material and sensuous dimensions of human activity and therefore human existence.

An example of the interaction of time-space compression, physical discomfort, and chemical intervention was on public display at the opening of the 2004 major league baseball season. In April 2004, the New York Yankees and the Tampa Bay Devil Rays played the first game of the season in Tokyo, Japan. This game was an effort by major league baseball to showcase baseball internationally. It was also used to promote the idea of a World Cup of Baseball to parallel soccer's World Cup, with some even dreaming of a global baseball league. The players and fans were, however, reporting something different. Fans in New York grumbled about the game's beginning at 5:00 a.m. (EST). The day after the Yankees returned to New York, the *Daily News* reported Yankee outfielder Gary Sheffield as saying, "Man, I still don't know what time it is" (Borden 2004, 67). The newspaper story went on:

Sheffield still felt out of it yesterday and he wasn't the only one. Tony Clark's eyes had rivers of red running through them and Derek Jeter said he still couldn't get back on a normal sleep schedule.

"I might even go drink some coffee today," Clark said. "And I never do that—it messes with my stomach and everything—but I just need the caffeine."

Jason Giambi said his surgically repaired knee felt fine, but the rest of him felt "like a train wreck."

"I think everybody was dragging a bit," Giambi added. "I think the jet lag really hit."

This time-space compression worked to make someone feel like a train wreck and inspired a non-coffee-drinker to drink coffee for the caffeine even though he expected it to make him sick.

Speed of transportation technology would not cure this problem. Even if the Concorde were still in operation, when

the Yankees played in Japan their bodies would still manifest their New York circadian cycles, and their Japanese opponents would still manifest Japanese circadian cycles—the time chosen to play the game would give one team a significant advantage. This effect has been documented with regard to games played between teams in the eastern and Pacific time zones in the United States. In the 1991–93 seasons, home teams in the eastern time zone had a statistically significant advantage in the number of runs they scored when playing teams that were based in the Pacific time zone (Recht, Lew, and Schwartz 1995). As anyone who has experienced jet lag knows, along with luggage one also travels with the cycles—both social and biological—of the place from which one comes. In addition, studies of jet lag have long demonstrated that it is worse if one travels eastward (Klein and Wegmann 1974).

The relationship of place and time, then, is psychologically, socially, and biologically encoded. Flows of goods, services, people, and capital across time zones should make apparent the temporal differences between places, and, in fact, many people exhibit a great deal of practical knowledge of how to deal with such temporal obstacles, yet this issue is theoretically underappreciated. This is, in part, because of the history of cultural concepts of time-reckoning that have tended to bring different cycles and processes into the single, homogeneous representation of clock time.

The Homogenization of Times

The development of modern timekeeping homogenizes times—solar time, longitudinal time, and biological rhythms. This homogenization pushes these different temporalities out of awareness in favor of the clock. Solar cycles do not coincide with lunar cycles, and seasonal weather cycles are not clearly delineated by astronomical events, although we now use calendars that subsume lunar cycles under a solar year and 12 culturally constructed months and we define the beginning of seasons by solar rather than weather events. At the level of daily experience, multiple rhythms of activity are subsumed under clock time. For instance, what I found in rural Trinidad was that the activity cycles of farming, shopkeeping, schooling, and transportation did not coincide. Each of these activities had its own rhythm and pace. The farmers in the village engaged in what Comitas (1973) calls "occupational multiplicity" and had to manage several different cycles of work. Some farmers worked on the roads and some on the large teak tree plantation. In the tropics, morning is not only the most comfortable time to work (particularly if the work involves cutting grass and brush) but also the most efficient. Road work and teak plantation work occurred at the best time for doing agricultural work. Local shops kept erratic hours, and some rum shops boldly posted signs that declared "Open any day at any time." This signage was not only an indication of the flexible hours of the establishment but also mandated by law for establishments with a particular type of

liquor license. Under circumstances of such diversity of activity cycles and rhythms, reference to the clock was as often cause for disputes as for coordination of activities (Birth 1999), and representations of these rhythms in terms of clock time dissolved their intricate relationships. Clock time created a homogeneous representation of these different temporal cycles and activities.

Historically, the process of homogenizing time was long and laborious. The steps included ignoring the difference between sidereal time (the earth's orientation to the stars) and solar time (the earth's orientation to the sun) and developing standard mean time in order to hide the differing lengths of the solar day (Landes 1983; Dohrn-van Rossum 1996; Borst 1993; Howse 1980; Steel 2000). There is no longer any direct link between solar time and clock time. The use of solar time was a casualty of the need to standardize time, and the need to standardize time was a necessary condition for converting labor into a commodity. Because the earth rotates while revolving around the sun, a full rotation (360°) is not the same as one cycle of a point's returning to the same orientation toward the sun, say, from zenith to zenith. This is further complicated by the earth's elliptical orbit and its changing speed as it moves around the sun. The result of this is that solar days vary slightly in length and equal 24 mean standard hours only four times a year—around April 15, June 15, August 31, and December 24. Initially, clock time as we experience it was computed as an average of the different lengths of solar day—hence the term “mean time”—but as measurements of the earth's rotation became more accurate, fluctuations such as those caused by the wobbling of the earth's poles were noted. Even the average of solar time did not achieve the consistent accuracy desired, so the measurement of time needed to be divorced from the earth's rotation and linked to a more predictable oscillator. Today, clock time is determined by the averaging of the time indicated by cesium clocks distributed across the world. Ironically, the communications technology that enables time-space compression is also necessary for contemporary determinations of accurate clock time.

The multitude of local, longitudinally determined times is reduced to a small number of time zones. Every meridian has its own solar time, but the clock time of a location is based on its time zone. Time zones represent a step toward time-space compression in that they erase regional spatial differences; the times of all longitudes in a time zone are represented by the time at a single longitude. The determination of zone-defining longitudes is the result of national and regional political and economic processes, and time zones are easily divorced from any reckoning of solar time. In a time zone such as that of China, the difference in longitudes at the edges of the national time zone results in over three hours' difference in solar time but no difference in standard time: when the sun rises in Shanghai, there are still several hours of darkness left in Kashgar, but it is the same clock time in both locations. In fact, there are several places on the globe where one un-

dergoes a time change moving along a north-south axis. The most extreme example of this is moving from Samoa northward to Kiribati and then northward to Atka in the Aleutians (table 1).

The time change with which we are most familiar, though, is daylight saving time. If one takes into account all of these issues, the relationship of solar time to standard time is approximated by the following equation: $9.87 \sin 2[360^\circ (N - 81)/365] - 7.53 \cos [360^\circ (N - 81)/365] - 1.5 \sin [360^\circ (N - 81)/365]$, where N is the day number (e.g., January 1 is day 1). This equation must be adjusted for the difference between one's longitude and the meridian that defines standard time for the time zone—each degree of longitude implies a four-minute difference in mean solar time. Finally, it must be adjusted further if daylight savings time is in effect. The reason the result is only an approximation is that the earth's tilt and rate of rotation vary slightly.

Ignoring the differences between solar time and longitudinal time, averaging the length of the solar day to create mean time, ignoring variable cycles of daylight in favor of regular clock hours, creating time zones, and making these definitions of time internationally accepted were important features of both the scientific and the industrial revolution. In natural science, this concept of time has been universally accepted as a standard of measurement, and in the social sciences it has been used as a means of documenting the historically and culturally specific ideological constructions of industrial capitalism. Not surprisingly, those different views contribute to the epistemological divide between these disciplines, yet in these seemingly opposed reactions to contemporary concepts of time there is a common rejection of the relationship of time to the globe. This divide creates an obstacle to grappling with the biological consequences of globalization or, more broadly, the interrelationship between biology and social systems, because both perspectives ignore globeness.

