memory of his story. And I have by me, for my comfort, two strange white flowers—shrivelled now, and brown and flat and brittle—to witness that even when mind and strength had gone, gratitude and a mutual tenderness still lived on in the heart of man.

Appendix A: The Evolutionary Context: Biology

1. Charles Darwin. From *The Origin of Species*. 1859. 6th ed. 2 vols. New York and London: D. Appleton, 1872.

[Darwin's great work had both a positive and negative influence on Wells. The first extract is taken from the summary concluding Chapter IV, "Natural Selection; or The Survival of the Fittest," of the sixth edition, the one Wells is likely to have known best. In it, Darwin (1809-82) connects the ideas of natural selection, diversification, and extinction, together so crucial in determining Wells's vision in *The Time Machine* of the fate of humanity in the far future.]

If under changing conditions of life organic beings present individual differences in almost every part of their structure, and this cannot be disputed; if there be, owing to their geometrical rate of increase, a severe struggle for life at some age, season, or year, and this certainly cannot be disputed; then, considering the infinite complexity of the relations of all organic beings to each other and to their conditions of life, causing an infinite diversity in structure, constitution, and habits, to be advantageous to them, it would be a most extraordinary fact if no variations had ever occurred useful to each being's own welfare, in the same manner as so many variations have occurred useful to man. But if variations useful to any organic being ever do occur, assuredly individuals thus characterised will have the best chance of being preserved in the struggle for life; and from the strong principle of inheritance, these will tend to produce offspring similarly characterised. This principle of preservation, or the survival of the fittest, I have called Natural Selection.

... we have already seen how [Natural Selection] entails extinction; and how largely extinction has acted in the world's history, geology plainly declares. Natural Selection, also, leads to divergence of character; for the more organic beings diverge in structure, habits, and constitution, by so much the more can

a large number be supported on the area,—of which we see proof by looking to the inhabitants of any small spot, and to the productions naturalised in foreign lands. Therefore, during the modification of the descendants of any one species, and during the incessant struggle of all species to increase in numbers, the more diversified the descendants become, the better will be their chance of success in the battle for life. Thus the small differences distinguishing varieties of the same species, steadily tend to increase, till they equal the greater differences between species of the same genus, or even of distinct genera. (I:159-61)

[In this second extract, from Chapter XV: "Recapitulation and Conclusion," Darwin encourages the optimistic attitude to the future of humanity that Wells, following Huxley's cue, would refer to scathingly as "Excelsior biology" (see Appendix A4) and attacked in *The Time Machine*.]

As all the living forms of life are the lineal descendants of those which lived long before the Cambrian epoch, we may feel certain that the ordinary succession by generation has never once been broken, and that no cataclysm has desolated the whole world. Hence we may look with some confidence to a secure future of great length. And as natural selection works solely by and for the good of each being, all corporeal and mental endowments will tend to progress towards perfection. (II:305)

2. E. Ray Lankester. From *Degeneration: A Chapter in Darwinism*. London: Macmillan, 1880.

[Sir Edwin Ray Lankester (1847-1929) had a distinguished career as a marine biologist, and became a close friend of Wells. In this short early work Lankester provided evidence of biological degeneration from his research on the life-cycle of molluscs, especially ascidians (sea squirts). His pessimistic analogies between biological degeneration and cultural processes (the fall of ancient Rome, linguistic decay, moral decadence) were characteristic of that body of late-nineteenth-century Darwinian thought out of which also emerged the world of the Eloi and Morlocks.]

Degeneration may be defined as a gradual change of the structure in which the organism becomes adapted to *less* varied and *less* complex conditions of life; whilst Elaboration is a gradual change of structure in which the organism becomes adapted to more and more varied and complex conditions of existence. In Elaboration there is a new *expression* of form, corresponding to new perfection of work in the animal machine. In Degeneration there is *suppression* of form, corresponding to the cessation of work. Elaboration of some one organ *may* be a necessary accompaniment of Degeneration in all the others; in fact, this is very generally the case; and it is only when the total result of the Elaboration of some organs, and the Degeneration of others, is such as to leave the whole animal in a *lower* condition, that is, fitted to less complex action and reaction in regard to its surroundings, than was the ancestral form with which we are comparing it (either actually or in imagination) that we speak of that animal as an instance of Degeneration.

Any new set of conditions occurring to an animal which render its food and safety very easily attained, seem to lead as a rule to Degeneration; just as an active healthy man sometimes degenerates when he becomes suddenly possessed of a fortune; or as Rome degenerated when possessed of the riches of the ancient world. The habit of parasitism clearly acts upon animal organisation in this way. Let the parasitic life once be secured, and away go legs, jaws, eyes, and ears; the active, highly-gifted crab, insect, or annelid[1] may become a mere sac, absorbing nourishment and laying eggs. (32-33)

... wherever in fact the great principle of evolution has been recognised, degeneration plays an important part. In tracing the development of languages, philologists have long made use of the hypothesis of degeneration. Under certain conditions, in the mouths and minds of this or that branch of a race, a highly elaborate language has sometimes degenerated and become no longer fit to express complex or subtle conceptions, but only such as are simpler and more obvious.

The traditional history of mankind furnishes us with notable

1 A class of worms.

examples of degeneration. High states of civilisation have decayed and given place to low and degenerate states. At one time it was a favourite doctrine that the savage races of mankind were degenerate descendants of the higher and civilised races. This general and sweeping application of the doctrine of degeneration has been proved to be erroneous by careful study of the habits, arts, and beliefs of savages; at the same time there is no doubt that many savage races as we at present see them are actually degenerate and are descended from ancestors possessed of a relatively elaborate civilisation. As such we may cite some of the Indians of Central America, the modern Egyptians, and even the heirs of the great oriental monarchies of præ-Christian times....

With regard to ourselves, the white races of Europe, the possibility of degeneration seems to be worth some consideration. In accordance with a tacit assumption of universal progress—an unreasoning optimism—we are accustomed to regard ourselves as necessarily progressing, as necessarily having arrived at a higher and more elaborated condition than that which our ancestors reached, and as destined to progress still further. On the other hand, it is as well to remember that we are subject to the general laws of evolution, and are as likely to degenerate as to progress. As compared with the immediate forefathers of our civilisation—the ancient Greeks—we do not appear to have improved so far as our bodily structure is concerned, nor assuredly so far as some of our mental capacities are concerned. Our powers of perceiving and expressing beauty of form have certainly *not* increased since the days of the Parthenon and Aphrodite of Melos. In matters of the reason, in the development of intellect, we may seriously inquire how the case stands. Does the reason of the average man of civilised Europe stand out clearly as an evidence of progress when compared with that of the men of bygone ages? Are all the inventions and figments of human superstition and folly, the self-inflicted torturing of mind, the reiterated substitution of wrong for right, and of falsehood for truth, which disfigure our modern civilisation—are these evidences of progress? In such respects we have at least reason to fear that we may be degenerate. Possibly we are all

drifting, tending to the condition of intellectual Barnacles or Ascidians. It is possible for us—just as the Ascidian throws away its tail and its eye and sinks into a quiescent state of inferiority—to reject the good gift of reason with which every child is born, and to degenerate into a contented life of material enjoyment accompanied by ignorance and superstition....

There is only one means of estimating our position, only one means of so shaping our conduct that we may with certainty avoid degeneration and keep an onward course.... To us has been given the power to *know the causes of things*, and by the use of this power it is possible for us to control our destinies. It is for us by ceaseless and ever hopeful labour to try to gain a knowledge of man's place in the order of nature. When we have gained this fully and minutely, we shall be able by the light of the past to guide ourselves in the future. In proportion as the whole of the past evolution of civilised man, of which we at present perceive the outlines, is assigned to its causes, we and our successors on the globe may expect to be able duly to estimate that which makes for, and that which makes against, the progress of the race. The full and earnest cultivation of Science—the Knowledge of Causes—is that to which we have to look for the protection of our race—even of this English branch of it—from relapse and degeneration. (58-62)

3. Thomas H. Huxley. From "The Struggle for Existence in Human Society." [*Nineteenth Century* 23 (February 1888): 61-80.] *Collected Essays. Vol. IX. Evolution and Ethics and Other Essays*. New York: D. Appleton, 1902. 195-236.

[No other single figure had a greater influence on the young Wells than Huxley (1825-95), the chief promoter of Darwinian ideas and the champion of science against the forces of superstition in the later Victorian age. A master of prose style, Huxley differed from Darwin in his refusal to associate evolution with inevitable social or moral progress, though he denied being a pessimist. Huxley's vision of evolution as a "materialized logical process" influenced *The Time Machine* in innumerable ways.]

... it is an error to imagine that evolution signifies a constant tendency to increased perfection. That process undoubtedly involves a constant remodelling of the organism in adaptation to new conditions; but it depends on the nature of those conditions whether the direction of the modifications effected shall be upward or downward. Retrogressive is as practicable as progressive metamorphosis. If what the physical philosophers tell us, that our globe has been in a state of fusion, and, like the sun, is gradually cooling down, is true; then the time must come when evolution will mean adaptation to a universal winter, and all forms of life will die out, except such low and simple organisms as the Diatom of the arctic and antarctic ice and the Protococcus[1] of the red snow. If our globe is proceeding from a condition in which it was too hot to support any but the lowest living thing to a condition in which it will be too cold to permit of the existence of any others, the course of life upon its surface must describe a trajectory like that of a ball fired from a mortar; and the sinking half of that course is as much a part of the general process of evolution as the rising. (199)

Pessimism is as little consonant with the facts of sentient existence as optimism. If we desire to represent the course of nature in terms of human thought, and assume that it was intended to be that which it is, we must say that its governing principle is intellectual and not moral; that it is a materialized logical process, accompanied by pleasures and pains, the incidence of which, in the majority of cases, has not the slightest reference to moral desert. (202)

4. H. G. Wells. From "Zoological Retrogression." *Gentleman's Magazine* 271 (September 1891): 246–53.

[This essay, showing the strong influence of Huxley and Lankester, was Wells's most complete non-fictional discussion of the implications of biological degeneration. Intended for a non-specialist readership, it was the first work by Wells to have a transatlantic impact, for it was summarized under the title "Degeneration and Evolution" in *Scientific American* (10 October 1891) and then reprinted in full in the Boston periodical *Living Age* in November 1891.]

Perhaps no scientific theories are more widely discussed or more generally misunderstood among cultivated people than the views held by biologists regarding the past history and future prospects of their province—life. Using their technical phrases and misquoting their authorities in an invincibly optimistic spirit, the educated public has arrived in its own way at a rendering of their results which it finds extremely satisfactory. It has decided that in the past the great scroll of nature has been steadily unfolding to reveal a constantly richer harmony of forms and successively higher grades of being, and it assumes that this "evolution" will continue with increasing velocity under the supervision of its extreme expression—man. This belief, as effective, progressive, and pleasing as transformation scenes at a pantomime, receives neither in the geological record nor in the studies of the phylogenetic[1] embryologist any entirely satisfactory confirmation.

On the contrary, there is almost always associated with the suggestion of advance in biological phenomena an opposite idea, which is its essential complement. The technicality expressing this would, if it obtained sufficient currency in the world of culture, do much to reconcile the naturalist and his traducers. The toneless glare of optimistic evolution would then be softened by a shadow; the monotonous reiteration of "Excelsior"[2] by people who did not climb would cease; the too sweet harmony of the spheres would be enhanced by a discord, this evolutionary antithesis—degradation.

Isolated cases of degeneration have long been known, and popular attention has been drawn to them in order to point well-meant moral lessons, the fallacious analogy of species to individual being employed. It is only recently, however, that the

1 A kind of microscopic algae.

1 Specializing in the evolution of a phylum or primary biological division of organisms.

2 "Excelsior" (Latin for "Higher!") alludes to the popular poem (1842) of that title by Longfellow.

enormous importance of degeneration as a plastic process in nature has been suspected and its entire parity with evolution recognised.

It is no libel to say that three-quarters of the people who use the phrase, "organic evolution," interpret it very much in this way:—Life began with the amoeba, and then came jelly-fish, shell-fish, and all those miscellaneous invertebrate things, and then *real* fishes and amphibia, reptiles, birds, mammals, and man, the last and first of creation. It has been pointed out that this is very like regarding a man as the offspring of his first cousins; these, of his second; these, of his relations at the next remove, and so forth—making the remotest living human being his primary ancestor. Or, to select another image, it is like elevating the modest poor relation at the family gathering to the unexpected altitude of fountain-head—a proceeding which would involve some cruel reflections on her age and character. The sounder view is, as scientific writers have frequently insisted, that living species have varied along divergent lines from intermediate forms, and, as it is the object of this paper to point out, not necessarily in an upward direction.

In fact, the path of life, so frequently compared to some steadily-rising mountain-slope, is far more like a footway worn by leisurely wanderers in an undulating country. Excelsior biology is a popular and poetic creation—the *real* form of a phylum, or line of descent, is far more like the course of a busy man moving about a great city. Sometimes it goes underground, sometimes it doubles and twists in tortuous streets, now it rises far overhead along some viaduct, and, again, the river is taken advantage of in these varied journeyings to and fro. Upward and downward these threads of pedigree interweave, slowly working out a pattern of accomplished things that is difficult to interpret, but in which scientific observers certainly fail to discover that inevitable tendency to higher and better things with which the word "evolution" is popularly associated.

