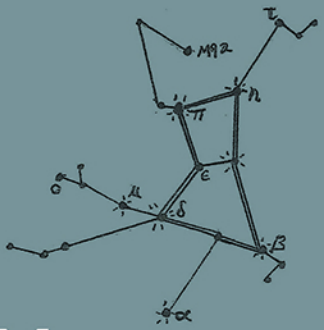

The Biology of Human Behavior

A Brief Inquiry

Thomas Rowland

The Biology of Human Behavior

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A Brief Inquiry

By

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Cambridge
Scholars
Publishing

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This book first published 2020

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

Cover: *Hercules, revealed* by Thomas Rowland

ISBN (10): 1-5275-4476-1
ISBN (13): 978-1-5275-4476-5

We are so small in every way compared with what there is,
and so ignorant.
Mystery surrounds us on every side.
—Bryan Magee

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PREFACE

Biological science. And human behavior. Hardly expected to be close travelling companions, these two. The first describes the quest for understanding the objective reality in the living world around us (including *Homo sapiens)*, while the second involves a confusion of emotions and experiences shared by the human psyche as we act out our lives, uncertain and subjective to say the least. The series of chapters that follow, however, will examine how evidence is gradually emerging that the two might surprisingly interface, and that much of what we experience and drives our behavior in our daily lives is controlled—at least to some extent—by objective biological processes. That's what this book is all about—what science can tell us about the ways we behave and relate to our fellow humans. A spoiler alert: on reaching the final chapter, the reader should not expect to have discovered any facile solutions or definitive insights to such "inquiries," but, rather, the author hopes, an awakening to lines of thinking that may ultimately provide us with such understandings.

Of course, it would demand an inappropriate expenditure of ink and paper to consider all the means that science and its applications through technology have impacted our modern lives. Science has brought us the ability to communicate instantaneously with all our friends, back up our car in a tight parking lot without risk of collision, permit a denizen of Miami to demand a restaurant reservation for tomorrow night in Vancouver just by making an oral command. We no longer worry about contracting poliomyelitis, going blind from cataracts, or suffering gnawing heartburn from over-indulgences. One can be transported from Boston to any of the major capitals of Europe in not much more time than it takes to cook a 25-pound Thanksgiving turkey. The list could go on and on.

Without doubt, science and technology have served us well in making our lives easier, safer, and more efficient. At the same time, one hesitates to be convinced that such advances have provided any advances in the more meaningful—and often challenging—aspects of the human experience. Here we can make a different list: establishing satisfying relationships with other persons, forming a loving, supportive family, working at a fulfilling occupation, behaving in an ethical manner, providing for the common good, finding a true meaning for one's life. Again, the list could go on. But here, on these more substantial aspects of human existence, little appreciation

exists for the input of science.[1] And that's it, the point of this book: in this more elevated and meaningful atmosphere of scholarly inquiry, evidence grows that biological science is beginning to shed light on the complexity of human behavior.

Before embarking on this "brief inquiry," let's be certain we know what we're talking about. *Science* is essentially a method, a means by which the reality of the natural world can be logically and accurately examined. The *scientific method* is a step-wise approach which assesses a *hypothesis (*a conjecture based on previous experience, observation, or studies) by a careful structured and controlled experiment. This method, then, is based on inductive empiricism rather than assuming that truths of the natural world can be revealed by reason alone. The assumption here is that there exists in any field of inquiry an objective truth, and that the scientific method is the means for discovering it.

Despite its time-tested validity, a number of issues swirl about this conclusion. To start with, does an ultimate truth actually exist? Is the human brain—or even, by extension, a computer—capable of understanding this truth? Does use of the scientific method to examine a hypothesis imply that truth can be assumed only when there exists a test to determine if it is "falsifiable"? Is there a "real" objective universe that surrounds us? Or, does reality only exist in light of how we human beings observe it?[2]

The link of science and what constitutes the "real world" has undergone a series of serious upheavals, beginning with the teachings of Euclid, which held that the universe conformed to rules set forth by geometrical principles, then Newton, who described a deterministic, mechanistic universe based on physical laws of motion, which was superseded by Einstein's theories of relativity, by which reality depends on the condition and motion of the observer, to, most recently the bizarre subatomic world of quantum mechanics, where uncertainty rules, and chance replaces cause and effect.[3] Even within the realm of deterministic behavior, chaos theory indicates that minor differences in initial conditions can be manifest as random and unpredictable outcomes (such as weather forecasting).

Each of these approaches truly describes an aspect of the "real world." But they reflect a reality only in a certain perspective, and these domains are often mutually exclusive. The conclusion therefore is that the goal of *science* as an endeavor to describe the natural world must be appreciated only within certain restrictions of the form of "reality" being addressed.

Living beings share functions that obey the laws of physics and chemistry, yet there exists the obvious observation that "something" sets apart living systems, or biological truths, from those of other scientific disciplines. Whether such biological "laws" exist (most would think so),

and of what these consist (no one yet knows) remain issues that have drawn controversy for centuries. Particularly, for the discussion at hand, one can reasonably ask (without expecting an answer) whether such unique biological determinants are responsible for human behavior, or, on the other hand, how we act is simply an outcome of the cerebral interaction of molecular attractions, biochemical neurotransmitters, and ion-derived electrical charges—all conforming to traditional physical and chemical laws.