Epistemological Divides

Elias complains that the different developments of the human and natural sciences have created difficulties in studying time: “By making the two fields appear not only as existentially different, but also as faintly antagonistic to and incompatible with each other, this type of conceptualization quite effectively closes the door to enquiries into the problem of the rela-

Table 1. Time Zone Changes along a North-South Axis

Place	Longitude	Time Zone Relative to Greenwich Mean Time
Samoa	171°	-11 hours
Kiribati (Gilbert Islands)	174°	+14 hours
Atka (Aleutian Islands)	174°	-10 hours

tionship between what we call ‘nature’ and ‘society’” (1992, 86), and “If one explores ‘time’ one explores people within nature, not people and nature set apart” (p. 97).

The divisions between human nature and human culture created by the science wars contribute to the hiding of many contradictions of contemporary capitalism. In biology, psychology, and medicine there have been many studies of circadian cycles (see Foster and Krietzman 2004; Moore-Ede, Sulzman, and Fuller 1982; Palmer 2002; Pittendrigh 1993; Wever 1979), and the robustness of the 24-hour circadian biological clock in humans is now well established (Czeisler et al. 1999). This is true even under unusual circumstances. For instance, astronauts on the space shuttle maintain most aspects of the 24-hour cycle, with the exception of the duration and quality of sleep (Monk et al. 1998), and sailors following an 18-hour sleep/wake cycle on a U.S. Navy submarine maintained a 24-hour melatonin cycle despite the 18-hour cycle of activity (Kelly et al. 1999). The strength of the biological clock produces conflicts between body processes and labor demands. The U.S. Congress even commissioned a study of the effects of night work on health (U.S. Congress, Office of Technology Assessment 1991), and this literature has grown very large, with Costa et al. reporting more than 1,000 references (2004, 837). The effect of these work patterns on productivity and safety has spurred a new breed of consulting firm, such as Circadian Technologies Incorporated, that specializes in using chronobiology to increase shift-work productivity.

Chronobiology regards light as one of the most important environmental factors in regulating circadian cycles (Czeisler et al. 1999; Czeisler and Brown 1999; Czeisler and Wright 1999; Shanahan, Zeitzer, and Czeisler 1997; Wehr 2001; Wright et al. 2005). Studies of biological rhythms are often conducted in controlled environments in which the timing of light/dark cycles is defined in relationship to the clock. This raises a methodological problem, however: the transition from night to day is different from the transition from dark to light in the laboratory. Danilenko et al. write, “The natural zeitgeber, the dawn and dusk signal, is an obvious but little investigated paradigm given the standard laboratory procedure of rectangular wave (on/off) illumination” (2000, 438). The light intensity of dawn is sufficient to entrain circadian cycles (Danilenko et al. 2000; Meijer and Schwartz 2003). This implies that organisms synchronize to light/dark cycles, not to 24-hour days—that the concept of the 24-hour day is a cultural creation.

Since light/dark cycles are the most important influence on circadian rhythms, it is not the earth’s rotation per se but the timing of sunrise and sunset that are the relevant variables, and these do not occur at 24-hour intervals but change daily and according to season, latitude, and longitude. The longitudinal variation is further complicated by time zones and, in some locations, the use of daylight savings time. There is considerable difference between the earliest sunrise at 5:07 a.m. (EST) and the latest sunrise at 7:14 a.m. (EST) in Boston

in 2006, and whereas the change to daylight saving time equals one hour on the clock from one day to the next, it is not a one-hour change in the time of sunrise—in Boston the difference was 58 minutes.

Despite this, most studies of biological rhythms, even those outside the laboratory, continue to make reference to clock time, even though the more relevant indicators of light/dark cycles are sunrise and sunset. Even the literature on transportation accidents, most of which occur outdoors, tends to represent the timing of accidents in relationship to the clock and not to the sun (see Åkerstedt and Folkard 1995, 1996; Folkard 1997; Folkard et al. 1999), with one study that encompassed 17 countries of differing latitudes and longitudes ignoring how location can affect the duration and timing of daylight (Adams-Guppy and Guppy 2003). If sunlight is an important zeitgeber, its neglect is permissible only with populations that live and work solely in conditions of artificial light and are not exposed to the entraining power of natural sunlight at dawn.

The emphasis on the stability of circadian biological cycles measured and charted by hours and minutes over the latitudinally and seasonally variable light/dark cycles creates a false image of a 24-hour biological clock that remains unchanged throughout the year. Presentations of biological “knowledge,” then, are consequently refracted through the culturally created clock of hours defined in relationship to midnight, not by the variable cycles of the solar day.

Similarly, medications are given at regular, clock-determined schedules rather than according to metabolic cycles (Zerubavel 1979), and the significant physiological processes of childbirth are mapped by the calendar and the clock, so that “the more intrusive the obstetric assistance, the more the woman is forced to oscillate between the all-encompassing body time of her labour and the rational framework of her clock time environment” (Adam 1995, 49).

Social scientists often ignore or play down biological cycles in their discussions of different cultural concepts of time and the links between temporal frameworks and power relations (Birth 2005; Gell 1992; Greenhouse 1996; LeVine 1997; Rutz 1992; Zerubavel 1981). The emphasis of these studies has often been to show the historically and culturally contingent nature of contemporary, clock-driven timekeeping, and attention paid to natural and biological cycles does not seem relevant. In some cases, when “natural rhythms” are invoked, they are dismissed. For instance, Castells recognizes that the network society’s effort to “escape from the clock” is at odds with the close connection between the “rhythm of human life” and the “rhythms of nature” (2000, 276), and he suggests “that the network society is characterized by the breaking down of the rhythms, either biological or social, associated with the notion of a life-cycle” (p. 277). Discussions of cultural conceptions of time, then, tend to be refracted through the representation of alterity and consequently ignore pan-cultural tendencies to acknowledge and organize social rela-

tionships around day, night, and biologically driven cycles of sleep and activity.

Consequently, atomic time, with its standardized 24-hour day, has come to be viewed as “natural” by scientists who examine human biological flexibility and variation, and this has permitted social scientists to study time as culturally constructed without having to examine the relationship of these constructions to local environmental cycles or human biology. Both scholarly communities rely on methodologies that erase nature. The social sciences admit their dismissal of nature more openly than the physical sciences, but such openness does not make the dismissal legitimate.

Instead of arguing against reductionism as a justification for ignoring science—a standard social scientific stance—we need to grapple with the knowledge that science creates, and instead of rejecting evidence that scientific methods might be culturally shaped we need to wrestle with the constraints of that cultural influence on the knowledge that could be gained. In the case of time and biological cycles, this leads to recognizing that the standardization of time in science has led to relating the many cycles of living organisms to the vibration of cesium atoms, not to the earth’s somewhat variable rotation and cycles of daylight. Precision of measurement in the study of biological cycles has overshadowed the understanding of the relationship between solar cycles and biological cycles. Ironically, the imposition of culturally created standardized timekeeping on the study of biological rhythms has generated a body of knowledge on the relationship between these rhythms and the homogenized, standardized time created in the process of globalization but not a body of knowledge on their relationship to the earth’s erratic cycles of rotation and daylight. Both science and social science have produced absolute, globally transcendent concepts of time.