The best known, and, perhaps, the most graphic and typical, illustration of the downward course is ... the fairly common Sea Squirts, or *Ascidians*, of our coasts. By an untrained observer a specimen of these would at first very probably be placed in the mineral or vegetable kingdoms. Externally they are simply shapeless lumps of a stiff, semi-transparent, cartilaginous substance, in which pebbles, twigs, and dirt are imbedded, and only the most careful examination of this unpromising exterior would discover any evidence of the living thing within. A penknife, however, serves to lay bare the animal inside this house, or "test," and the fleshy texture of the semi-transparent body must then convince the unscientific investigator of his error.

He would forthwith almost certainly make a fresh mistake in his classification of this new animal. Like most zoologists until a comparatively recent date, he would think of such impassive and, from the human point of view, lowly beings as the oyster and mussel as its brethren, and a superficial study of its anatomy might even strengthen this opinion. As a matter of fact, however, these singular creatures are far more closely related to the vertebrata—they lay claim to the quarterings, not of molluscs, but of imperial man! and, like novelette heroes with a birthmark, they carry their proofs about with them....

Like a tadpole, the [young ascidian] has a well-developed tail which propels its owner vigorously through the water. There is a conspicuous single eye, reminding the zoologist at once of the Polyphemus eye[1] that almost certainly existed in the central group of the vertebrata. There are also serviceable organs of taste and hearing, and the lively movements of the little creature justify the supposition that its being is fairly full of endurable sensations. But this flush of golden youth is sadly transient: it is barely attained before a remarkable and depressing change appears in the drift of the development.

The ascidian begins to take things seriously—a deliberate sobriety gradually succeeds its tremulous vivacity. L'Allegro dies away; the tones of Il Penseroso[2] become dominant.

On the head appear certain sucker-like structures.... The animal becomes dull, moves about more and more slowly, and

1 A single eye, like that of Polyphemus the Cyclops in Homer's *Odyssey*.

2 "L'Allegro" and "Il Penseroso" (both 1645) are companion poems by Milton, contrasting the cheerful and melancholy temperaments.

finally fixes itself by these suckers to a rock. It has settled down in life. The tail that waggled so merrily undergoes a rapid process of absorption; eye and ear, no longer needed, atrophy completely, and the skin secretes the coarse, inorganic-looking "test." It is very remarkable that this "test" should consist of a kind of cellulose—a compound otherwise almost exclusively confined to the vegetable kingdom. The transient glimpse of vivid animal life is forgotten, and the rest of this existence is a passive receptivity to what chance and the water bring along. The ascidian lives henceforth an idyll of contentment, glued, head downwards, to a stone,

The world forgetting, by the world forgot.[1]

Now here, to all who refer nature to one rigid table of precedence, is an altogether inexplicable thing. A creature on a level, at lowest, immediately next to vertebrated life, turns back from the upward path and becomes at last a merely vegetative excrescence on a rock.

It is lower even than the patriarchal amoeba of popular science if we take psychic life as the standard: for does not even the amoeba crawl after and choose its food and immediate environment? We have then, as I have read somewhere—I think it was in an ecclesiastical biography—a career not perhaps teemingly eventful, but full of the richest suggestion and edification.

And here one may note a curious comparison which can be made between this life-history and that of many a respectable pinnacle and gargoyle on the social fabric. Every respectable citizen of the professional classes passes through a period of activity and imagination, of "liveliness and eccentricity," of "*Sturm und Drang*."[2] He shocks his aunts. Presently, however, he realizes the sober aspect of things. He becomes dull; he enters a profession; suckers appear on his head; and he studies. Finally, by virtue of these he settles down—he marries. All his wild ambitions and subtle aesthetic perceptions atrophy as needless

1 Pope, "Eloisa to Abelard" (1717), line 208.

2 Literally "storm and stress," a German expression referring to an artistic movement of the Romantic period specializing in the depiction of extreme emotions.

in the presence of calm domesticity. He secretes a house, or "establishment," round himself, of inorganic and servile material. His Bohemian tail is discarded. Henceforth his life is a passive receptivity to what chance and the drift of his profession bring along; he lives an almost entirely vegetative excrescence on the side of a street, and in the tranquillity of his calling finds that colourless contentment that replaces happiness.

But this comparison is possibly fallacious, and is certainly a digression. (246–50)

[Wells cites many more examples of degeneration in nature.]

These brief instances of degradation may perhaps suffice to show that there is a good deal to be found in the work of biologists quite inharmonious with such phrases as "the progress of the ages," and "the march of mind." The zoologist demonstrates that advance has been fitful and uncertain; rapid progress has often been followed by rapid extinction or degeneration, while, on the other hand, a form lowly and degraded has in its degradation often happened upon some fortunate discovery or valuable discipline and risen again, like a more fortunate Antæos,[1] to victory. There is, therefore, no guarantee in scientific knowledge of man's permanence or permanent ascendency. He has a remarkably variable organisation, and his own activities and increase cause the conditions of his existence to fluctuate far more widely than those of any animal have ever done. The presumption is that before him lies a long future of profound modification, but whether that will be, according to present ideals, upward or downward, no one can forecast. Still, so far as any scientist can tell us, it may be that, instead of this, Nature is, in unsuspected obscurity, equipping some now humble creature with wider possibilities of appetite, endurance, or destruction, to rise in the fulness of time and sweep *homo* away into the darkness from which his universe arose. The Coming Beast must certainly be reckoned in any anticipatory calculations regarding the Coming Man. (253)

1 In Greek mythology a giant who, when wrestling Heracles, would rise stronger each time he made contact with his mother, the Earth.

5. H. G. Wells. From *Text-Book of Biology* [University Correspondence College Tutorial Series]. 2 vols. Intro. G.B. Howes. London: W. B. Clive & Co., University Correspondence College P, 1893.

[As this short extract from the chapter entitled "The Theory of Evolution" from his first book suggests, Wells was aware of a huge untapped metaphoric potential in evolutionary biology and its connected sciences. Both *The Time Machine* and the yet unformed genre of science fiction are prefigured in such ruminations.]

In the place of disconnected species of animals, arbitrarily created, and a belief in the settled inexplicable, the student finds [in the theory of evolution] an enlightening realization of uniform and active causes beneath an apparent diversity. And the world is not made and dead like a cardboard model or a child's toy, but a living equilibrium; and every day and every hour, every living thing is being weighed in the balance and found sufficient or wanting.

Our little book is the merest beginning in zoology.... The great things of the science of Darwin, Huxley, Wallace, and Balfour[1] remain mainly untold. In the book of nature there are written, for instance, the triumphs of survival, the tragedy of death and extinction, the tragi-comedy of degradation and inheritance, the gruesome lesson of parasitism, and the political satire of colonial organisms. Zoology is, indeed, a philosophy and a literature to those who can read its symbols. (1:131)

1 Alfred Russel Wallace (1823–1913) was the naturalist who formulated a theory of natural selection independently from Darwin. "Balfour" refers probably to Francis Maitland Balfour (1851–82), the Scottish embryologist.

6. Thomas H. Huxley. From "Evolution and Ethics" [The Romanes Lecture, 1893]. *Collected Essays. Vol. IX. Evolution and Ethics and Other Essays*. New York: D. Appleton, 1902. 46–116.

[On 18 May 1893, Huxley gave the Romanes lecture at Oxford on "Evolution and Ethics," a subject that he had been struggling with ever since his reputation-making *Evidence as to Man's Place in Nature* (1863). A masterpiece of Victorian prose, "Evolution and Ethics" affirmed that natural cycles, such as that of the bean plant, involved growth followed by decay regardless of "moral desert." By analogy, this was also true of human civilizations—but Huxley appealed to man to apply his ethical sense to a morally indifferent universe, thereby starting the process of humanizing it. The influence of "Evolution and Ethics" on *The Time Machine* is very complex. It is particularly noticeable in the narrator's comments on the white flowers at the end of the novel, but there are also several ironic twists on some of Huxley's more earnest ideas. In this way Wells, launching his literary career, at once acknowledged his debt to and asserted his independence from his former professor.]

[Of the bean plant] By insensible steps, the plant builds itself up into a large and various fabric of root, stem, leaves, flowers, and fruit, every one moulded within and without in accordance with an extremely complex but, at the same time, minutely defined pattern.... But no sooner has the edifice, reared with such exact elaboration, attained completeness, than it begins to crumble. By degrees, the plant withers and disappears from view, leaving behind more or fewer apparently inert and simple bodies, just like the bean from which it sprang; and, like it, endowed with the potentiality of giving rise to a similar cycle of manifestations.

Neither the poetic nor the scientific imagination is put to much strain in the search after analogies with this process of going forth and, as it were, returning to the starting-point. It may be likened to the ascent and descent of a slung stone, or the course of an arrow along its trajectory. Or we may say that

the living energy takes first an upward and then a downward road....

The value of a strong intellectual grasp of the nature of this process lies in the circumstance that what is true of the bean is true of living things in general. From very low forms up to the highest—in the animal no less than in the vegetable kingdom—the process of life presents the same appearance of cyclical evolution. Nay, we have but to cast our eyes over the rest of the world and cyclical change presents itself on all sides. It meets us in the water that flows to the sea and returns to the springs; in the heavenly bodies that wax and wane, go and return to their places; in the inexorable sequence of the ages of man's life; in that successive rise, apogee, and fall of dynasties and of states which is the most prominent topic of civil history. (47-49)

[Huxley's idea in these next two passages, that civilized man is no longer bound by the savage instincts necessitated by the struggle for existence, will be given a strongly ironic twist by Wells in his depiction of the Eloi, while Huxley's own ironic point about "fitness" in a cooling world will be dramatized strikingly by Wells in "The Further Vision."]

Man, the animal, in fact, has worked his way to the headship of the sentient world, and has become the superb animal which he is, in virtue of his success in the struggle for existence. The conditions having been of a certain order, man's organization has adjusted itself to them better than that of his competitors in the cosmic strife. In the case of mankind, the self-assertion, the unscrupulous seizing upon all that can be grasped, the tenacious holding of all that can be kept, which constitute the essence of the struggle for existence, have answered. For his successful progress, throughout the savage state, man has been largely indebted to those qualities which he shares with the ape and the tiger; his exceptional physical organization; his cunning; his sociability, his curiosity, and his imitativeness; his ruthless and ferocious destructiveness when his anger is roused by opposition.

But, in proportion as men have passed from anarchy to social organization, and in proportion as civilization has grown in worth, these deeply ingrained serviceable qualities have become defects. After the manner of successful persons, civilized man would gladly kick down the ladder by which he has climbed. He would be only too pleased to see "the ape and the tiger die."[1] (51-52)

There is another fallacy which appears to me to pervade the so-called "ethics of evolution." It is the notion that because, on the whole, animals and plants have advanced in perfection of organization by means of the struggle for existence and the consequent "survival of the fittest"; therefore men in society, men as ethical beings, must look to the same process to help them towards perfection. I suspect that this fallacy has arisen out of the unfortunate ambiguity of the phrase "survival of the fittest." "Fittest" has a connotation of "best"; and about "best" there hangs a moral flavour. In cosmic nature, however, what is "fittest" depends upon the conditions. Long since, I ventured to point out that if our hemisphere were to cool again, the survival of the fittest might bring about, in the vegetable kingdom, a population of more and more stunted and humbler and humbler organisms, until the "fittest" that survived might be nothing but lichens, diatoms, and such microscopic organisms as those which give red snow its colour; while, if it became hotter, the pleasant valleys of the Thames and Isis[2] might be uninhabitable by any animated beings save those that flourish in a tropical jungle. They, as the fittest, the best adapted to the changed conditions, would survive.

Men in society are undoubtedly subject to the cosmic process. As among other animals, multiplication goes on without cessation, and involves severe competition for the means of support. The struggle for existence tends to eliminate those less fitted to adapt themselves to the circumstances of their existence. The strongest, the most self-assertive, tend to tread down the weaker. But the influence of the cosmic process on the evolution of society is the greater the more rudimentary its

1 An allusion to Tennyson, *In Memoriam A.H.H.* (1850), 118, line 28.

2 The name by which the River Thames is known as it flows through Oxford.

civilization. Social progress means a checking of the cosmic process at every step and the substitution for it of another, which may be called the ethical process; the end of which is not the survival of those who may happen to be the fittest, in respect of the whole of the conditions which obtain, but of those who are ethically the best. (80–81)

[Huxley's concluding idea about the evolutionary importance of pain and sorrow is echoed strongly in the Time Traveller's naïve ruminations upon the "perfect comfort and security" of Eloi society in Chapter VII of *The Time Machine*.]

The theory of evolution encourages no millennial anticipations. If, for millions of years, our globe has taken the upward road, yet, some time, the summit will be reached and the downward route will be commenced. The most daring imagination will hardly venture upon the suggestion that the power and intelligence of man can ever arrest the procession of the great year....[1]

But if we may permit ourselves a larger hope of abatement of the essential evil of the world than was possible to those who, in the infancy of exact knowledge, faced the problem of existence more than a score of centuries ago, I deem it an essential condition of the realization of that hope that we should cast aside the notion that the escape from pain and sorrow is the proper object of life.

We have long since emerged from the heroic childhood of our race, when good and evil could be met with the same "frolic welcome";[2] the attempts to escape from evil, whether Indian or Greek, have ended in flight from the battle-field; it remains to us to throw aside the youthful over-confidence and the no less youthful discouragement of nonage. We are grown men, and must play the man

strong in will
To strive, to seek, to find, and not to yield.... (85–86)

1 For the significance of Huxley's "great year," see p. 123, n. 3.

2 This and the concluding quotation are both from Tennyson, "Ulysses" (1842), lines 47, 69–70.

7. [H. G. Wells.] "On Extinction." *Chambers's Journal of Popular Literature, Science, and Art* 10 (30 September 1893): 623–24.

[From this short piece published anonymously, one may speculate that Wells conceived *The Time Machine* partly as a dramatization of the "tragedy of extinction" ending with "the most terrible thing that man can conceive as happening to man," as the Last Man is left alone to contemplate the annihilation of the human species.]

The passing away of ineffective things, the entire rejection by Nature of the plans of life, is the essence of tragedy. In the world of animals, that runs so curiously parallel with the world of men, we can see and trace only too often the analogies of our grimmer human experiences; we can find the equivalents to the sharp tragic force of Shakespeare, the majestic inevitableness of Sophocles, and the sordid dreary tale, the middle-class misery of Ibsen. The life that has schemed and struggled and committed itself, the life that has played and lost, comes at last to the pitiless judgment of time, and is slowly and remorselessly annihilated. This is the saddest chapter of biological science—the tragedy of Extinction.

In the long galleries of the geological museum are the records of judgments that have been passed graven upon the rocks. Here, for instance, are the huge bones of the "Atlantosaurus," one of the mightiest land animals that this planet has ever seen. A huge terrestrial reptile this, that crushed the forest trees as it browsed upon their foliage, and before which the pigmy ancestors of our present denizens of the land must have fled in abject terror of its mere might of weight. It had the length of four elephants, and its head towered thirty feet—higher, that is, than any giraffe—above the world it dominated. And yet this giant has passed away, and left no children to inherit the earth. No living thing can be traced back to these monsters; they are at an end among the branchings of the tree of life. Whether it was through some change of climate, some subtle disease, or some subtle enemy, these titanic reptiles dwindled in numbers, and faded at last altogether among things

Appendix B: The Evolutionary Context: Society

1. Thomas Carlyle. From *Past and Present*. 1843. London: Chapman & Hall, 1897.

[Thomas Carlyle (1795-1881), the Scottish historian and social prophet, whose work often attacked the Victorian *status quo*, was a major influence on the young Wells. *Past and Present* contrasts medieval and Victorian England at the expense of the latter. This extract from Chapter II is an obvious source for and one of the keys to the meaning of the central symbol of the White Sphinx in *The Time Machine*.]

How true ... is that other old Fable of the Sphinx, who sat by the wayside, propounding her riddle to the passengers, which if they could not answer she destroyed them! Such a Sphinx is this Life of ours, to all men and societies of men. Nature, like the Sphinx, is of womanly celestial loveliness and tenderness; the face and bosom of a goddess, but ending in claws and the body of a lioness. There is in her a celestial beauty,—which means celestial order, pliancy to wisdom; but there is also a darkness, a ferocity, fatality, which are infernal. She is a goddess, but one not yet disimprisoned; one still half-imprisoned,—the articulate, lovely, still encased in the inarticulate, chaotic. How true! And does she not propound her riddles to us? Of each man she asks daily, in mild voice, yet with a terrible significance, "Knowest thou the meaning of this Day? What thou canst do Today; wisely attempt to do?" Nature, Universe, Destiny, Existence, howsoever we name this grand unnamable Fact in the midst of which we live and struggle, is as a heavenly bride and conquest to the wise and brave, to them who can discern her behests and do them; a destroying fiend to them who cannot. Answer her riddle, it is well with thee. Answer it not, pass on regarding it not, it will answer itself; the solution for thee is a thing of teeth and claws; Nature is a dumb lioness, deaf to thy pleadings, fiercely devouring. Thou art not now her victorious bridegroom; thou art her mangled victim, scattered on the precipices, as a slave found treacherous, recreant, ought to be and must. (7)

2. Karl Marx. From various writings (1844-64).

[In *Experiment in Autobiography*, Wells notes that he first directly encountered Marxism in his second year at South Kensington, by which point he was able to evaluate and reject it as a plausible but dangerous creed based on resentment and malice. Though it is true that Wells was never in any sense a follower of Karl Marx (1818-83), as a socialist and a critic of Victorian society he could hardly help being indirectly influenced by such Marxian ideas as had permeated radical thinking about social class. In *The Time Machine* these ideas are evident particularly in the symbolic implications of the Eloi-Morlock relationship.]

i. From *Economic and Philosophic Manuscripts of 1844*. Ed. and intro. Dirk J. Struik. Trans. Martin Milligan. New York: International Publishers, 1964. 106-19.

[In "Estranged Labor" the young Marx deals with what he sees as the inevitable increasing estrangement between owners and workers in capitalist society. In *The Time Machine* Wells gives this split a biological dimension.]

On the basis of political economy itself ... we have shown that the worker sinks to the level of a commodity and becomes indeed the most wretched of commodities ... and that finally the distinction between capitalist and land rentier, like that between the tiller of the soil and the factory worker, disappears and that the whole of society must fall apart into the two classes—the property *owners* and the propertyless *workers*. (106)

It is true that labor produces for the rich wonderful things—but for the worker it produces privation. It produces palaces—but for the worker, hovels. It produces beauty—but for the worker, deformity. It replaces labor by machines, but it throws a

section of the workers back to a barbarous type of labor, and it turns the other workers into machines. It produces intelligence—but for the worker stupidity, cretinism. (110)

[Marx's analysis of estrangement in "The Meaning of Human Requirements" in terms of the duality of light and darkness is clearly echoed in the world of A.D. 802,701.]

This estrangement ... produces sophistication of needs and of their means on the one hand, and a bestial barbarization, a complete, unrefined, abstract simplicity of need, on the other.... Even the need for fresh air ceases for the worker. Man returns to a cave dwelling, which is now, however, contaminated with the pestilential breath of civilization.... A dwelling in the *light*, which Prometheus in Aeschylus designated as one of the greatest boons, by means of which he made the savage into a human being,[1] ceases to exist for the worker. Light, air, etc.—the simplest *animal* cleanliness—ceases to be a need for man. *Filth*, this stagnation and putrefaction of man—the *sewage* of civilization (speaking quite literally)—comes to be the *element of life* for him. (148-49)

ii. From "The Holy Family (1844), or Critique of Critical Criticism against Bruno Bauer and Company." 1845. Karl Marx. *Writings of the Young Marx on Philosophy and Society*. Trans. and ed. Loyd D. Easton and Kurt H. Guddat. Garden City, NY: Anchor, 1967.[2] 361-98.

[In "Critical Comment No. II on Proudhon," Marx expands on the political dimension of the estrangement of classes, unwittingly casting some light on the Morlocks' eating habits.]

Proletariat and wealth are antitheses. As such they constitute a whole. They are both manifestations of the world of private property. The question at issue is the specific position they occupy in the antithesis. It is not enough to describe them as two sides of a whole....

Within this antithesis the property owner is ... the *conservative* party, and the proletarian is the *destructive* party. From the *former* arises action to maintain the antithesis, from the *latter*, action to destroy it. (367)

iii. From Karl Marx and Frederick Engels. *Selected Correspondence*. Vol. I. Moscow: Foreign Languages Publishing House; and London: Lawrence & Wishart, 1955.

[Two comments from Marx's correspondence reveals that Darwin was an important common factor in Marx's and Wells's analysis of social estrangement in English society in particular.]

[From letter to F. Lassalle, 16 January 1861] ... Darwin's book [*The Origin of Species*] is very important and serves me as a natural-scientific basis for the class struggle in history. One has to put up with the crude English method of development, of course. (151)

[From letter to Friedrich Engels, 18 June 1862] It is remarkable how Darwin recognizes among beasts and plants his English society with its division of labour, competition, opening up of new markets, "inventions," and the Malthusian "struggle for existence."[1] It is Hobbes's *bellum omnium contra omnes*....[2] (156-57)

1 See Aeschylus, *Prometheus Bound*, especially lines 448ff.

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1 Thomas Malthus (1766-1834) was the English economist whose *Essay on the Principle of Population* (1798), inspired by the overcrowded conditions of the Industrial Revolution, was an important influence on Darwin's theory of natural selection.

2 "The war of every man against every man" as invoked by the English political philosopher Thomas Hobbes (1588-1679) in Chapter 13 of *Leviathan* (1651).

iv. From "Inaugural Address of the Working Men's International Association." 1864. Karl Marx and Frederick Engels. *Selected Works*. Vol. II. Moscow: Progress Publishers, 1969. 11–18.

[Perhaps one source for the name "Morlock" can be found in this well-known passage in which Marx refers to the dominant social class metaphorically feeding on the life of the workers.]

... the middle class had predicted, and to their heart's content proved, that any legal restriction of the hours of labour must sound the death knell of British industry, which, vampyre like, could but live by sucking blood, and children's blood, too. In olden times, child murder was a mysterious rite of the religion of Moloch,[1] but it was practised on some very solemn occasions only, once a year perhaps, and then Moloch had no exclusive bias for the children of the poor. (16)

3. Frederick Engels. From *The Condition of the Working-Class in England in 1844*. 1845. Trans. Florence Kelley Wischnewetzky. London: Allen & Unwin, 1892.

[Friedrich Engels (1820–95) was Marx's chief collaborator. German-born, but based in England for much of his working life, he observed at first hand the plight of the industrial classes in Manchester during the depression of the 1840s. His most important independent work, *The Condition of the Working Class* was not available in English translation until 1886. It is likely that Wells knew of Engels's work even if he had not actually read it before he wrote *The Time Machine*, for Engels's ideas, like Marx's, had permeated socialist and sociological thought by the early 1890s. The following selections, based on Engels's observation of class and economic divisions in nineteenth-century English society, strongly suggest themselves as a source for both the Eloi–Morlock relationship (in which an ironic reversal has occurred) and the physical appearance of the Morlocks.]

1 See II Kings 23:10.

[From "Competition."] The proletarian is helpless; left to himself, he cannot live a single day. The bourgeoisie has gained a monopoly of all means of existence in the broadest sense of the word. What the proletarian needs, he can obtain only from this bourgeoisie, which is protected in its monopoly by the power of the State. The proletarian is, therefore, in law and in fact, the slave of the bourgeoisie, which can decree his life or death. (76)

[From "Results"] ... the working class has gradually become a race wholly apart from the English bourgeoisie. The bourgeoisie has more in common with every other nation of the earth than with the workers in whose midst it lives. The workers speak other dialects, have other thoughts and ideals, other customs and moral principles, a different religion and other politics than those of the bourgeoisie. Thus they are two radically dissimilar nations, as unlike as difference of race could make them, of whom we on the Continent have known but one, the bourgeoisie. (124)

[From "Single Branches of Industry—Factory Hands." Engels quotes a Dr. Hawkins's testimony in a report on the condition of factory workers, then summarizes his conclusions.]

> "I believe that most travellers are struck by the lowness of stature, the leanness and the paleness which present themselves so commonly to the eye at Manchester, and, above all, among the factory classes. I have never been in any town in Great Britain, nor in Europe, in which degeneracy of form and colour from the national standard has been so obvious.... I must confess that all the boys and girls brought before me from the Manchester mills had a depressed appearance, and were very pale...."

... That the growth of young operatives is stunted, by their work, hundreds of statements testify.... One of the largest manufacturers of Manchester, leader of the opposition against the working-men ... said, on one occasion, that if things went on as at present, the operatives of Lancashire would soon be a race of pigmies. (158–59)

4. Benjamin Disraeli, Earl of Beaconsfield. From *Sybil; or, The Two Nations*. Vol. I. 1845. [Earl's Edition, Vol. XIV.] New York and London: M. Walter Dunne, 1904.

[It was not only German socialists who observed an unprecedented class division developing in mid-nineteenth-century English society. Disraeli (1804–81), the leading Tory politician of the age and twice Prime Minister of England, was also a notable novelist. In the subtitle of *Sybil* he gave an enduring name—the Two Nations—to a phenomenon that Marx and Engels were analyzing simultaneously, and which Wells, from his later evolutionary perspective, would project forward into A.D. 802,701. This extract is from Chapter XI: "A Seraphic Appearance." A stranger, dressed in black, offers a disconcerting critique of early Victorian England to Lord Egremont. Notice how Disraeli uses the phrase "the struggle for existence" years before *The Origin of Species*.]

"It is a community of purpose that constitutes society," continued the younger stranger; "without that, men may be drawn into contiguity, but they still continue virtually isolated."

"And is that their condition in cities?"

"It is their condition everywhere; but in cities that condition is aggravated. A density of population implies a severer struggle for existence, and a consequent repulsion of elements brought into too close contact. In great cities men are brought together by the desire of gain. They are not in a state of co-operation, but of isolation, as to the making of fortunes; and for all the rest they are careless of neighbours. Christianity teaches us to love our neighbour as ourself; modern society acknowledges no neighbour."

"Well, we live in strange times," said Egremont....

"When the infant begins to walk, it also thinks that it lives in strange times," said his companion.

"Your inference?" asked Egremont.

"That society, still in its infancy, is beginning to feel its way."

"This is a new reign," said Egremont, "perhaps it is a new era."

"I think so," said the younger stranger.

"I hope so," said the elder one.

"Well, society may be in its infancy," said Egremont, slightly smiling; "but, say what you like, our Queen reigns over the greatest nation that ever existed."

"Which nation?" asked the younger stranger, "for she reigns over two."

The stranger paused; Egremont was silent, but looked inquiringly.