Linking natural and social phenomena is crucial to understanding social time (Adam 1995, 51; Elias 1992, 86) and consequently to understanding the interaction of homogenized time with local experiences of multiple socially and environmentally embedded cycles. The natural sciences’ adoption of homogenized time combined with the social sciences’ eschewing of biological knowledge obscures the ability to understand not only the interaction of nature and culture but also the interaction of the local and the global.

Embodied Contradictions

Thompson’s “Time, Work-Discipline, and Industrial Capitalism” (1967) provides an account of the relationship between the development of conceptions of time, timekeeping technologies, and work discipline during the industrial revolution. Foucault (1997) closely examines the relationship of discipline and time, although he uses examples of schooling and military drilling rather than the factory contexts described by Thompson. In *Discipline and Punish*, Foucault argues that the temporal structures of schools and the military control the body and its movements and inculcate an embodied tem-

poral discipline. On the one hand, this seems to be consonant with the logic of Taylorism: to increase production, one increases the efficiency of body movement on the assembly line. On the other hand, the literature on embodiment goes beyond the control of movement to examine the way power acts on the body. The new emphasis on instantaneous exchange has inspired new technologies to control the body. Enhancing productivity is no longer a matter of manipulating distances and movements as if bodies were extensions of the machine but a matter of the manipulation of circadian cycles and mental capacities to reduce the duration of circulation. This ideologically involves a denial of nature at the same time that biological capacities are embraced and sometimes pharmacologically enhanced.

Chronobiologists recognize that humans, while diurnal animals, are unusual among animals in their ability to exert “volitional control over their temporal niche (e.g., in the form of self-imposed sleep deprivation, night work, and high-speed travel across multiple time zones)” (Dijk and Edgar 1999, 112). Consequently, when studying humans in their natural habitat as opposed to the laboratory, it is impossible to understand many human biological cycles without reference to humans’ choices and social lives. Even in the laboratory, social contact is a powerful zeitgeber (Wever 1979, 151). McEachron and Schull point out that such entrainment does not mean that humans’ biological diurnal tendencies are overcome; instead, current social relations, particularly in the workplace, create pressure “to be active behaviorally at times when our endocrine systems are most urgently demanding retreat” (McEachron and Schull 1993, 336). There have been multiple studies of the effects of artificial light on the human biological clock, and all demonstrate that this clock is influenced by such cues (Koller et al. 1994; Trinder et al. 1996; Boivin and Czeisler 1998; Waterhouse et al. 1998; Wehr 2001; Wehr et al. 1995; Wright et al. 2005; Zeitzer et al. 2000). One study even revealed that the timing of melatonin secretion shifted by an hour whenever subjects changed between daylight savings time and standard time (Wehr et al. 1995, R177). Consequently, any social activity, either labor or leisure, that relies on artificial light at night will have an effect on human biological circadian cycles. One chronobiologist has mentioned “prime-time TV scheduling” and early start times for morning shifts as two factors that can disrupt sleep (Monk 2000, 90).

There are particular hormones that are implicated, of which cortisol, thyrotropin, and melatonin will be emphasized here. These hormones are also involved in metabolism and in many mental states and psychiatric disorders, particularly mental states related to stress. Cortisol plays a major role in protein and lipid metabolism and increasing blood glucose levels, and it is also part of the body’s response to stress. In diurnally active humans, cortisol rises just before awakening and then begins to decline during the first hours of wakefulness. Thyrotropin works on the thyroid to generate the production of thyroid hormone, a hormone involved in cell metabolism. Its levels peak at night and decline during the day. Melatonin

acts to promote sleep at night and peaks before the onset of sleep. In sum, metabolism and consequently the physiological basis for physical activity are tied to temporally sensitive hormones. Among diurnal primates (including humans) the cycles of these hormones are synchronized. Among humans who deviate from diurnal activity cycles, the levels and cycles of these hormones change and their relationship becomes desynchronized. This is most acutely felt by most people on the second or third day after a significant time shift such as that caused by jet lag. The reason for this is that all the hormone rhythms are equally out of synch with the environment on the first day and adjust to the new temporal setting at different rates (Foster and Kreitzman 2004, 203).

One of the elements of Foucault's (1977) insights on discipline is the importance of inducing stress as a means of achieving discipline, and one strategy for inducing such stress is temporal control. Physical and emotional stress can result in elevated cortisol levels, and temporal discipline, if it disrupts sleep/wake cycles, also affects cortisol, thyrotropin, and melatonin levels. Foucault's emphasis on embodiment does not invoke biology, but with regard to circadian cycles what he argues is consistent with what endocrinology suggests—that temporally disciplined activity should elevate and alter thyrotropin and cortisol cycles and, if it occurs at night, suppress or at least delay melatonin secretion.

Research on night work demonstrates this flexibility in individual hormone levels (Weibel and Brandenberger 1998) but also indicates many negative consequences of the desynchronization of hormonal cycles that results from such work. These consequences include an inability to get sleep comparable to nocturnal sleep, increased stress, diminished cognitive performance, and negative health effects (Knutsson 2003; Rajaratnam and Arendt 2001). Such desynchronization demonstrates that it is possible to create circumstances in which the cycles of these different hormones are not directly linked but can become unhealthily independent. Night work disrupts the normal relationship of hormones, a state known as internal desynchronization. In night workers cortisol remains at higher levels throughout the period of sleep than in day workers but during working hours is lower than for day workers and declines throughout the working period. Thyrotropin is lower during sleep than for day workers, but in the course of the shift thyrotropin levels, which begin lower than those of day workers, rise to higher than day-worker levels—their slope during activity is the opposite of that for day workers (Weibel and Brandenberger 1998). Nighttime physical activity influences circadian cycles (Baehr et al. 2003; Mistlberger and Skene 2005; Mrosovsky 1996; Mrosovsky et al. 1989). It increases cortisol levels and causes phase delays in melatonin secretion (Buxton et al. 2003; Monteleone et al. 1992; Van Reeth et al. 1994) and a delay in temperature rhythms (Eastman et al. 1995). Nocturnal exercise also has an effect on thyrotropin levels, with early night activity increasing nocturnal levels and predawn activity delaying the normal morning reduction (Van Reeth et al. 1994). These

results are consistent with the growing awareness that physical activity can affect the phases of circadian cycles (Dijk and Edgar 1999, 115; Mrosovsky 1996). Indoor lighting is sufficiently strong to affect circadian cortisol and melatonin rhythms (Boivin and Czeisler 1998). These hormones, then, all demonstrate differences between night workers and day workers, but they do not show the same changes. Night work does not break down biological rhythms—instead, it fragments the coordination of the body's multiple hormonal rhythms. The 24-hour readiness demanded by time-space compression can produce internal desynchronization.

This has health consequences. There is a large literature on the effects on productivity and health of workers laboring at night. In fact, night work is a domain in which the flexibility of human cultural behavior confronts a degree of inflexibility in human biology. Weibel and Brandenberger discovered that night workers who were satisfied with their schedule still showed signs of internal desynchronization after two years (1998, 206). In night workers cortisol levels were unusually elevated and thyrotropin levels were unusually low when these workers were sleeping during the day. In comparing hormone levels at work, night workers had cortisol levels that were lower than those of their daytime counterparts but still higher than when their daytime counterparts were sleeping. In effect, night workers had consistently elevated levels of cortisol. The difference between the cycles of different hormones is striking. Thyrotropin ceases to act in concert with cortisol but instead cycles independently of cortisol under such circumstances.

Many diseases that are related to stress—for example, heart disease, high blood pressure, and cancer (see Sapolsky 1998)—and the disruption of embodied circadian cycles increasingly replace contagious diseases, workplace accidents, and malnutrition as major causes of worker mortality. Whitehead, Thomas, and Slapper (1992) associate peptic ulcers, cardiovascular mortality, chronic fatigue, excessive sleepiness, difficult sleeping, increased divorce rates, increased rates of substance abuse, and depression with night work. The study commissioned by the U.S. Congress found that night workers' desynchronization with daily social cycles disrupted their ability to meet responsibilities and created a feeling of alienation from the community because of the difficulty they have in participating in recreational, social, and religious events (U.S. Congress, Office of Technology Assessment 1991). The *Diagnostic and Statistical Manual IV-TR* (APA 2000, 622) has a category for "Circadian Rhythm Sleep Disorder" caused by "a mismatch between the individual's endogenous circadian sleep-wake system and exogenous demands regarding the timing and duration of sleep." The symptoms of this disorder are described as "clinically significant distress or impairment in social, occupational, or other important areas of functioning" (p. 629).

These deleterious effects are not only caused by night work; long-term restrictions on sleep also have a negative effect on alertness and mood (Czeisler 2003; Dinges et al. 1997; Van Dongen et al. 2003). Folkard and Barton (1993) demonstrated

that work shifts that start early in the morning (e.g., 7 a.m.) can disrupt sleep in ways similar to night shifts. One study found that people who chronically get six hours or less of sleep per night show cognitive impairments similar to those in people who have had two successive nights without sleep (Van Dongen et al. 2003), which means that the extension of the work day into the early morning and evening and the emerging importance of flexible schedules (Costa et al. 2004; Presser 1999; Sennett 1998) can influence human circadian cycles. When this flexibility is demanded by the employer rather than chosen by the worker, it tends to have negative effects on sleep and mental health and increases stress (Costa et al. 2004; Janssen and Nachreiner 2004), with flexible schedules that disrupt circadian cycles having the greatest negative effects (Giebel et al. 2004). Many patterns of labor and leisure that result from the use of indoor lighting and the nocturnal use of telecommunications that link the globe can restrict sleep in ways that, over time, share some consequences with shift work.

The problems created by sleep restriction and sleep deprivation not only affect the laborers involved but have potentially broader consequences. Moore-Ede (1993) notes that many major disasters caused by human error—the *Exxon Valdez* oil spill, the nuclear accidents at Three Mile Island and Chernobyl, and the Union Carbide disaster in India—all occurred at night and were associated with excessive overtime and poor shift-work scheduling.

The pressure of time-space compression can not only cause internal biological desynchronization but also disrupt the relationship between the body's processes and its environment causing external desynchronization. Athletic competitions, events tied to a particular locale in which pharmacological intervention is impossible (indeed, it is prohibited), may produce such external desynchronization. During the 2004 Summer Olympics in Athens, many journalists and commentators asked why events were scheduled during the heat of the day. For instance, both the men's and women's marathons were scheduled at 6:00 p.m., whereas in the Sydney Olympics in 2000 such events had been held in the early morning hours. To make matters worse, the endogenous cycle of core body temperature in humans peaks in the early evening, and therefore the heat of the time of day interacted with the cycle of body temperature to exacerbate heat-related problems. Both before and during the race, the heat of the day in the early evening hours was noted, particularly when the British runner Paula Radcliffe dropped out of the women's marathon because of heat exhaustion. The scheduling of these events was not the result of local tradition or conditions. The previous October there had been another marathon in Athens, and it had begun at 8:30 a.m. Throughout the world, the typical start time for competitive marathons is in the morning. The scheduling for the Olympics was anomalous for marathon running and seemed driven by the objective of maximizing the audience that inspired the greatest advertising revenues, namely, Western Europe and North America.

The Masking of Embodied Contradictions

Internal desynchronization and its health consequences are part of the physical costs of labor. The physiological contradiction is not currently resolvable except by using telecommunications to have daytime workers available to nocturnal interests halfway around the globe. The physiological contradiction can be masked, however, by a combination of intense social activity, intense physical activity, and pharmacological interventions such as stimulants to keep one awake and sedatives to force sleep during daytime hours. The manipulation of the timing and intensity of light has become an important component in strategies to assist night workers and those who suffer from jet lag to adapt to their schedules (Boivin and James 2002; Bonnefond et al. 2004; Dumont, Benhaberou-Brun, and Paquet 2001; Eastman and Martin 1999; Monk 2000; Revell and Eastman 2005).

Drug "therapies" are also being devised, with modafinil/provigil being the most prominent example. The emergence of this drug is not surprising: as Foster and Kreitzman note, circadian-related disorders cost an estimated \$40 billion in the United States in effects on production, use of medications, and increased accident rates. They add, "It is a virtual certainty that new, more targeted, pharmaceutical interventions for sleep disorders will become available" (2004, 198). Modafinil, which is hailed by some as a miracle drug that allows people to stay awake without any sign of the health consequences of amphetamine abuse, seems ideally designed for the challenges the body faces under conditions of time-space compression. While the approved use of the medication is for narcolepsy, most prescriptions are for other uses, including the treatment of depression and fatigue and as "go-pills" for U.S. Air Force pilots on long missions (Barrett 2004). It has received increasing attention as a means of treating shift-work sleep disorder (Czeisler et al. 2003; Revell and Eastman 2005; Walsh et al. 2004), although research on the alertness of night workers taking the drug throughout their shifts has found that these workers are still susceptible to severe sleepiness and diminished psychomotor performance (Czeisler et al. 2003, 2005). In addition, modafinil does not have identical effects in all cognitive tasks (Turner et al. 2003), with tasks of short duration showing the smallest difference between subjects taking modafinil and those taking a placebo (Walsh et al. 2004). Not surprisingly, media claims are exaggerated. As a report in the *New York Times* said, "In a culture of 24-hour stores, graveyard shifts, and coffee shops on every corner, modafinil might also pose a more subtle danger: to the countless Americans in search of an extra edge, modafinil could be a cure for sleep" (O'Connor 2004). This indicates that some, at least, view the body's need for sleep as pathological. The desire of some for such a cure is echoed by scientists who document the limitations of modafinil—"the residual sleepiness that was observed in the treated patients underscores the need for the development of interventions that are even more effective"

(Czeisler et al. 2005, 476). Thus even the science that demonstrates the “stability” and “precision” of endogenous circadian human biological rhythms (Czeisler et al. 1999) seeks therapies that manipulate these cycles to promote nocturnal alertness and reduce the health consequences of night work and sleep deprivation. At the same time, some scientists warn that the use of modafinil “is not natural and may cause ethical attention whenever it is regularly used in work situations, for its long-term effects after several months or years are still today completely unknown” (Bonnefond et al. 2004).

Thus the globeness of time-space compression not only creates internal biological conflicts but is met with new therapeutic interventions—new commodities that empower ideological compliance. The desire for such therapies drives consumers and health professionals to find more effective treatments for the pathological consequences of forcing humans to work at night or with too little sleep. Will this type of commodity become one of the new basic subsistence needs?

Global Distributions of Power and Embodied Contradictions

The global distribution of these embodied contradictions and the technologies and the drugs used to address them are not even, and neither is the distribution of the power to influence how time-space compression is experienced in a particular time zone. The technologies, drugs, and power are concentrated in Europe, East Asia, and North America. This constellation leads to absurdities that strike one as both humorous and patently unfair. In *Caribbean Discourse*, Glissant provides an example of this: “Candidates in an official examination (for entry into the police force, May 1979) sat their tests at 3:00 a.m., in order to coincide with the time of the exam in France” (1989, 57n). It is our residing on a globe that results in this coincidence.