"Yes," resumed the younger stranger after a moment's interval. "Two nations; between whom there is no intercourse and no sympathy; who are as ignorant of each other's habits, thoughts, and feelings, as if they were dwellers in different zones, or inhabitants of different planets; who are formed by a different breeding, are fed by a different food, are ordered by different manners, and are not governed by the same laws."

"You speak of—" said Egremont, hesitatingly.

"The Rich and the Poor." (92–93)

5. Herbert Spencer. From *Social Statics; or, The Conditions Essential to Human Happiness Specified, and the First of Them Developed*. 1851. New York: D. Appleton, 1888.

[Spencer (1820–1903) was an English philosopher and sociologist whose attempt to provide a systematic account of all phenomena was very influential in the later Victorian age. (In 1894 Wells called him "a noble & wondrous thinker but lacking humour.") Spencer believed in the inevitability of progress, offering in *Social Statics* a "logical" proof of its necessity that is a classic expression of Victorian optimism, and that unquestionably influenced Darwin in such passages as his conclusion to *The Origin of Species* (see Appendix A1). It was the complacency arising from such optimism that was Wells's chief target in *The Time Machine*. The passage below is from Part I, Chapter II of *Social Statics*, "The Evanescence of Evil."]

All imperfection is unfitness to the conditions of existence.

This unfitness must consist either in having a faculty or fac-

ulties in excess; or in having a faculty or faculties deficient; or in both.

A faculty in excess, is one which the conditions of existence do not afford full exercise to; and a faculty that is deficient, is one from which the conditions of existence demand more than it can perform.

But it is an essential principle of life that a faculty to which circumstances do not allow full exercise diminishes; and that a faculty on which circumstances make excessive demands increases.

And so long as this excess and this deficiency continue, there must continue decrease on the one hand, and growth on the other.

Finally, all excess and all deficiency must disappear; that is, all unfitness must disappear; that is, all imperfection must disappear.

Thus the ultimate development of the ideal man is logically certain. ... humanity must in the end become completely adapted to its conditions....

Progress, therefore, is not an accident, but a necessity. Instead of civilization being artificial, it is a part of nature; all of a piece with the development of the embryo or the unfolding of a flower. ... so surely must the human faculties be moulded into complete fitness for the social state; so surely must the things we call evil and immorality disappear; so surely must man become perfect. (79–80)

6. Herbert Spencer. From *First Principles*. 1862. 4th. ed. 1880. New York: P. F. Collier, 1902.

[Spencer felt that evolutionary theory supported, rather than undermined, his optimism. Attempting to reconcile evolution and progress, he asserted that there was a law governing the development of all organisms, biological and social, that ensured that they would inevitably advance from homogeneous simplicity to heterogeneous complexity on their way to perfection. But ideas about biological degeneration as they came to the fore in the 1880s (see Appendix A2) provided evidence to those, like Wells, whose intuitions about existence differed from Spencer's, that such a law was based on wishful thinking, not science. The passage below is from Chapter XV of *First Principles*, "The Law of Evolution Continued."]

The advance from the simple to the complex, through a process of successive differentiations, is seen alike in the earliest changes of the Universe to which we can reason our way back, and in the earliest changes which we can inductively establish; it is seen in the geologic and climatic evolution of the Earth, and of every single organism on its surface; it is seen in the evolution of Humanity, whether contemplated in the civilized individual, or in the aggregations of races; it is seen in the evolution of Society, in respect alike of its political, its religious, and its economical organization; and it is seen in the evolution of all those endless concrete and abstract products of human activity, which constitute the environment of our daily life. From the remotest past which Science can fathom, up to the novelties of yesterday, an essential trait of Evolution has been the transformation of the homogeneous into the heterogeneous.

... As we now understand it, Evolution is definable as a change from an incoherent homogeneity to a coherent heterogeneity, accompanying the dissipation of motion and integration of matter. (358–59)

7. Jules Verne. From *The Child of the Cavern; or, Strange Doings Underground*]. Trans. W. H. G. Kingston. London: Sampson Low, Marston, Searle & Rivington, 1877. Trans. of *Les Indes-noires*. 1877.

[Jules Verne (1828–1905) was the French author of many adventure-romances with a scientific element, works that attained a global popularity. Verne and Wells felt they had little in common with one another (see Appendix G4), and most historians of science fiction have emphasized their very different roles in the evolution of the genre. However, the young Wells almost certainly read Verne's works, which became

quickly available in English. The following passage from one of Verne's lesser-known romances suggests itself as a source for the subterranean habitat of the Morlocks.]

If, by some superhuman power, engineers could have raised in a block, a thousand feet thick, all that part of the terrestrial crust which supports the lakes, rivers, gulfs, and territories of the counties of Stirling, Dumbarton, and Renfrew,[1] they would have found, under that enormous lid, an immense excavation, to which but one other in the world can be compared—the celebrated Mammoth caves of Kentucky.

This excavation was composed of several hundred divisions of all sizes and shapes. It might be called a hive with numberless ranges of cells, capriciously arranged, but a hive on a vast scale, and which, instead of bees, might have lodged all the ichthyosaurii, megatheriums, and pterodactyles of the geological epoch....

Although unfit for any vegetable product, the place could be inhabited by a whole population. And who knows but that in this steady temperature, in the depths of the mines of Aberfoyle, as well as in those of Newcastle, Alloa or Cardiff[2]—when their contents shall have been exhausted—who knows but that the poorer classes of Great Britain will some day find a refuge? (88-91)

8. Henry George. From *Progress and Poverty*. 1880. London and Toronto: Dent, 1911.

[Henry George (1839-97), the American economist and social reformer, was known for his advocacy of a single tax and the nationalization of land, ideas promoted in his popular and highly influential critique of capitalism, *Progress and Poverty*. Wells read the book at Midhurst, and later credited it with awakening his interest in socialism. The following passages reveal the compatibility of George on social evolution with Huxley on biological evolution, and suggest that *The Time Machine* was also influenced by George's rhetorical power and apocalyptic imagination.]

[From Book X Chapter I, "The Current Theory of Human Progress—Its Insufficiency"] ... if progress operated to fix an improvement in man's nature, and thus to produce further progress, though there might be occasional interruption, yet the general rule would be that progress would be continuous—that advance would lead to advance, and civilisation develop into higher civilisation.

Not merely the general rule, but *the universal rule*, is the reverse of this. The earth is the tomb of dead empires, no less than of dead men. Instead of progress fitting men for greater progress, every civilisation that was in its own time as vigorous and advancing as ours is now, has of itself come to a stop. Over and over again, art has declined, learning sunk, power waned, population become sparse, until the people who had built great temples and mighty cities, turned rivers and pierced mountains, cultivated the earth like a garden and introduced the utmost refinement into the minute affairs of life, remained but in a remnant of squalid barbarians, who had lost even the memory of what their ancestors had done, and regarded the surviving fragments of their grandeur as the work of genii, or of the mighty race before the flood. (342-43)

... an analogy may be drawn between the life of a society and the life of a solar system upon the nebular hypothesis. As the heat and light of the sun are produced by the aggregation of atoms evolving motion, which finally ceases when the atoms at length come to a state of equilibrium or rest, and a state of immobility succeeds, which can be only broken in again by the impact of external forces, which reverse the process of evolution, integrating motion and dissipating matter in the form of gas, again to evolve motion by its condensation; so, it may be said, does the aggregation of individuals in a community evolve a force which produces the light and warmth of civilisation, but when this process ceases and the individual components are brought into a state of equilibrium, assuming their fixed places, petrification ensues, and the breaking up and diffusion caused

1 Counties in Scotland.
2 Coal-mining areas of Great Britain.

by an incursion of barbarians is necessary to the recommencement of the process and a new growth of civilisation. (344–45)

[From Book X Chapter III, "How Modern Civilisation May Decline"] ... there are many things about which there can be no dispute, which go to show that our civilisation has reached a critical period, and that unless a new start is made in the direction of social equality, the nineteenth century may to the future mark its climax.... Everywhere is it evident that the tendency to inequality, which is the necessary result of material progress where land is monopolised, cannot go much further without carrying our civilisation into that downward path which is so easy to enter and so hard to abandon. Everywhere the increasing intensity of the struggle to live, the increasing necessity for straining every nerve to prevent being thrown down and trodden underfoot in the scramble for wealth, is draining the forces which gain and maintain improvements. In every civilised country pauperism, crime, insanity, and suicides are increasing. In every civilised country the diseases are increasing which come from overstrained nerves, from insufficient nourishment, from squalid lodgings, from unwholesome and monotonous occupations, from premature labour of children, from the tasks and crimes which poverty imposes upon women. In every highly civilised country the expectation of life, which gradually rose for several centuries, and which seems to have culminated about the first quarter of this century, appears to be now diminishing.

It is not an advancing civilisation that such figures show. It is a civilisation which in its under currents has already begun to recede.... When the sun passes the meridian, it can only be told by the way the short shadows fall; for the heat of the day yet increases. But as sure as the turning tide must soon run full ebb; as sure as the declining sun must bring darkness, so sure is it, that though knowledge yet increases and invention marches on, and new states are being settled, and cities still expand, yet civilisation has begun to wane.... (383–84)

[From "Conclusion"] ... if human life does not continue beyond what we see of it here, then we are confronted with regard to the race with the same difficulty as with the individual. For it is as certain that the race must die as it is that the individual must die. We know that there have been geologic conditions under which human life was impossible on this earth. We know that they must return again. Even now, as the earth circles on her appointed orbit, the northern ice cap slowly thickens, and the time gradually approaches when its glaciers will flow again, and austral seas, sweeping northward, bury the seats of present civilisation under ocean wastes, as it may be they now bury what was once as high a civilisation as our own. And beyond these periods, science discerns a dead earth, an exhausted sun—a time when, clashing together, the solar system shall resolve itself into a gaseous form, again to begin immeasurable mutations. (398–99)

9. Edward Bellamy. From *Looking Backward 2000–1887.* Boston: Ticknor and Company, 1888.

[As the nineteenth century drew to a close, there was a widespread assumption that a social cataclysm was inevitable. The narrator, Julian West, of this famous and influential American utopian novel by Bellamy (1850–98), summarizes such gloomy assumptions as they were expressed in 1887—a gloom which his narrative will attempt to dispel.]

Humanity ... having climbed to the top round of the ladder of civilization, was about to take a header into chaos, after which it would doubtless pick itself up, turn round, and begin to climb again.... Human history, like all great movements, was cyclical, and returned to the point of beginning. The idea of indefinite progress in a right line was a chimera of the imagination, with no analogue in nature. The parabola of a comet was perhaps a yet better illustration of the career of humanity. Tending upward and sunward from the aphelion of barbarism, the race attained the perihelion of civilization only to plunge

counterblast to *Looking Backward*. Morris envisions a completely deindustrialized future England (based on an idealized later Middle Ages) in which society is organized on pure communist lines. Wells envisioned *The Time Machine*, especially those scenes set in A.D. 802,701, as an astringent corrective to *both* Bellamy and Morris. In this first passage, Morris's first-person protagonist, having fallen asleep in 1890 and awoken in the twenty-first century, views the Thames-side at Hammersmith. To underline his differences with Morris, Wells would set *The Time Machine* only a few miles upstream, in Richmond.]

I was going to say, "But is this the Thames?" but held my peace in my wonder, and turned my bewildered eyes eastward to look at the bridge again, and thence to the shores of the London river; and surely there was enough to astonish me. For though there was a bridge across the stream and houses on its banks, how all was changed from last night! The soap-works with their smoke-vomiting chimneys were gone; the engineer's works gone; the lead-works gone; and no sound of riveting and hammering came down the west wind....

Both shores had a line of very pretty houses, low and not large, standing back a little way from the river; they were mostly built of red brick and roofed with tiles, and looked, above all, comfortable and as if they were, so to say, alive, and sympathetic with the life of the dwellers in them. There was a continuous garden in front of them, going down to the water's edge, in which the flowers were now blooming luxuriantly, and sending delicious waves of summer scent over the eddying stream. Behind the houses I could see great trees rising, mostly planes, and looking down the water there were the reaches towards Putney almost as if they were a lake with a forest shore, so thick were the big trees.... (14–16)

[Meeting the women of the communist future for the first time, the protagonist is struck by their contrast with those of his own time. Compare the scene in which the Time Traveller first meets the Eloi.]

In this pleasant place, which of course I knew to be the hall of the Guest House, three young women were flitting to and fro. As they were the first of the sex I had seen on this eventful morning, I naturally looked at them very attentively, and found them at least as good as the gardens, the architecture, and the male men. As to their dress, which of course I took note of, I should say that they were decently veiled with drapery, and not bundled up with millinery; that they were clothed like women, not upholstered like arm-chairs, as most women of our time are. In short, their dress was somewhat between that of the ancient classical costume and the simpler forms of the fourteenth-century garments, though it was clearly not an imitation of either: the materials were light and gay to suit the season. As to the women themselves, it was pleasant indeed to see them, they were so kind and happy-looking in expression of face, so shapely and well-knit of body, and thoroughly healthy-looking and strong. All were at least comely, and one of them very handsome and regular of feature. They came up to us at once merrily and without the least affectation of shyness, and all three shook hands with me as if I were a friend newly come back from a long journey.... (23)

[The historian Old Hammond sums up past history, unwittingly offering a kind of prequel to The Time Traveller's voyage into futurity.]