The motivation for time-space compression is often described in terms of taking advantage of technology that abbreviates or eliminates the time of transactions in order to make more money. Basically, the relationship of this idea to global capitalism and flexible accumulation is similar to the relationship of commoditized clock time to industrial production. There is one important difference, however: it is not necessary for laborers to adopt an ideology of time-space compression for the system to work. This is an ideology of those engaged in financial markets and service economics. This makes it different from the shifting temporal consciousness of workers during the industrial revolution. These workers adopted an equation of time and wages. In fact, the industrial capitalist link between average labor time and wage coexists uneasily with time-space compression, particularly if night workers receive higher wages. One alternative to this disruption of socially average labor costs is to take advantage of modern telecommunications technology to distribute workers across the globe so that night wages are not necessary—a process noted by Friedman (2005) in his efforts to

represent the global economy as working as if the world were flat. This strategy defers to human diurnal circadian cycles rather than breaking down natural rhythms. It also suggests that some corporations recognize that the temporal qualities of a place might be an asset.

It is the classes involved in flexible accumulation that are most subject to the ideology of time-space compression. This is implied not only by work habits but also by leisure activities. As Chatterton and Hollands describe for Britain, “The dominant audiences of nightlife spaces are mainstream, higher-spending consumption groups such as young professionals, aspiring ‘townies,’ and students” (2002, 12). This creates potential splits within this class between those who reside and operate out of the metropolises that define time and consequently the timing of financial markets versus those who reside and operate out of other parts of the globe. Live events, whether the operation of exchange floors or sports competitions, tend to occur in greater concentrations in time-defining locations. The uneven longitudinal distribution of the global cities listed by Sassen (1998)—New York, Los Angeles, Paris, London, and Tokyo—is apparent, as is the fact that a huge proportion of the world’s population lives outside of these cities’ time zones. Time-space compression and its associated physiological conflicts are manifested most in relationships with these cities and consequently are unevenly distributed across classes and around the globe. In addition, time difference becomes an important display and means of reproducing the power of these locales.

The metropolises also, in subtle ways, define chronobiological knowledge. The use of standardized 24-hour clock time for representing circadian rhythms is most methodologically sound for discussing city-dwelling humans who live their lives by artificial light tied to clock-driven schedules—in other words, discussing the temporal habits of metropolitan populations.

Whatever one’s local time, consumption patterns that rely on global communications and media tend to be in terms of the time zone of one of these global cities. Through consumption, differential power relations that privilege certain time zones can create the internal desynchronization of endocrine rhythms in people in other time zones through the external desynchronization caused by relationships that span time zones. The embodied consequences of global capitalist circulation are products of both labor and leisure.

Conclusions

Time-space compression is a significant feature of contemporary global capitalism, and as such it generates several contradictions that are ideologically concealed. First, it relies on pitting biology against society—a contradiction most acutely felt in night work and jet lag. This division of nature from society is reinforced by a refusal to address the biological consequences of ignoring circadian cycles and the maintenance of a divide between biological and social science. Second, it generates contradictions between different local times.

The absurdity of Martiniquan students' taking an examination at three in the morning is evidence of this. The logic of many of those enmeshed in capitalism is that certain activities must take place simultaneously across the globe, even though such simultaneity is also an illusory product of modern concepts of time (Galison 2003). This logic has the often unacknowledged consequence that the time of convenience in the metropole determines the time of execution of the activity globally, regardless of time differences. Third, it adds a dimension to the conflict between production and labor that Marx emphasized. Capital accumulation defers to no biological clock, but the experience of human labor and consumption includes the effects of the timing of these processes on the body and its cycles. The consequence of disrupting human circadian cycles is both internal and external desynchronization. This creates short-term problems in mood, sleep/wake cycles, and cognitive performance that are addressed with drugs, and it substantially increases the likelihood of long-term health problems. Fourth, it reinforces the power of those in particular locations in controlling such flows not only through access to technology but through timing. To gain immediate access to information, much of the world must realign its temporal habits to a very limited number of influential places. This has the consequence that those who control the timing of the distribution of important information are able to affect the bodily habits and physiological functions of everyone in the world who relies on that information. This effect is not complete control, however, but instead creates conflicts between different physiological cycles that are adaptive when synchronized. Time-space compression does not make a flat earth, but by virtue of our existing on a globe it makes some of capitalism's contradictions physically and mentally excruciating for those touched by it.

Thus we arrive at an important irony—that the so-called emphasis on space found in recent social theory results in globalization without a globe. This globalization cannot capture the material, environmental, physical, and biological influences on human activity, the technological and pharmacological attempts to overcome those limitations, or the new means of temporal exploitation based not simply on the quantity of labor or the productivity of labor but on the timing of labor. Marx was very clear about describing the toll exploitation took on the human body in disease and suffering (see Marx 1977, chap. 25). The physical and physiological dimensions of capitalism need to be acknowledged if we are to comprehend the material and not just the financial and conceptual consequences of time-space compression.

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diversity of expertise across the natural and social sciences, were also extremely helpful—I doubt that I fully responded to all of their astute observations and recommendations, but I immensely enjoyed their efforts to broaden my thinking.

Comments

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Birth examines an emerging conflict among social, biological, and economic spheres in the context of night work. He shows that spatial, temporal and seasonal differences are not external but embodied and that the capitalist leveling of such differences is a flattening of the body's internal rhythms. To avoid night work, he favors the use of communication technologies to distribute work across the globe. The proposed day-night sequence is already in use (Aneesh 2001, 2006): When offices close in the United States, software workers in India start working on the project during their daytime. When offices open in the morning in the United States, a good deal of work has already been done, thus creating a twenty-four-hour virtual office. But this global distribution of work is fraught with problems. Many Indian firms have started working at night to serve their U.S. clients during their daytime. The development of international call centers in India produces work-time inequality at the global level. As a global regime of "real time" prevails over the previously secluded temporal pockets of life, it not only reconfigures the local contexts of people's lives but also effects a break with local mechanisms of social integration and solidarity.

Despite its enormous promise, Birth's article faces a few quandaries. The assertion that postmodernism replaces the importance of time with that of space is a little too facile. Postmodernist discourse may have other theoretical problems, but it does not dispense with "time"; it only unmask the notion of modern time-consciousness as trapped in a philosophy of origins positing history as a teleological progression. Following Nietzsche's critique of reason via Heidegger's disapproval of "time" as a phenomenon separate from "being," postmodernism deconstructs the modern construction of time as something that can be cut up like space, a critique closer to Birth's own criticism of standardized hours, days, and time. There is no undermining of "lived time" in postmodernism, which is deeply influenced by Heidegger, who went to the extent of replacing static nouns such as "memory" with temporal nouns such as "remembering" throughout his writing.

With reference to biology, Birth's taken-for-granted scientific realism is also troubling. Scientific realism was based

on the theory that truth was empirically verifiable. Paradoxically, the theory itself could not be verified. Karl Popper's attempt to save it by replacing verifiability with falsifiability was rejected by Thomas Kuhn, who argued that if "failure to fit" were grounds for theory rejection, all theories would be rejected. Even Stephen Hawking gave up on scientific realism: "A theory is just a model of the universe. . . . It exists *only in our minds* and *does not have any other reality* (whatever that might mean). . . . Any physical theory is always provisional . . . no matter how many times the results of experiments agree with some theory" (1988, 10). Birth's scientific realism brings him back to the jaded binary of nature and culture when he criticizes anthropology for the erasure of "nature" just as his analysis promises to overcome the divide.