"This is how we stand. England was once a country of clearings among the woods and wastes, with a few towns interspersed, which were fortresses for the feudal army, markets for the folk, gathering-places for the craftsmen. It then became a country of huge and foul workshops and fouler gambling-dens, surrounded by an ill-kept, poverty-stricken farm, pillaged by the masters of the workshops. It is now a garden, where nothing is wasted and nothing is spoiled...." (100)

[Wells was able to see rather further than Morris into the ironies emerging from this dialogue between Old Hammond and the protagonist.]

"... it is the childlike part of us that produces works of imagination. When we are children time passes so slow with us that we seem to have time for everything."

He sighed, and then smiled and said: "At least let us rejoice that we have got back our childhood again. I drink to the days that are!"

"Second childhood," said I in a low voice, and then blushed at my double rudeness, and hoped that he had n't heard. But he had, and turned to me smiling, and said: "Yes, why not? And for my part I hope it may last long...." (141–42)

12. Benjamin Kidd. *Social Evolution*. 1894. New ed. New York and London: Macmillan, 1895.

[Today, knowing so much more about genetics, we might hesitate to draw a close analogy between biological evolution and social development. But in the 1890s, before the mechanisms of heredity had begun to be understood, so high was the prestige of Darwinian biology that the embryonic social sciences were very much in its shadow. This can be seen in the following passages from an influential work by the English sociologist Benjamin Kidd (1858–1916), revealing the some of the ideas in the field circulating as Wells was composing the final versions of *The Time Machine*.]

[From Chapter I: "The Outlook."] By those sciences which deal with human society it seems to have been for long ignored or forgotten that in that society we are merely regarding the highest phenomena in the history of life, and that consequently all departments of knowledge which deal with social phenomena have their true foundation in the biological sciences.

... Yet the social phenomena which are treated of under the heads of politics, history, ethics, economics, and religion must all be regarded as but the intimately related phenomena of the science of life under its most complex aspect. The biologist whose crowning work in the century has been the establishment of order and law in the lower branches of his subject has carried us up to human society and there left us without a guide.... The time has come ... for a better understanding and for a more radical method; for the social sciences to strengthen themselves by sending their roots deep into the soil underneath from which they spring; and for the biologist to advance over the frontier and carry the methods of his science boldly into human society.... (28–30)

[From Chapter II: "Conditions of Human Progress."] It is now coming to be recognised as a necessarily inherent part of the doctrine of evolution, that if the continual selection which is always going on amongst the higher forms of life were to be suspended, these forms would not only possess no tendency to make progress forwards, but must actually go backwards. *That is to say, if all the individuals of every generation in any species were allowed to equally propagate their kind, the average of each generation would continually tend to fall below the average of the generation which preceded it, and a process of slow but steady degeneration would ensue.* It is, therefore, an inevitable law amongst the higher forms, that competition and selection must not only always accompany progress, but that they must prevail amongst every form of life which is not actually retrograding. ... the wider the limits of selection, the keener the rivalry, and the more rigid the selection, the greater will be the progress. (39–40)

Appendix C: The Evolutionary Context: Culture

1. Winwood Reade. From *The Martyrdom of Man*. 1872. 2nd ed. London: Trübner & Co., 1875.

[*The Martyrdom of Man* by (William) Winwood Reade (1838–75) was an early and influential example of sweeping cultural history written from an agnostic-Darwinian point of view—Wells's own *The Outline of History* (1920) is a notable later example. Wells read *The Martyrdom of Man* at Up Park, and frequently cited it as important in shaping his early thinking. There are several important foreshadowings of the world of A.D. 802,701 in the passage below on the debt of the future to the past, including yet another possible source for the White Sphinx.]

[From Chapter IV: "Intellect."] This great and glorious city in which we dwell, this mighty London, the metropolis of the earth; these streets flowing with eager-minded life, and gleaming with prodigious wealth; these forests of masts, these dark buildings, turning refuse into gold, and giving bread to many thousand mouths; these harnessed elements which whirl us along beneath the ground, and which soon will convey us through the air; these spacious halls, adorned with all that can exalt the imagination or fascinate the sense; these temples of melody; these galleries, exhibiting excavated worlds; these walls covered with books in which dwell the souls of the immortal dead, which, when they are opened, transport us by a magic spell to lands which are vanished and passed away, or to spheres created by the poet's art; which make us walk with Plato beneath the plane trees, or descend with Dante into the dolorous abyss;—to whom do we owe all these? First, to the poor savages, forgotten and despised, who, by rubbing sticks together, discovered fire, who first tamed the timid fawn, and first made the experiment of putting seeds into the ground. And, secondly, we owe them to those enterprising warriors who established Nationality, and to those priests who devoted their life-time to the culture of their minds. There is a land where the air is always tranquil, where nature wears always the same bright yet lifeless smile; and there, as in a vast museum, are preserved the colossal achievements of the past. Let us enter the sad and silent river; let us wander on its dusky shores. Buried cities are beneath our feet; the ground on which we tread is the pavement of a tomb. See the Pyramids towering to the sky, with men, like insects, crawling round their base; and the Sphinx, couched in vast repóse, with a ruined temple between its paws. Since those great monuments were raised, the very heavens have been changed. When the architects of Egypt began their work, there was another polar star in the northern sky, and the Southern Cross shone upon the Baltic shores. How glorious are the memories of those ancient men, whose names are forgotten, for they lived and laboured in the distant and unwritten past. (494–96)

2. Friedrich Nietzsche. From *The Complete Works of Friedrich Nietzsche*. Ed. Oscar Levy. *Vol. X. The Joyful Wisdom ("La Gaya Scienza")*. Trans. Thomas Common, with Poetry Rendered by Paul V. Cohn and Maud D. Petre. 2nd. ed. Edinburgh and London: J.N. Foulis, 1910. Trans. *Fröhliche Wissenschaft*. 1882, 1886.

[Though there is little likelihood that Wells had read any Nietzsche (1844–1900) when composing *The Time Machine*, it is also clear that the German philosopher's work by the mid-1890s had already started to strike indirectly many already receptive chords among his contemporaries. It is interesting to juxtapose Nietzsche's attempt at a transvaluation of human values from a nihilistic perspective in these now famous passages from *Joyful Wisdom*, with Wells's vision of nature by implication "entirely undeified" and of providentially-unsupervised cosmic evolution in "The Further Vision."]

[From Book III, section 109] *Let us be on our Guard.*—Let us be on our guard against thinking that the world is a living being. Where could it extend itself? What could it nourish

itself with? How could it grow and increase? We know tolerably well what the organic is; and we are to reinterpret the emphatically derivative, tardy, rare and accidental, which we only perceive on the crust of the earth, into the essential, universal and eternal, as those do who call the universe an organism? That disgusts me. Let us now be on our guard against believing that the universe is a machine; it is assuredly not constructed with a view to *one* end; we invest it with far too high an honour with the word "machine." Let us be on our guard against supposing that anything so methodical as the cyclic motions of our neighbouring stars obtains generally and throughout the universe; indeed a glance at the Milky Way induces doubt as to whether there are not many cruder and more contradictory motions there, and even stars with continuous, rectilinearly gravitating orbits, and the like. The astral arrangement in which we live is an exception; this arrangement, and the relatively long durability which is determined by it, has again made possible the exception of exceptions, the formation of organic life. The general character of the world, on the other hand, is to all eternity chaos; not by the absence of necessity, but in the sense of the absence of order, structure, form, beauty, wisdom, and whatever else our aesthetic humanities are called. Judged by our reason, the unlucky casts are far oftenest the rule, the exceptions are not the secret purpose; and the whole musical box repeats eternally its air, which can never be called a melody,—and finally the very expression, "unlucky cast" is already an anthropomorphising which involves blame. But how could we presume to blame or praise the universe! Let us be on our guard against ascribing to it heartlessness and unreason, or their opposites; it is neither perfect, nor beautiful, nor noble; nor does it seek to be anything of the kind, it does not at all attempt to imitate man! It is altogether unaffected by our æsthetic and moral judgments! Neither has it any self-preservative instinct, nor instinct at all; it also knows no law. Let us be on our guard against saying that there are laws in nature. There are only necessities: there is no one who commands, no one who obeys, no one who transgresses. When you know that there is no design, you know also that there is no chance: for it

is only where there is a world of design that "chance" has meaning. Let us be on our guard against saying that death is contrary to life. The living being is only a species of dead being, and a very rare species.—Let us be on our guard against thinking that the world eternally creates the new. There are no eternally enduring substances; matter is just another such error as the God of the Eleatics.[1] But when shall we be at an end with our foresight and precaution! When will all these shadows of God cease to obscure us? When shall we have nature entirely undeified! When shall we be permitted to *naturalise* ourselves by means of the pure, newly discovered, newly redeemed nature? (151–53)

[From Book III, section 125.] *The Madman.*—Have you ever heard of the madman who on a bright morning lighted a lantern and ran to the market-place calling out unceasingly: "I seek God! I seek God!"—As there were many people standing about who did not believe in God, he caused a great deal of amusement. Why! is he lost? said one. Has he strayed away like a child? said another. Or does he keep himself hidden? Is he afraid of us? Has he taken a sea-voyage? Has he emigrated?—the people cried out laughingly, all in a hubbub. The insane man jumped into their midst and transfixed them with his glances. "Where is God gone?" he called out. "I mean to tell you! *We have killed him,*— you and I! We are all his murderers! But how have we done it? How were we able to drink up the sea? Who gave us the sponge to wipe away the whole horizon? What did we do when we loosened this earth from its sun? Whither does it now move? Whither do we move? Away from all suns? Do we not dash on unceasingly? Backwards, sideways, forewards, in all directions? Is there still an above and below? Do we not stray, as through infinite nothingness? Does not empty space breathe upon us? Has it not become colder? Does not night come on continually, darker and darker? Shall we not have to light lanterns in the morning? Do we not hear the noise of the grave-diggers who are burying God? Do we not

1 Idealist school of philosophers founded by Parmenides of Elea (5th century B.C.)

smell the divine putrefaction?—for even Gods putrefy! God is dead! God remains dead! And we have killed him! How shall we console ourselves, the most murderous of all murderers? The holiest and the mightiest that the world has hitherto possessed, has bled to death under our knife,—who will wipe the blood from us? With what water could we cleanse ourselves? What lustrums,[1] what sacred games shall we have to devise? Is not the magnitude of this deed too great for us? Shall we not ourselves have to become Gods, merely to seem worthy of it? There never was a greater event,—and on account of it, all who are born after us belong to a higher history than any history hitherto!" (167–68)

3. H. G. Wells. From "The Rediscovery of the Unique." *Fortnightly Review* 56 (July 1891): 106–11.

[This extract from the conclusion of Wells's first major published essay, while revealing several interesting Wellsian parallels with Nietzsche (see Appendix C2), concludes with a striking metaphor that sheds an interesting light on the significance of all the Time Traveller's references to matches.]

The work of Darwin and Wallace was the clear assertion of the uniqueness of living things; and physicists and chemists are now trying the next step forward in a hesitating way—they must take it sooner or later. We are on the eve of man's final emancipation from rigid reasonableness, from the last trace of the trim clockwork thought of the seventeenth and eighteenth centuries. . . .

The neat little picture of a universe of souls made up of passions and principles in bodies made of atoms, all put together so neatly and wound up at the creation, fades in the series of dissolving views that we call the march of human thought. We no longer believe, whatever creed we may affect, in a Deity whose design is so foolish and little that even a theological bishop can trace it and detect a kindred soul. Some of the most pious can

1 Ritual purifications.

hardly keep from scoffing at Milton's world—balanced just in the middle of those crystalline spheres that hung by a golden chain from the battlements of heaven.[1] We no longer speculate

"What varied being peoples ev'ry star,"[2]

because we have no reason at all to expect life beyond this planet. We are a century in front of that Nuremberg[3] cosmos, and in the place of it there looms a dim suggestion of the fathomlessness of the unique mystery of life. The figure of a roaring loom with unique threads flying and interweaving beyond all human following, working out a pattern beyond all human interpretation, we owe to Goethe,[4] the intellectual father of the nineteenth century. Number—Order, seems now the least law in the universe; in the days of our great-grandfathers it was heaven's first law.

So spins the squirrel's cage of human philosophy.

Science is a match that man has just got alight. He thought he was in a room—in moments of devotion, a temple—and that his light would be reflected from and display walls inscribed with wonderful secrets and pillars carved with philosophical systems wrought into harmony. It is a curious sensation, now that the preliminary splutter is over and the flame burns up clear, to see his hands lit and just a glimpse of himself and the patch he stands on visible, and around him, in place of all that human comfort and beauty he anticipated—darkness still. (111)

1 See *Paradise Lost* (1667), II, lines 1051–52.
2 Pope, *An Essay on Man* (1733), I, line 27.
3 City that was the centre of the German Renaissance, perhaps here associated with the precise calculations of one of its notable residents, the astronomer Regiomontanus (1436–76).
4 See *Faust*, I ("Night") (1808), lines 151–59.

4. Max Nordau. *Degeneration*. [Trans. W. F. Barry.] New York: D. Appleton, 1895. Trans. *Entartung*. 1892.

[Nordau (1849–1923), an Austro-Hungarian journalist with a medical training, wrote in *Degeneration* one of the best-sellers of the 1890s, a apocalyptic polemic which widely popularized the supposed connection between biological degeneration and cultural expression, in particular by "proving" that unconventional or pessimistic modern works (e.g., by Ibsen, Zola, and Wagner) were symptoms of their authors' pathology. Though Nordau's work did not appear in English until the month before *The Time Machine* was published, and there is very little likelihood that Wells had read it before then, *Degeneration* is an articulation of very general fin-de-siècle cultural anxieties that are visible in innumerable ways in *The Time Machine*. These passages are both from Book 1: "Fin-de-Siècle," Chapter 1: "The Dusk of the Nations."]

[H]owever silly a term *fin-de-siècle* may be, the mental constitution which it indicates is actually present in influential circles. The disposition of the times is curiously confused, a compound of feverish restlessness and blunted discouragement, of fearful presage and hang-dog renunciation. The prevalent feeling is that of imminent perdition and extinction. *Fin-de-siècle* is at once a confession and a complaint. The old Northern faith contained the fearsome doctrine of the Dusk of the Gods. In our days there have arisen in more highly-developed minds vague qualms of a Dusk of the Nations, in which all suns and all stars are gradually waning, and mankind with all its institutions and creations is perishing in the midst of a dying world. (2)

[*Fin-de-siècle*] means a practical emancipation from traditional discipline, which theoretically is still in force. To the voluptuary this means unbridled lewdness, the unchaining of the beast in man; to the withered heart of the egoist, disdain of all consideration for his fellow-men, the trampling under foot of all barriers which enclose brutal greed of lucre and lust of pleasure; to the contemner of the world it means the shameless ascendancy of base impulses and motives, which were, if not virtuously suppressed, at least hypocritically hidden; to the believer it means the repudiation of dogma, the negation of a super-sensuous world, the descent into flat phenomenalism; to the sensitive nature yearning for æsthetic thrills, it means the vanishing of ideals in art, and no more power in its accepted forms to arouse emotion. And to all, it means the end of an established order, which for thousands of years has satisfied logic, fettered depravity, and in every art matured something of beauty.

One epoch of history is unmistakably in its decline, and another is announcing its approach. There is a sound of rending in every tradition, and it is as though the morrow would not link itself with to-day. Things as they are totter and plunge, and they are suffered to reel and fall, because man is weary, and there is no faith that it is worth an effort to uphold them. Views that have hitherto governed minds are dead or driven hence like disenthroned kings, and for their inheritance they that hold the titles and they that would usurp are locked in struggle. Meanwhile interregnum in all its terrors prevails; there is confusion among the powers that be; the million, robbed of its leaders, knows not where to turn; the strong work their will; false prophets arise, and dominion is divided amongst those whose rod is the heavier because their time is short....

Such is the spectacle presented by the doings of men in the reddened light of the Dusk of the Nations. Massed in the sky the clouds are aflame in the weirdly beautiful glow which was observed for the space of years after the eruption of Krakatoa.[1] Over the earth the shadows creep with deepening gloom, wrapping all objects in a mysterious dimness, in which all certainty is destroyed and any guess seems plausible. Forms lose their outlines, and are dissolved in floating mist. The day is over, and the night draws on. (5–6)

1 A volcano in Indonesia, producing in 1883 one of the greatest eruptions in history.

Evolution + Disappearance of order
v.
Idealist deduction of mathematics
Cong. from 19→20→30-40)

Appendix D: The Spatiotemporal Context: The Fourth Dimension

1. Edwin A. Abbott [as "A Square"]. From *Flatland: A Romance of Many Dimensions*. 1884. New and rev. ed. London: Seeley & Co., 1884.

[Abbott (1838–1926) was an English clergyman and mathematician, now chiefly remembered for his ingenious and amusing scientific romance about how the inhabitants of a two-dimensional world might perceive reality, and their probable difficulty in conceiving of our own three-dimensional universe. *Flatland* was published just as Wells was starting at South Kensington, where the novel clearly stimulated ideas among the students about the possibility of a fourth dimension. In 1937 Wells would cite *Flatland* as a primary origin of *The Time Machine*: see Appendix F17.]

[From Chapter 18, *"How I came to Spaceland, and what I saw there."* Square, the two-dimensional narrator, describes the feeling of entering a three-dimensional world. Compare the Time Traveller's sensations when first travelling through time.] An unspeakable horror seized me. There was a darkness; then a dizzy, sickening sensation of sight that was not like seeing; I saw a Line that was no Line; Space that was not Space: I was myself, and not myself. When I could find voice, I shrieked aloud in agony, "Either this is madness or it is Hell." "It is neither," calmly replied the voice of the Sphere, "it is Knowledge; it is Three Dimensions: open your eye once again and try to look steadily." (78–79)

[From Chapter 19, *"How, though the Sphere showed me other mysteries of Spaceland, I still desired more; and what came of it."* Two-dimensional Square argues with three-dimensional Sphere about the existence of a Fourth Dimension.] ... just as there *was* close at hand, and touching my frame, the land of Three Dimensions, though I, blind senseless wretch, had no power to

touch it, no eye in my interior to discern it, so of a surety there is a Fourth Dimension, which my Lord perceives with the inner eye of thought. And that it must exist my Lord himself has taught me. Or can he have forgotten what he himself imparted to his servant?

In One Dimension, did not a moving Point produce a Line with *two* terminal points?

In Two Dimensions, did not a moving Line produce a Square with *four* terminal points?

In Three Dimensions, did not a moving Square produce—did not this eye of mine behold it—that blessed Being, a Cube, with *eight* terminal points?

And in Four Dimensions shall not a moving Cube—alas, for Analogy, and alas for the Progress of Truth, if it be not so—shall not, I say, the motion of a divine Cube result in a still more divine Organization with *sixteen* terminal points?

Behold the infallible confirmation of the Series, 2, 4, 8, 16: is not this a Geometrical Progression? Is not this—if I might quote my Lord's own words—"strictly according to Analogy"?

Again, was I not taught by my Lord that as in a Line there are *two* bounding Points, and in a Square there are *four* bounding Lines, so in a Cube there must be *six* bounding Squares? Behold once more the confirming Series, 2, 4, 6: is not this an Arithmetical Progression? And consequently does it not of necessity follow that the more divine offspring of the divine Cube in the Land of Four Dimensions, must have 8 bounding Cubes: and is not this also, as my Lord has taught me to believe, "strictly according to Analogy"? (88–89)

[From Chapter 22, *"How I then tried to diffuse the Theory of Three Dimensions by other means, and of the result."* Square, jailed for seven years for his belief in the world of three dimensions, despairs of ever converting the Flatlanders. In this passage is yet another source for the White Sphinx.] Yet I exist in the hope that these memoirs, in some manner, I know not how, may find their way to the minds of humanity in Some Dimension, and may stir up a race of rebels who shall refuse to be confined to limited Dimensionality.

That is the hope of my brighter moments. Alas, it is not

always so. Heavily weighs on me at times the burdensome reflection that I cannot honestly say I am confident as to the exact shape of the once-seen, oft-regretted Cube; and in my nightly visions the mysterious precept, "Upward, not Northward," haunts me like a soul-devouring Sphinx. (101–02)

2. C.H. Hinton. From "What Is the Fourth Dimension?" 1884. *Scientific Romances: First Series*. London: Swan Sonnenschein, 1886. 3–32.

[Charles Howard Hinton (1853–1907) was a British mathematician and supernaturalist chiefly remembered for his speculative essays on the possibility of a fourth dimension of space, as well as for his first use of the phrase "scientific romance," which Wells would later borrow as a label for his own fiction. "What Is the Fourth Dimension?" was first published as a pamphlet in 1884, then collected with other speculative pieces (chiefly nonfictional) as a book, *Scientific Romances: First Series*, in 1886. After the machine itself, the oldest element in *The Time Machine* is the Time Traveller's argument for the existence of the fourth dimension, and in dramatizing it Wells was unquestionably influenced by the following passages from Hinton.]

"Why should there be three and only three directions?" Space, as we know it, is subject to a limitation....

Suppose a being confined to a plane superficies,[1] and throughout all the range of its experience never to have moved up or down, but simply to have kept to this one plane. Suppose, that is, some figure, such as a circle or rectangle, to be endowed with the power of perception; such a being if it moves in the plane superficies in which it is drawn, will move in a multitude of directions; but, however varied they may seem to be, these directions will all be compounded of two, at right angles to each other. By no movement so long as the plane superficies remains perfectly horizontal, will this being move in the direction we call up and down. And it is important to notice that the plane would be different, to a creature confined to it, from what it is to us. We think of a plane habitually as having an upper and a lower side, because it is only by the contact of solids that we realize a plane. But a creature which had been confined to a plane during its whole existence would have no idea of there being two sides to the plane he lived in. In a plane there is simply length and breadth. If a creature in it be supposed to know of an up or down he must already have gone out of the plane.

Is it possible, then, that a creature so circumstanced would arrive at the notion of there being an up and down, a direction different from those to which he had been accustomed, and having nothing in common with them? Obviously nothing in the creature's circumstances would tell him of it. It could only be by a process of reasoning on his part that he could arrive at such a conception. If he were to imagine a being confined to a single straight line, he might realise that he himself could move in two directions, while the creature in a straight line could only move in one. Having made this reflection he might ask, "But why is the number of directions limited to two? Why should there not be three?" (5–7)

For the sake of convenience, let us call the figure we are investigating—the simplest figure in four dimensions—a four-square.

First of all we must notice, that if a cube be formed from a square by the movement of the square in a new direction, each point of the interior of the square traces out part of the cube. It is not only the bounding lines that by their motion form the cube, but each portion of the interior of the square generates a portion of the cube. So if a cube were to move in the fourth dimension so as to generate a four-square, every point in the interior of the cube would start *de novo*,[1] and trace out a portion of the new figure uninterfered with by the other points.

Or, to look at the matter in another light, a being in three dimensions, looking down on a square, sees each part of it

1 I.e., a plane having only length and breadth.

1 Anew.

extended before him, and can touch each part without having to pass through the surrounding parts, for he can go from above, while the surrounding parts surround the part he touches only in one plane.

So a being in four dimensions could look at and touch every point of a solid figure. No one part would hide another, for he would look at each part from a direction which is perfectly different from any in which it is possible to pass from one part of the body to another. To pass from one part of the body to another it is necessary to move in three directions, but a creature in four dimensions would look at the solid from a direction which is none of these three. (13)

Let us investigate the conception of a four-dimensional existence in a simpler and more natural manner—in the same way that a two-dimensional being should think about us, not as infinite in the third dimension, but limited in three dimensions as he is in two. A being existing in four dimensions must then be thought to be as completely bounded in all four directions as we are in three. All that we can say in regard to the possibility of such beings is, that we have no experience of motion in four directions. The powers of such beings and their experience would be ampler, but there would be no fundamental difference in the laws of force and motion.

Such a being would be able to make but a part of himself visible to us, for a cube would be apprehended by a two-dimensional being as the square in which it stood. Thus a four-dimensional being would suddenly appear as a complete and finite body, and as suddenly disappear, leaving no trace of himself, in space, in the same way that anything lying on a flat surface, would, on being lifted, suddenly vanish out of the cognisance of beings, whose consciousness was confined to the plane. The object would not vanish by moving in any direction, but disappear instantly as a whole. There would be no barrier no confinement of our devising that would not be perfectly open to him. He would come and go at pleasure; he would be able to perform feats of the most surprising kind. (25)

3. "S." "Four-Dimensional Space." [Letter to the Editor, dated March 16, 1885.] *Nature* 31 (26 March 1885): 481.

[This letter to the editor of *Nature* has been cited as the first serious mention of the idea of time as the fourth dimension in an English-language scientific journal. That it should have appeared in a periodical founded by T. H. Huxley at a time when Wells was in his first year at the Normal School suggests that its author, identified only as "S," was possibly one of Wells's circle of students—or even Wells himself. Whoever "S" was, it is clear that time as fourth dimension was one of the ideas circulating in South Kensington while Wells was there, as he himself later recalled: see Appendix G3.]

Possibly the question, What is the fourth dimension? may admit of an indefinite number of answers. I prefer, therefore, in proposing to consider Time as a fourth dimension of our existence, to speak of it as *a* fourth dimension rather than *the* fourth dimension. Since this fourth dimension cannot be introduced into space, as commonly understood, we require a new kind of space for its existence, which we may call time-space. There is then no difficulty in conceiving the analogues in this new kind of space, of the things in ordinary space which are known as lines, areas, and solids. A straight line, by moving in any direction not in its own length, generates an area; if this area moves in any direction not in its own plane it generates a solid; but if this solid moves in any direction, it still generates a solid, and nothing more. The reason of this is that we have not supposed it to move in the fourth dimension. If the straight line moves in its own direction, it describes only a straight line; if the area moves in its own plane, it describes only an area; in each case, motion in the dimensions in which the thing exists, gives us only a thing of the same dimensions; and, in order to get a thing of higher dimensions, we must have motion in a new dimension. But, as the idea of motion is only applicable in space of three dimensions, we must replace it by another which is applicable in our fourth dimension of time. Such an idea is

that of successive existence. We must, therefore, conceive that there is a new three-dimensional space for each successive instant of time; and, by picturing to ourselves the aggregate formed by the successive positions in time-space of a given solid during a given time, we shall get the idea of a four-dimensional solid, which may be called a sur-solid. It will assist us to get a clearer idea, if we consider a solid which is in a constant state of change, both of magnitude and position; and an example of a solid which satisfies this condition sufficiently well, is afforded by the body of each of us. Let any man picture to himself the aggregate of his own bodily forms from birth to the present time, and he will have a clear idea of a sur-solid in time-space.