Scientific realism is only a theoretical problem until it becomes the sole authority on truth. By gaining this power over life, it subordinates experience to knowledge. The resulting devaluation of experience forces one to legitimize even so basic an experience as "a good night's sleep" through chronobiology. The authority of science is already formidable; if biology propagated the idea that sleeping less than six hours a night was better for one's health, the public would begin to move in that direction, discounting experiences of fatigue. The idea that scientifically created infant formula was at least as nutritious as breast milk brought down the percentage of women who breastfed their newborns to an all-time low (25%) in the 1970s. There is also the larger problem of the paradox of rationality: in pursuit of mastery over nature, the knowing rational subject not only constitutes a knowable world of objects but also becomes an object to be known and researched, producing an "iron cage" of rationality. Foucault's idea of biopower refers to this encompassing nature of reason.

Besides, biological research is often funded not for emancipation but for drug development (e.g., for sleep disorders); most biological research in both its funding and its function moves within capitalism, not outside it (as Birth himself notes). With the development of medications for sleep disorders, biological research has the ironic effect of hiding the social conditions that produce sleep disorders. This does not mean that it cannot be appropriated for emancipatory interests, as Birth shows, but it does explain why biological knowledge and the resulting drugs have nipped in the bud possible forms of opposition to night work. In short, what would help is not necessarily more research on the fact that humans are diurnal animals but a social movement against night work quite like industrial struggles for an eight-hour workday, a form of resistance to exploitation in order to loosen the consuming grip of the economic system on everyday social experience. I congratulate Birth for calling attention to a collective slumber on this issue and contributing to the formation of possible consensus.

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Birth describes the conflicts between human circadian rhythms and the current time schedule of social life. He shows that these conflicts are not sufficiently recognized by postmodernism, economics, the history of contemporary time-reckoning, and the epistemological divide between natural and social science. On all these points, his criticisms are more often than not pertinent, but at times the contradictions are also overestimated. For example, it is not correct, as he writes, that "clock time is determined by the averaging of the time indicated by cesium clocks distributed across the world." This averaging supplies atomic time, and atomic time is only one of the two determinants (the other being Greenwich Mean Time—universal time) of coordinated universal time, which is the basis of "standard time." Otherwise we could not use global positioning systems! Similarly, the establishment of "time zones" was a way not to divorce universal time from "solar time," which remains, as he is right to emphasize, the frame of our natural rhythms (work/rest) and especially the chief zeitgeber (or synchronizer) of our circadian biological rhythms. On these circadian rhythms his comments are welcome and accurate. Indeed, the prescribed work times in our industrial society produce internal desynchronization of circadian rhythms and external desynchronization with regard to daylight cycles. Of course it is only for administrative convenience that China has one time zone and not three. The same administrative convenience appears in Martinique when the candidates for entry into the police force are called together at 3:00 a.m. to sit their tests in order to coincide with the time of the exam in France. In this latter example, the true reason for this, which Birth does not report, is to prevent the candidates from being informed before their exam about the tests to be performed; but one could prevent this trickery by giving other tests of the same difficulty at 8:00 a.m. On these two examples and other assaults on body rhythms, such as night work, Birth is perfectly right to denounce rigidities that are useful for dominant people and cities but injurious to subordinated people. More attention to daylight cycles should be a rule for the scheduling of all human activities. It is scandalous that "the scheduling for the [2004] Olympics was anomalous for marathon running, and seemed driven by the objective of maximizing the audience that inspired the greatest advertising revenues, namely, Western Europe and North America." Birth reports that, on this occasion, "the British runner Paula Radcliffe dropped out of the women's marathon because of heat exhaustion," an example of numerous diseases provoked by misplacing activities that demand the full possession of capacities that are available only during a few hours of the body cycle. He mentions, citing Moore-Ede (1993), that "many major disasters caused by human error . . . occurred at night

and were associated with excessive overtime and poor shift-work scheduling.” It would not be surprising if the beginning of the next nuclear war (God forbid!) occurred at night, when politicians exhausted by day and night discussions could see no other way of preserving their power than to push the button releasing a catastrophe.

Must we be pessimistic about the consequences of globalization? Birth denounces “globalization without a globe,” meaning “a rotating globe where each locale has its own cycles of day and night.” It is true that globalization, if not controlled, tends to exaggerate the homogenization of standard time for numbers of people without attention to their location on the globe and to create “space-time compression.” But this tendency is not the consequence of the modern scientific conception of standard time itself. On the contrary, universal time and time zones are compromises between the regularity of new clocks (first mechanical, then quartzic, finally atomic) and the less regular rotation of the globe, which is not forgotten but observed. Besides, the very concept of time in all cultures is founded upon natural and cultural “invariants,” as I have outlined elsewhere (Barreau 2000). In the face of globalization, all cultures have their own means to accept what is reasonable and reject what is contrary to human dignity.

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Globalization finds expression in different ways, but most conceptualizations stress the way it has changed the nature of time and space. Whilst there are some who see the forces involved as threatening to gloss over their differences by asserting their interchangeability, others have highlighted the way in which time and space may work against each other. As Birth makes clear, time is the loser in this debate, with post-modernists arguing that the meaning of time has been eroded within the contemporary world but that of space enhanced. If such a view is accepted, the symmetrical, mutualized relationship implied by “time-space compression” would hardly make it an apt description for what is involved. Birth’s counter-case for recovering time and globeness in the face of such an argument invites three comments:

First, what is surprising about the post-modernist stress on the spatial is that it represents a discovery of space at the very moment when a significant number of geographers have started replacing its blandness with the particularity of place. Further, many would see the notion of place as capturing everything that typifies space-time individuality, though—except for Tommy Carlstein and Doreen Massey—none have defined this particularity in quite the same rounded way as Birth.

Second, with regard to the way he relates the homogenization of time to globalization and capitalism, Birth’s dis-

ussion has two interwoven strands, one stressing the homogenizing effect of clock time and the other the tendency of capitalism to erode time in its search for an instantaneity of profit. In response to the former, the critical issue is not so much clock time as the ends which it is made to serve. It is the zonal structuring of time and the temporal hegemony of dominant metropolises that matter most, yet both developments occurred relatively late in the evolution of capitalism. So-called commercial capitalism, with its exploitation of raw materials and goods over long distances, had already been a feature of European economies and their trade for nearly 300 years by the time systems like Greenwich Mean Time were instituted. The temporal hegemony of particular metropolises is even more recent. Neither was a base condition of capitalism. Yes, early forms of capitalism were interested in time savings on their exchanges. The more quickly capital was fed through each investment cycle, the more productive capital became. The standardization of time arguably arose from the nineteenth-century need to timetable communication systems, especially the railways, whose increasingly rapid pace brought local clock times into collision. Yet, that said, any world that involves rapid long-distance communication would have made the case for a zonal structuring of clock time. A further caution as regards capitalism’s sole complicity in eroding globeness is that whilst it undoubtedly works to homogenize the world at one level, it has also relied on the exploitation of difference at another by exploiting the disequilibria that come from difference in the costs of raw materials, labour, etc. More so today, differences in the cost of key factors of production such as labour drive the geography of investment. In this sense, a truly homogenized or flattened world would actually be anathema to capitalism.