Let us now consider the sur-solid formed by the movement, or rather, the successive existence, of a cube in time-space. We are to conceive of the cube, and the whole of the three-dimensional space in which it is situated, as floating away in time-space for a given time; the cube will then have an initial and a final position, and these will be the end boundaries of the sur-solid. It will therefore have sixteen points, namely, the eight points belonging to the initial cube, and the eight belonging to the final cube. The successive positions (in time-space) of each of the twelve edges of the cube, will form what may be called a time area; and, adding these to the twelve faces of the initial and final cubes, we see that the sur-solid has twenty-four areas. Lastly, the successive positions (in time-space) of each of the six faces of the cube, will form what may be called a time-solid; and, adding these to the initial and final cubes, we see that the sur-solid is bounded by eight solids. These results agree with the statements in your article.[1] But it is not permissible to speak of the sur-solid as resting in "space," we must rather say that the section of it by any time is a cube resting (or moving) in "space."

1 The "article" was an anonymous review of C.H. Hinton's *Scientific Romances*. No. 1. "What is the Fourth Dimension?" (1884) in *Nature* 31 (12 March 1885): 431.

4. E. A. Hamilton Gordon. From "The Fourth Dimension." *Science Schools Journal* 5 (April 1887): 145-51.

[Hamilton Gordon, Wells's fellow-student at the Normal School, read this paper to the Debating Society on 14 January 1887. In the penultimate paragraph, he ruefully notes the similarity of his ideas to Hinton's, but claims that he did not become aware of Hinton's work (see Appendix D2) until the paper was finished. The paper is more evidence of the importance of the idea of the fourth dimension at South Kensington, while Hamilton Gordon's dismissal of the idea of time as the fourth dimension suggests that even in 1887 Wells was a relatively original thinker whose mind was moving in the subversive direction pioneered by Abbott, rather than in the supernatural one suggested by Hinton.]

The question has been put to me with monotonous frequency, "What is the fourth dimension?" and it would be difficult to answer, were it not for the fact that the questioner usually answers it for himself, by suggesting some impossible thing. One thought it was "Time," another, "Life," a third "Heaven," while a fourth suggested "Velocity".... The most reasonable suggestion was that it was the "Soul," but with this I cannot agree at all. The soul is from its very nature immaterial, whilst the fourth dimension must necessarily be as material as the other three; the soul has none of the properties of a solid, namely size, inertia, &c.

What, then, is the fourth dimension?

Let us think out some of the phenomena we should observe if a body of the fourth power were to enter, or pass through, a plane of the third. Then let us see whether our experience furnishes us with any such phenomena, and draw our conclusions accordingly....

We must first of all imagine a plane figure in a plane to be endowed with senses of sight, touch, and hearing. Now let a solid body approach the plane; so long as it remains outside the plane it will be absolutely invisible, but as soon as it enters it, there will become visible that section of the solid which is

made by the plane; and if the solid continued moving, different sections would be continually presented to view; finally, when the solid had passed through the plane, it would suddenly and mysteriously vanish, and the thought-endowed plane figure would be unable to conceive whence it came or whither it went.

Moreover, if there were some impenetrable object in the plane, such as an impassable line, so that figures in the plane could not pass it, it would form no obstacle whatever to a solid body, which would pass through, or rather, round it, quite unconsciously; so that it could enter enclosed places which would be quite unattainable to bodies moving in the plane alone.

Again, if a voice spoke out of the third dimension so as to be heard by our imaginary person in the second, the sound would appear to come from everywhere at once, or rather from no definite direction; in fact we should describe it as sepulchral....

Although, possibly, none of us here to-night may have seen a ghost, yet we have all heard plenty of well-authenticated ghost stories, and we at once perceive the similarity between the two sets of phenomena. (149–50)

5. Oscar Wilde. From "The Canterville Ghost: A Hylo-Idealistic Romance." 1887. *The Works of Oscar Wilde*. [Sunflower Ed.] Vol. IV. New York: Lamb Publishing Co., 1909. 87–152.

[Hinton's interest in the fourth dimension of space was to try to account scientifically for the phenomenon of ghosts; Hamilton Gordon's argument moves in a similar direction. This passage from an early ghost story by Oscar Wilde (1854–1900) shows how rapidly speculative ideas about the fourth dimension were being assimilated into popular culture at the time when Wells was first beginning to mull over ideas about a time machine.]

For a moment the Canterville ghost stood quite motionless in natural indignation; then, dashing the bottle violently upon the

polished floor, he fled down the corridor, uttering hollow groans, and emitting a ghastly green light. Just, however, as he reached the top of the great oak staircase, a door was flung open, two little white-robed figures appeared, and a large pillow whizzed past his head! There was evidently no time to be lost, so, hastily adopting the Fourth Dimension of Space as a means of escape, he vanished through the wainscoting, and the house became quite quiet. (100)

6. William James. From *The Principles of Psychology*. New York: Henry Holt, 1890.

[William James (1842–1910), the American philosopher and older brother of Henry James, first came to prominence as the author of a vast overview of all that was known in 1890 of the science of mind, *The Principles of Psychology*. It is not known if Wells read James at this time, but it is clear from *The Time Machine* that he was familiar with some of the contemporary thought about how the mind perceives reality, space, and time, that is summarized so effectively by James in Chapter XV: "The Perception of Time."]

In short, the practically cognized present is no knife-edge, but a saddle-back, with a certain breadth of its own on which we sit perched, and from which we look in two directions into time. The unit of composition of our perception of time is a *duration*, with a bow and a stern, as it were—a rearward—and a forward-looking end....

When we come to study the perception of Space, we shall find it quite analogous to time in this regard. Date in time corresponds to position in space; and although we now mentally construct large spaces by mentally imagining remoter and remoter positions, just as we now construct great durations by mentally prolonging a series of successive dates, yet the original experience of both space and time is always of something already given as a unit, inside of which attention afterward discriminates parts in relation to each other. (1:609–10)

Suppose we were able, within the length of a second, to note 10,000 events distinctly, instead of barely 10, as now.... The motions of organic beings would be so slow to our senses as to be inferred, not seen. The sun would stand still in the sky, the moon be almost free from change, and so on. But now reverse the hypothesis and suppose a being to get only one 1000th part of the sensations that we get in a given time, and consequently to live 1000 times as long. Winters and summers will be to him like quarters of an hour. Mushrooms and the swifter-growing plants will shoot into being so rapidly as to appear instantaneous creations; annual shrubs will rise and fall from the earth like restlessly-boiling water springs; the motions of animals will be as invisible as are to us the movements of bullets and cannon-balls; the sun will scour through the sky like a meteor, leaving a fiery trail behind him.... (1:639)

7. Professor Simon Newcomb. From "Modern Mathematical Thought." [Address delivered before the New York Mathematical Society at the annual meeting, December 28, 1893.] *Nature* 49 (February 1, 1894): 325–29.

[The Nova Scotia–born mathematician, astronomer, and naval officer Simon Newcomb (1835–1909) was one of the most prominent American scientists of his generation. This is a passage from the actual address mentioned by the Time Traveller in Chapter 1 of *The Time Machine*, which allows us to date the opening dinner party at Richmond to early 1894.[1] Wells had clearly kept up with the evolving scientific debate on the fourth dimension, though it should be noted that Newcomb deals only with four dimensions of space. In early 1894 Newcomb was Professor of Mathematics and Astronomy at Johns Hopkins University.]

1 The Time Traveller notes in Chapter 1 that Newcomb's 28 December, 1893 lecture was "only a month or so ago." If he had attended it, then his dinner party would be in early February 1894. If he had like his creator merely read the text of the lecture in the 1 February 1894 issue of *Nature*, then the dinner party would be in March 1894, significantly the same month that the first instalment of the *National Observer* version of *The Time Machine* was published.

Now, it is a fundamental principle of pure science that the liberty of making hypotheses is unlimited. It is not necessary that we shall prove the hypothesis to be a reality before we are allowed to make it. It is legitimate to anticipate all the possibilities. It is, therefore, a perfectly legitimate exercise of thought to imagine what would result if we should not stop at three dimensions in geometry, but construct one for space having four. As the boy, at a certain stage in his studies, passes from two to three dimensions, so may the mathematician pass from three to four dimensions with equal facility. He does indeed meet with the obstacle that he cannot draw figures in four dimensions, and his faculties are so limited that he cannot construct in his own mind an image of things as they would look in space of four dimensions. But this need not prevent his reasoning on the subject, and one of the most obvious conclusions he would reach is this: As in space of two dimensions one line can be drawn perpendicular to another at a given point, and by adding another dimension to space a third line can be drawn perpendicular to these two; so in a fourth dimension we can draw a line which shall be perpendicular to all three. True, we cannot imagine how the line would look, or where it would be placed, but this is merely because of the limitations of our faculties. As a surface describes a solid by continually leaving the space in which it lies at the moment, so a four-dimensional solid will be generated by a three-dimensional one by a continuous motion which shall constantly be directed outside of this three-dimensional space in which our universe appears to exist. As the man confined in a circle can evade it by stepping over it, so the mathematician, if placed inside a sphere in four-dimensional space, would simply step over it as easily as we should over a circle drawn on the floor. Add a fourth dimension to space, and there is room for an indefinite number of universes, all alongside of each other, as there is for an indefinite number of sheets of paper when we pile them upon each other. (328)

Appendix E: The Spatiotemporal Context: Solar Death and the End of the World

1. Jonathan Swift [as "Lemuel Gulliver"]. From *Travels into Several Remote Nations of the World*.... London: Benjamin Motte, 1726.

[In his preface to the Atlantic edition of *The Time Machine* (see Appendix G2), Wells noted that he had undergone a "cleansing course" of Swift between "The Chronic Argonauts" and the *National Observer* version of *The Time Machine*. As a scientific romance with a satirical edge, *The Time Machine* has a generic affiliation with Part III of *Gulliver's Travels*, "A Voyage to Laputa," while the apocalyptic ending of Wells's novel may well owe something to this passage on the anxieties generated by science from Part III of the famous satire by Swift (1667–1745).]

THESE People are under continual Disquietudes, never enjoying a Minute's Peace of Mind; and their Disturbances proceed from Causes which very little affect the rest of Mortals. Their Apprehensions arise from several Changes they dread in the Celestial Bodies. For instance; that the Earth by the continual Approaches of the Sun towards it, must in Course of Time be absorbed or swallowed up. That the Face of the Sun will by Degrees be encrusted with its own Effluvia, and give no more Light to the World.... That the Sun daily spending its Rays without any Nutriment to supply them, will at last be wholly consumed and annihilated; which must be attended with the Destruction of this Earth, and of all the Planets that receive their Light from it. (164–65)

2. Professor W[illiam] Thomson [later Lord Kelvin]. From "On the Age of the Sun's Heat." *Macmillan's Magazine* 5 (March 1862): 388–93. [Rep. as "On the Age of the Sun's Heat." In Sir William Thomson and Peter Guthrie Tait. *Treatise on Natural Philosophy*. New ed. Vol. I Part 2. Cambridge: Cambridge UP, 1879. 485–94.]

[William Thomson, 1st Baron Kelvin (1824–1907) was one of the most distinguished British mathematicians and physicists of the nineteenth century. He was one of the chief proponents of the doctrine of the irreversible cosmic dissipation of energy—the heat-death of the universe—according to the second law of thermodynamics. One of his most widely read papers contained an estimate of the *total* lifespan of the sun at possibly as little as ten million years, perhaps at most a hundred million years. (Nuclear energy, and the solar fusion reaction that liberates it, was not yet then understood.) Kelvin's paper caused alarm in the scientific community and cast a pall over the fin de siècle because it suggested such a comparatively brief future for life on earth. For the sun was assumed to be well into its lifespan, as millions—preferably hundreds of millions—of years were required by biologists to account for evolution. Indeed, evolution according to Kelvin's scenario would have to have taken place rather more quickly than Darwinists had assumed. It is the result of Kelvin's influence that Wells in *The Time Machine* proposes that divergence of the human species could have taken place in so short a time as 800,000 years, and that life on earth would certainly be ending thirty million years hence.]

The second great law of Thermodynamics involves a certain principle of *irreversible action in nature*. It is thus shown that, although mechanical energy is *indestructible*, there is a universal tendency to its dissipation, which produces gradual augmentation and diffusion of heat, cessation of motion, and exhaustion of potential energy through the material universe. The result would inevitably be a state of universal rest and death, if the universe were finite and left to obey existing laws. (388)

There is no difficulty in accounting for [the sun providing] 20,000,000 years' heat by the meteoric theory.[1]

It would extend this article to too great a length, and would require something of mathematical calculation, to explain fully the principles on which this last estimate is founded. It is enough to say that bodies, all much smaller than the sun, falling together from a state of relative rest, at mutual distances all large in comparison with their diameters, and forming a globe of uniform density equal in mass and diameter to the sun, would generate an amount of heat which, accurately calculated according to Joule's[2] principles and experimental results, is found to be just 20,000,000 times Pouillet's[3] estimate of the annual amount of solar radiation....

... there is reason to believe that even the most rapid conglomeration [of the bodies that supposedly originally coalesced to form the sun] that we can conceive to have probably taken place could only leave the finished globe with about half the entire heat due to the amount of potential energy of mutual gravitation exhausted. We may, therefore, accept, as a lowest estimate for the sun's initial heat, 10,000,000 times a year's supply at present rate, but 50,000,000 or 100,000,000 as possible, in consequence of the sun's greater density in his central parts.