Finally, Birth’s case is undoubtedly persuasive, but we are left with the impression that it is the recent demands of a globalization driven by capitalism that have challenged it most. What is possibly missing here is greater acknowledgement of the extent to which globeness has been challenged in purely traditional societies or in noncapitalist ones either because the psychologically, socially, and biologically encoded relationships between time and space have been disrupted or because standardized forms of clock time have been asserted over solar time. Thus, in traditional societies, we might see large-scale migrations as carrying with them a psychological and biological encoding of solar time different from that of the areas into which they moved. In a lesser way, the adoption of new crops and labour routines that mapped onto the growing season or calendar differently or even the adoption of farming itself might be seen as fundamentally changing how societies interacted with the local rhythms of solar time. Likewise, in noncapitalist societies like the former Soviet Union or China, the centralization of authority was a powerful incentive to treat time as a resource to be socially defined and deployed around the centre. Of the two, the Soviet Union was the more latitudinally challenged, but whilst early Soviet planning was minded—as William Husband has shown—to

“correct nature’s mistakes”, it still had to cope with 11 different time zones, though airports and stations do acknowledge the temporal needs of the centre. China is perhaps the better illustration. Organized into five time zones in 1912, it was reorganized into a single time zone in 1949 after the communist revolution.

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Birth presents Old and New World scenarios of daily lives influenced by what he calls “time-space compression.” The “flat world” described by Friedman (2005) has made worldwide instant communication available everywhere. People are able to communicate at lightning speed no matter how far apart they are geographically, and this facilitates the outsourcing of services. The idea of a “flat world” undoubtedly puts a new face on the global era. It is having an immense impact on global business, mostly in urban areas but already affecting rural populations. The migration of capital and manufacturing of goods across countries and continents through international commercial cooperation has resulted in productivity gains for international companies and market growth but resulted in fewer jobs and benefits as work becomes precarious across the globe (Alves 2000).

Important questions are posed in this new world: What are the benefits and negative consequences of time-space compression? The positive aspects cannot be denied, but are we ready for the new work times and the effects of irregular working hours on psychosocial health and well-being (Harma 1988, 3)? As Costa (2001, 15) puts it, “What kind of 24-hour society do we need? At what costs? Are they acceptable/sustainable?” The increasing devaluation of our temporality as diurnal animals living in a predominantly diurnal society has significant health and social effects. The biological desynchronization caused by nondiurnal work and irregular working hours is associated with social-family difficulties (Costa 2004; Nachreiner 2004). As Birth points out, business oriented in terms of time-space compression respects neither the difference between solar and biological times nor societal values and traditions. Religions have established distinctive days of rest: Saturday (Shabat) for Jews, Friday for Muslims, Sunday for Christians. Can time-space compression eliminate such differences?

Some years ago the Brazilian Supreme Court decided that work performed in continuous rotating shift work schedules should be limited to 36 hours a week as specified in the Brazilian constitution. The decision was taken after the judges had examined the petitions of citizens saying that they could not attend normal religious services or participate in family gatherings because of their work schedules. Nowadays labor unions and companies are implementing longer daily and

weekly work hours, but the reduced working time for continuous shift workers remains in force, particularly in the oil production sector (because of its strong labor union) and in public services.

Job scarcity induces workers to accept unfavorable conditions. A survey conducted in 15 European countries in 2000 showed that flexible working times meant longer, irregular daily and weekly and even weekend hours for most of the labor force (Costa et al. 2004), in spite of the regulation of working times.

Individual characteristics are often overlooked in hiring workers for night jobs: younger and older workers and single parents with small children may have additional difficulties balancing work, rest, and family responsibilities. Biological features may also make it easier or harder to tolerate work and sleep at irregular times and during traditional free-times (Costa 2004; Nachreiner 2004). The threats to our physical and mental health can no longer be ignored. Epidemiological studies provide evidence of short- and long-term illness and increased risk of incidents and accidents due to the performance of work during nondiurnal times (Knutsson 2003) and/or over long periods (Caruso et al. 2004). Private and public safety may be at risk, because production systems are more difficult to maintain and control when human beings are working at low-efficiency times, even when assisted by ergonomics specialist support systems. Birth mentions this issue in discussing the “embodied contradictions” of temporal efficiency and manipulation of circadian cycles.

Innovative worktime arrangements should be compatible with workers’ lives. Technology is a powerful tool for increasing knowledge and leading us to healthier lives, greater social freedom, and more productive livelihoods, but its use to compress the time-space dimension should be mostly for the public good.

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Birth’s essay opens up a series of issues concerning space and time that have been too little attended to. It does valuable service in once again emphasizing the importance of the so-called spatial turn across the social sciences and humanities and in pointing to the still often neglected importance of biorhythms. In fact, insofar as the spatial turn can be reduced to one theme, it must be linked to the extreme difficulty of thinking of process as both “spatial” and “temporal”—as the continuous unfolding of events, an unfolding that must be conceived as a continually renewed spacetime manifold which depends on a set of nonrepresentational biological-cultural preconceptions (e.g., in anthropology, Ingold 2006). In what follows I want to make three criticisms of a paper that has much to commend it.

First, Birth too often falls back on what might be called

the standard account of the triumph of a globalized time. Roughly, this follows E.P. Thompson's famous account, which has taken on the status of a folk theory and has become accordingly difficult to dislodge. The story goes like this: There was a time when people took the time necessary for the task, but then capitalism came along in the guise of clock time and living close to the "natural" rhythms of the body and nature was replaced by the artificial routines of structured environments. The problem is that this account is not only theoretically suspect but empirically incorrect. For example, in England, detailed empirical research by Paul Glennie and myself (Glennie and Thrift 2002, 2005, 2007) shows that clock time came into general use long before the Industrial Revolution and the stuff of work discipline, law courts, love affairs, gambling, and all the minutiae of everyday life. Therefore, the supposition that the conflict between a logic of temporal flexibility and lived time is a recent occurrence is highly suspect. Further, it is one which too often makes clock time into an all-encompassing and largely malevolent force at the expense of its partial and liberatory features.

Second, counterposing capitalism to an authentic lived time does a signal disservice to what might be possible to think—a tendency which is only enhanced by talk of "time-space compression," a concept that is too general to be helpful and is based on some simple psychological premises about the effect of speed on the psyche that date from the eighteenth century and were subsequently recycled by Marx and others. There are certainly circuits in which clock time locks with capitalism and does what most of us would regard as damage, but there are many other circuits in which it does not, not least because cultures take only limited notice of clock time in many situations and adapt it to their own purposes. In turn, the highlighting of this process of accommodation can be counted as part of a more general theoretical and practical turn in the social sciences towards approaches that liken the world to a series of unfolding hybrid assemblages which cannot be easily contained by conventional analytical categories such as "social" or "cultural." Indeed, to do so may be actively misleading insofar as these categories draw attention away from all manner of other unfolding assemblages which it is correspondingly difficult to see through the lens they provide.

Finally, I was very pleased to see this area of work being revived (see Parkes and Thrift 1980), but it has to be done in such a way that "culture" and "biology" are no longer seen as signifying radically different entities, the one impacting the other. At the risk of repetition, it is not clear to me that global capitalism can be unproblematically seen as a generalized culprit somehow threatening an authentic lived time. For example, in England, biological rhythms have been being played with since at least the sixteenth century, when equal hours and minutes first became general currency. Though one can certainly see all kinds of exploitation and immiseration in that period, it is not clear that the chronobiological consequences of these processes have created a serious problem for human well-being. This is certainly not to argue that stress

has simply been ironed out around the globe. It has increased—and unequally, in that some places dictate the temporal mores of others. But, at the same time, interesting new hybrids seem to have been formed based on practices like reading, writing, entertainment, and leisure, all of which have depended on dislodging chronobiological determinants to an extent. In other words, though it is possible to produce a narrative of capitalism pitting biology against society via time-space compression, some caution needs to be used in deploying it or one ends up striking out incidentals which turn out to be central.

Reply

I thank the commentators for their constructive discussions and regret that there is not space to develop all the interesting issues they raise.

Barreau and Thrift both mention issues that I oversimplified. Barreau observes that coordinated universal time involves both the use of cesium clocks and a recognition of the rotation of the earth. This time relies on the atomic clocks I described and adjusts them with "leap seconds." These leap seconds are added irregularly and are based on the empirical observation of the slightly irregular rotation of the earth. Thrift criticizes me for using Thompson's narrative of time consciousness in industrial capitalism (1967), and his work with Glennie criticizing Thompson's representation as historically inaccurate is extremely valuable and something that I need to incorporate into my future work (Glennie and Thrift 2002, 2005).

Aneesh points to important postmodernist discourses about time in criticizing my claim that postmodernism privileges space. In contrast, Thrift and Dodgshon agree with my claim. It is possible to reconcile these two views. The work to which Aneesh refers (e.g., Heidegger 1962, 1989, 1992) addresses the temporal assumptions in teleological concepts of history, whereas I address the homogenization of durations. Fabian's work (1983, 1991) has also been important in this regard within anthropology. Benjamin criticizes narratives of progress for assuming "homogeneous, empty time" (1968: 261), and this resonates with my concern about the homogenization of duration. My use of chronobiology and local time on a globe is meant to be disruptive of the concept of homogeneous time. Aneesh has prompted me to consider the parallels between this and criticisms of historical narratives, although my work is more inspired by Deleuze's (1994) discussion of repetition and difference than by Heidegger's concern with time and ontology.

Aneesh refers to the quandary of scientific realism. This is a very real concern in my attempt to synthesize chronobiology and political economy. I admit that there is a danger of adopting scientific realism in applying chronobiological knowledge,

and it is possible that I may have committed that error rhetorically. Despite the risk of such errors, I want to incorporate biological theories into my interpretive frameworks. I do so with an awareness that knowledge, whether of chronobiology or of Foucault, is culturally shaped and historically contingent. Knowledge from the physical sciences contributes to my hermeneutic, holistic approach to the study of time.

Barreau raises an epistemological concern very different from that of Aneesh, namely, that I do not properly recognize recurring empirical observations, such as the fact that the difference between regular clock time and the rotation of the globe “is not forgotten but observed.” As with scientific realism, I probably rhetorically slip into too constructivist a position at times. Still, whereas discussions of clock time in relation to the rotation of the globe are easily found, I wonder to what extent this knowledge is part of the temporal consciousness of many people. I think there is a danger that many people, particularly those engaged in management of workforces, may view homogeneous clock time as “real” time and then make decisions based on this humanly created reality.

Even though Aneesh and Barreau criticize the article from very different epistemological positions, they both support the potential of bringing together chronobiological and social scientific ideas to develop a holistic critique of globalization. Such a critique can ideally generate interest across disciplinary boundaries. I think chronobiological knowledge has great potential for contributing to social critique, and I see value in engaging chronobiologists in dialogues about the consequences of contemporary capitalism. Still, Aneesh’s warning against adopting scientific realism and Barreau’s warning against neglecting accepted scientific knowledge are both important in any attempt to relate physical to social scientific discourses.

Both Aneesh and Thrift are concerned about reinforcing the divide between culture and biology. I seek to explore how culture and biology are contrapuntal processes—sometimes working in unison, sometimes resonating, and sometimes dissonant. The article does emphasize moments when, in Thrift’s imagery, capitalism pits biology against society. I do believe capitalism pits biology against global processes, but this is not based on an assumption that biology and society are always in conflict. Elsewhere (Birth n.d.) I discuss how social processes enlist environmentally sensitive hormonal cycles to achieve culturally desired goals in Trinidadian parangs, a Christmas musical tradition of revelry in which musicians often strive to defy their diurnal tendencies. Thrift is right to point out that society and biology can work harmoniously, but the subject matter of this article is not conducive to the demonstration of that point.

Dodgshon and Thrift also express concern over my conceptualization of the relationship between capitalism, time-space compression, clock time, and globeness. The close link I make between homogenized clock time and capitalism is justified by classical economic theory’s treatment of the relationship of time, labor, and surplus value in capitalism. Marx’s idea of

“socially average labor time” (1970, 20–33; 1977, 684–85; 1993, 673) builds on the work of Adam Smith (1991) and Ricardo (1969) and is a significant move toward the homogenization of time in social scientific theories of capitalism. For Marx, it is not that all moments are equally productive but that, by averaging them, they can be represented as if they were. Homogenized clock time is not, however, a critical assumption in neoclassical economics, and this makes Dodgshon’s and Thrift’s criticisms justified. Indeed, Marx, in his *Grundrisse* (1993, 660), noted a contradiction between circulation time and labor time that was compounded by what he described as a tendency of capital to promote “*circulation without circulation time*” (p. 671). Rather than resolve this contradiction, my article seeks to show that it has physiological and social consequences.

The contemporary relationship in globalization between capitalism and the consequences of living on a globe demands attention. I agree with Dodgshon that a homogenized or flattened world is anathema to capitalism, and maybe I did not make this point strongly enough. Part of the intent of my paper was to criticize *New York Times* columnist Thomas Friedman’s (2005) metaphor of a “flat” world. The world is not flat; it is a globe. One implication of my argument is that we may be entering an era in which particular locations will have a competitive advantage based on their time zones in relationship to other key locations on the globe and that locations without a time advantage will compensate by attempting to trick the body, whether it is through high-wattage lighting or through drugs.

Such concerns lead to the important issue of human dignity and the practical implications of relating geography, chronobiology, and political economy. Barreau argues that “all cultures have their own means to accept what is reasonable and reject what is contrary to human dignity.” Scholarship can play a role in the determination of what is reasonable and the rejection of what is contrary to human dignity. Sometimes this involves challenging what some might call common sense and others might label hegemony. Fischer offers important practical insights along these lines. She asks what the benefits of time-space compression are and whether we are ready for new work times. Related to Barreau’s point about how cultures will seek a means to preserve human dignity, Fischer provides a source of optimism in a ruling by the Brazilian Supreme Court about rotating shift-work schedules. Yet, she also offers cases in which people are unable to resist schedules that are at odds with the daily cycles of their locales. The statement that technology related to time-space compression should be used for the public good is important, and I alluded to two sorts of such technology in my paper. The first emphasized using global telecommunications to distribute information-processing work across the globe so that people work during their normal waking hours. This could be viewed as one case of using technology for the public good. To me, there are also sinister interventions. I am extremely concerned about the use of drugs to attempt to overcome our circadian proclivities in service of a 24-hour global economy.

All the comments point to the need for an ongoing discussion and dialogue about the tangled web of economic theory, management practice, capitalism, globalization, time-space compression, and chronobiology. This has practical and theoretical consequences. However one wishes to conceptualize these relationships, the condition of living on a rotating globe that revolves around the sun (i.e., globeness) for our embodied experience of circadian cycles and global cycles of work, exchange, and consumption has to be considered when we think about globalization.

—Kevin Birth

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