The considerations adduced above, in this paper, regarding the sun's possible specific heat, rate of cooling, and superficial temperature, render it probable that he must have been very sensibly warmer one million years ago than now; and, consequently, that if he has existed as a luminary for ten or twenty million years, he must have radiated away considerably more than the corresponding number of times the present yearly amount of loss.

It seems, therefore, on the whole most probable that the sun has not illuminated the earth for 100,000,000 years, and almost certain that he has not done so for 500,000,000 years. As for the future, we may say, with equal certainty, that inhabitants of the earth cannot continue to enjoy the light and heat essential to their life, for many million years longer, unless sources now unknown to us are prepared in the great storehouse of creation. (393)

1 Namely, that the loss of some of the sun's heat has been compensated for by meteors or other cosmic debris which, drawn into the sun by its gravitational force, would add to its pool of fuel and thus lengthen its lifespan.

2 James Prescott Joule (1818–89), the English physicist.

3 Claude Pouillet (1791–1868), the French physicist.

3. Balfour Stewart. From *The Conservation of Energy. Being an Elementary Treatise on Energy and Its Laws.* 2nd ed. London: Henry S. King, 1874.

[Balfour Stewart (1828–87) the Scottish-born physicist, latterly Professor of Natural Philosophy at Owens College, Manchester, had an ability to explain clearly, sometimes through striking metaphors, the implications of the second law of thermodynamics for the future of humanity in books that were widely read as Wells was growing up. He noted, for example, that the sun expends its energy like a man "whose expenditure exceeds his income. He is living upon his capital, and is destined to share the fate of all who act in a similar manner" (152).]

Probable Fate of the Universe

209. ... We have spoken already about a medium pervading space, the office of which appears to be to degrade and ultimately extinguish all differential motion, just as it tends to reduce and ultimately equalize all difference of temperature. Thus the universe would ultimately become an equally heated mass, utterly worthless as far as the production of work is concerned, since such production depends upon difference of temperature.

Although, therefore, in a strictly mechanical sense, there is a conservation of energy, yet, as regards usefulness or fitness for living beings, the energy of the universe is in process of deterioration. Universally diffused heat forms what we may call the great waste-heap of the universe, and this is growing larger year by year. At present it does not sensibly obtrude itself, but who knows that the time may not arrive when we shall be practically conscious of its growing bigness?

210. It will be seen that ... we have regarded the universe,

not as a collection of matter, but rather as an energetic agent—in fact, as a lamp. Now, it has been well pointed out by Thomson,[1] that looked at in this light, the universe is a system that had a beginning and must have an end; for a process of degradation cannot be eternal. If we could view the universe as a candle not lit, then it is perhaps conceivable to regard it as having been always in existence; but if we regard it rather as a candle that has been lit, we become absolutely certain that it cannot have been burning from eternity, and that a time will come when it will cease to burn. We are led to look to a beginning in which the particles of matter were in a diffuse chaotic state, but endowed with the power of gravitation, and we are led to look to an end in which the whole universe will be one equally heated inert mass, and from which everything like life or motion or beauty will have utterly gone away. (152–53)

4. [Balfour Stewart and Peter Guthrie Tait.] From *The Unseen Universe; or, Physical Speculations on a Future State*. 3rd. ed. London: Macmillan, 1875.

[In *The Unseen Universe*, Stewart and Peter Guthrie Tait (1831–1901), Professor of Natural Philosophy at the University of Edinburgh and collaborator with Lord Kelvin, prepared the nineteenth-century reading public for the apocalyptic scenario in "The Further Vision."]

[From Article 114: "Degradation of Energy"; following a historical sketch of the Second Law of Thermodynamics.] It ... appears that at each transformation of heat-energy into work a large portion is degraded, while only a small portion is transformed into work. So that while it is very easy to change all of our mechanical or useful energy into heat, it is only possible to transform a portion of this heat-energy back again into work. After each change too the heat becomes more and more dissipated or degraded, and less and less available for any future transformation.

In other words, the tendency of heat is towards equalisation; heat is *par excellence* the communist of our universe, and it will no doubt ultimately bring the system to an end. This universe may in truth be compared to a vast heat engine, and this is the reason why we have brought such engines so prominently before our readers. The sun is the furnace or source of high-temperature heat of our system, just as the stars are for other systems, and the energy which is essential to our existence is derived from the heat which the sun radiates, and represents only a very small portion of that heat. But while the sun thus supplies us with energy he is himself getting colder, and must ultimately, by means of radiation into space, part with the life-sustaining power which he at present possesses. Besides the cooling of the sun we must also suppose that owing to something analogous to ethereal friction the earth and the other planets of our system will be drawn spirally nearer and nearer to the sun, and will at length be engulfed in his mass. In each such case there will be, as the result of the collision, the conversion of visible energy into heat, and a partial and temporary restoration of the power of the sun. At length, however, this process will have come to an end, and he will be extinguished until, after long but not immeasurable ages, by means of the same ethereal friction his black mass is brought into contact with that of his nearest neighbour.

115. Not much further need we dilate on this. It is absolutely certain that life, so far as it is physical, depends essentially on transformations of energy; it is also absolutely certain that age after age the possibility of such transformations is becoming less and less; and, so far as we yet know, the final state of the present universe must be an aggregation (into one mass) of all the matter it contains, *i.e.* the potential energy gone, and a practically useless state of kinetic energy, *i.e.* uniform temperature throughout that mass. (90–92)

1 See Appendix E2.

5. George Howard Darwin. From "The Determination of the Secular Effects of Tidal Friction by a Graphical Method." *Proceedings of the Royal Society of London*, XXIX (1879), pp. 168-81. In *Scientific Papers. Volume II: Tidal Friction and Cosmogony*. Cambridge: Cambridge UP, 1908. 195-207.

[The "younger Darwin" mentioned by the Time Traveller in Chapter VIII was Charles Darwin's second son Sir George Howard Darwin (1845-1912), an astronomer recognized in his time as the leading authority on tidal effects. Below is Darwin's clearest explanation of how the frictional effect of gravity retards the motion of a planet like the earth—the equations underlying Wells's fin-de-siècle vision of a universe running down.]

Suppose an attractive particle or satellite of mass m to be moving in a circular orbit, with an angular velocity Ω, round a planet of mass M, and suppose the planet to be rotating about an axis perpendicular to the plane of the orbit, with an angular velocity n; suppose, also, the mass of the planet to be partially or wholly imperfectly elastic or viscous, or that there are oceans on the surface of the planet; then the attraction of the satellite must produce a relative motion in the parts of the planet, and that motion must be subject to friction, or, in other words, there must be frictional tides of some sort or other. The system must accordingly be losing energy by friction, and its configuration must change in such a way that its whole energy diminishes.

Such a system does not differ much from those of actual planets and satellites, and, therefore, the results deduced in this hypothetical case must agree pretty closely with the actual course of evolution, provided that time enough has been and will be given for such changes. (195)

6. George Howard Darwin. From "On the Precession of a Viscous Spheroid, and on the Remote History of the Earth." *Philosophical Transactions of the Royal Society*, Part II. Vol. 170 (1879), pp. 447-530. In *Scientific Papers. Volume II: Tidal Friction and Cosmogony*. Cambridge: Cambridge UP, 1908. 36-139.

[In *The Time Machine* Wells took into account G. H. Darwin's speculations on the specific orbital fate of the earth and moon in constructing the worlds of the far future. Just before the extract below, G. H. Darwin has established that in the distant future tidal friction will lengthen the earth day to almost 56 present days, while the moon will at first move away from the earth.]

... the sun's tidal friction will go on lengthening the day even beyond this point, but then the lunar tides will again come into existence, and the lunar tidal friction will tend in part to counteract the solar. The tidal reaction will also be reversed, so that the moon will again approach the earth. Thus the effect of the sun is to make this a state of dynamical instability. (102)

[Darwin argues that in the remote past both the day and month were about 5 hours 36 minutes in length.] First consider the case where the sun does not exist. Suppose the earth to be rotating in about 5½ hours, and the moon moving orbitally around it in a little less than that time. Then the motion of the moon relatively to the earth is consentaneous with[1] the earth's rotation, and therefore the tidal friction, small though it be, tends to accelerate the earth's rotation; the tidal reaction is such as to tend to retard the moon's linear velocity, and therefore increase her orbital angular velocity, and reduce her distance from the earth. The end will be that the moon falls into the earth....

Secondly, take the case where the sun also exists, and suppose the system started in the same way as before. Now the

1 Accords with.

motion of the earth relatively to the sun is rapid, and such that the solar tidal friction retards the earth's rotation; whilst the lunar tidal friction is, as before, such as to accelerate the rotation.

Hence, if the viscosity be very large the earth's rotation may be accelerated, but if it be not very large it will be retarded. The tidal reaction, which depends on the lunar tides alone, continues negative, and the moon approaches the earth as before. Thus after a short time the motion of the moon relatively to the earth is more rapid than in the previous case, whatever be the ratio between solar and lunar tidal friction. Hence in this case the moon will fall into the earth more rapidly than if the sun did not exist, and the dynamical instability is more marked.

If, however, the day were shorter than the month, the moon must continually recede from the earth, until it reaches the outer limit of a day of 56 m[ean] s[olar] days. (103)

7. [H. G. Wells.] From "The 'Cyclic' Delusion." ***Saturday Review*** **78 (10 November 1894): 505-06.**

[Wells's perhaps simplistic interpretation of G. H. Darwin's speculations on tidal drag is clearly evident in this passage from one of his *Saturday Review* articles, preaching against constancy in nature.]

... we discover that ... apparent cycles seem cyclic only through the limitation of our observation. The tidal drag upon the planets slowly retards their rotation, so that every day is—though by an imperceptible amount—longer. "As certain as that the sun will rise" is a proverb for certainty, but one day the sun will rise for the last time, will become as motionless in the sky as the earth is now in the sky of the moon. According to Professor G. H. Darwin, the actual motion of a satellite is spiral; it recedes from its source and primary until a maximum distance is attained, and thence it draws nearer again, until it reunites at last with the central body. (506)

8. Camille Flammarion. From ***Omega: The Last Days of the World.*** **New York: Cosmopolitan Publishing Co., 1894. Trans.** ***La Fin du monde.*** **1893-94.**

[The distinguished French astronomer Flammarion (1842-1925) popularized his discipline through both non-fictional works and scientific romances. *Omega* is the most ambitious of his fictions, revealing that in the early 1890s Wells had good scientific company for his apocalyptic fantasy in "The Further Vision." It is not known if *Omega* directly influenced *The Time Machine* (which was published a year after the English translation of *Omega*), but the similarities are striking. The extract is from Chapter IV: an astronomer from Colombia offers his theory of how the world will end.]

"One thing is certain, that the sun will finally lose its heat; it is condensing and contracting, and its fluidity is decreasing. The time will come when the circulation, which now supplies the photosphere,[1] and makes the central mass a reservoir of radiant energy, will be obstructed and will slacken. The radiation of heat and light will then diminish, and vegetable and animal life will be more and more restricted to the earth's equatorial regions. When this circulation shall have ceased, the brilliant photosphere will be replaced by a dark opaque crust which will prevent all luminous radiation. The sun will become a dark red ball, then a black one, and night will be perpetual. The moon, which shines only by reflection, will no longer illumine the lonely nights. Our planet will receive no light but that of the stars. The solar heat having vanished, the atmosphere will remain undisturbed, and an absolute calm, unbroken by any breath of air, will reign.

"If the oceans still exist they will be frozen ones, no evaporation will form clouds, no rain will fall, no stream will flow. Perhaps, as has been observed in the case of stars on the eve of extinction, some last flare of the expiring torch, some accidental development of heat, due to the falling in of the sun's crust,

1 The luminous and heat-radiating envelope of the sun.

will give us back for a while the old-time sun, but this will only be the precursor of the end; and the earth, a dark ball, a frozen tomb, will continue to revolve about the black sun, travelling through an endless night and hurrying away with all the solar system into the abyss of space. *It is to the extinction of the sun that the earth will owe its death, twenty, perhaps forty million years hence."* (109–10)

Appendix F: Extracts from Wells's Correspondence

[The following extracts offer insight into the composition, reception, and interpretation of *The Time Machine*. All are taken from *The Correspondence of H. G. Wells*. Ed. David C. Smith. 4 vols. London: Pickering & Chatto, 1998. The punctuation, dating (conjectural or otherwise), and numbering of letters are Smith's. Parenthetical volume and page references follow each extract.]

1. From Letter 90 to Elizabeth Healey, 19 June [1888].

[This postscript to a letter from Wells in Staffordshire to Elizabeth Healey, one of the few female students at the Normal School and a lifelong friend, implies that the just-completed serialization of "The Chronic Argonauts" in *Science Schools Journal* was not the end of the matter—its prophetic voice had not yet finished what it had to say.]

The Chronic Argonauts is no joke. There is a sequel—It is the latest Delphic voice but the Tripod[1] is not yet broken. (1:108)

2. From Letter 155 to the Editor, *Fortnightly Review*, 5 September 1891.

[This passage from a letter to Frank Harris indicates that even though Harris had just rejected "The Universe Rigid," Wells thought highly enough of "The Chronic Argonauts" to send him a copy. It is not known what Harris's response was.]

Dear Sir,

Some days ago I left a copy of "The Chronic Argonauts", a story you had very kindly promised to read, at Henrietta Street. I need scarcely say that whatever advice you can give me, for its disposal, will confer a great favour upon me. (1:174)

1 The allusion is to the oracle of Apollo at Delphi, near where a golden tripod stood.