Defining *human behavior* proves to be even more problematic. Perhaps one could start by thinking how one would respond to an alien visitor from outer space who asks "What is it like to be a human being?" You might start by answering "Well, I am a biological machine, although it remains a mystery as to precisely how, as a living being, I differ from non-living matter. This machine that I am has evolved through many millions of years by a process of natural selection so that my working parts are in fine harmony with each other and resist perturbations of environmental disturbances. For the most part, this machine operates beyond my awareness, automatically responding to my physiological needs. I have a brain inside my head, though, that *thinks*, and since I can in this way "talk" within myself (gratefully in my native language) I feel like I am the captain of a ship, providing orders of where I should go and what I should or should not do. It seems, though, that I am often deceived by this sense of free will and self-determination by my thinking brain, because it is now understood that a large part of how I behave is dictated by subconscious actions deep within its gray matter that, in fact, often direct what I mistakenly feel are my own thinking decisions and behaviors."

You could continue: The relationship of my sense as an individual and that of a member of an organized group, or society, is a complex one. For example, although "civilized," I still possess the instincts and drives of my animal ancestors. So, I must channel my appetites, aggression, sexual desires, and so on into socially acceptable ways. I have certain desires, or goals, in my life, and I direct many actions towards satisfying these—finding a love partner, raising a family, finding a satisfying life's work, financial security, seeking pleasure and courage in facing the challenges in life's ups and downs, and so forth. To accomplish this my behaviors must satisfy the requirements of the culture in which I live. And this sometimes requires that I sacrifice my desires as an individual for the collective good of that society. At the same time, it is clear that I need a surrounding society to provide me with an infrastructure—food, clothing, shelter, protection, health care—that allows me to survive. So, the relationship between myself as an individual and that of a constraining but nourishing society is a highly

complex one which must be satisfactorily negotiated to reach one's goals in life. The drive for individualism must be balanced against the demands of society, and my will for personal freedom must also be tempered by my requirements to find security and personal identity as part of a human group.

In fact, this "escape from freedom" has been considered as an essential aspect of my psyche, paradoxically contradicting the will toward my nature to exist as an individual. That we should seek "freedom or death" is everywhere from historical accounts to New Hampshire license plates, but the meaning here (one supposes) is freedom against tyranny of society (or more precisely, society's government). Yet, in fact, freedom from acting as a member of a society would be intolerable. Edward Wilson wrote insightfully about this:

> "An hereditary peculiarity of human behavior is the overpowering instinctual urge to belong to groups in the first place. To be kept in solitude is to be kept in pain and put on the road to madness. A person's membership in his group—his tribe—is a large part of his identity. It also confers upon him to some degree or other a sense of superiority….All thing being equal (fortunately things are seldom equal, not exactly), people prefer to be with others who look like them, speak the same dialect and hold the same beliefs."[4]

All of these multi-directional arrows of that link me with my society influence the human experience. The ultimate human condition that looms over my daily existence, though, is that my time here on Earth is a limited one. We human beings are, in fact, the only living beings who are aware of their own mortality. How to face this inevitable reality is perhaps the most confounding of my difficulties in defining a meaning for my short stay. For many a certain fatalism can thus haunt their lives, the resigned acceptance that any of our actions and behaviors are of temporary consequence; others, particularly those with a belief in God and the reward of an after-life, find this faith to be a more accepting resolution.

"It probably strikes you," you say to your Martian visitor, "that each morning a human being awakes with a blank slate of behaviors, unlimited options, which can be freely adopted to satisfy one's need for pleasure and happiness in life." "Yes," he replies. "Then why don't you just do that?" "It just doesn't work like that," you say. "There is a line in popular song by the Eagles which says 'we are just prisoners here of our own device,' which says it all. We are obligated to elect certain behaviors (some would insist that these are pre-determined instead of subject to free will) for not only our benefit but also for the good of living in a nurturing society as well."

It has not been lost on dramatists (including the Bard himself) that in our daily lives we behave as if we are acting roles—father, boss, rock star, spouse, best friend, and so on—in a giant play, which we adopt to satisfy the complicated arrangements we have with personal goals and ego-supportive activities consistent with our part in organized society. Think about a list of what governs how we learn to behave, or act out our roles. You might include:

- Parents and family members
- Behavior of peers
- School teachers
- Religious leaders, athletic coaches as role models
- Imitation of behaviors in films, plays, literature, television shows
- Legal constraints

Looking at this compilation, one might easily conclude that the determinants of human behavior are all culturally-derived—that the script of our lives that we play out reflects the influence of family, community, and society in general. That is, we adopt behaviors according to what is expected of us by the culture in which we live. At least theoretically, one could cognitively decide to do or not to do this (or at least some of this). We have, it could be argued, a choice.

However, this perspective ignores the central role of emotions in triggering human behavior as well—sadness from personal loss, jealousy, euphoria, the pain of rejection, anger at being cut off in traffic, etc. A good many would argue that these reactions which guide behavior are biological, being evolutionary-derived (as witnessed even in animals). And, in accepting this concept, one is left with a more deterministic outlook on human behavior. Controlling emotions is difficult, although the behavioral reactions to such emotions may be managed.

Just *why* biological determinants should underlie human emotions is, of course, a fabulous mystery. What would be the evolutionary value of all the sentiments that flood our minds on a daily basis? How do they fit into a general picture of an advantageous reproductive capability? Now we're getting down to what this book is about. Again, no answers will be provided, but food for thought will be gratuitous.

Now that we have a general sense of the meanings of biological science and human behavior, we can proceed with a description of the focus of this book--an examination of how the former might impact the latter. What follows is a series of factual discussions of just how different aspect of

human behavior and experience—love, travel, aging, jealousy, and so on—can be placed in the context of the growing awareness of both philosophical and scientific inquiry. Thrown in, too, are a pair of fictional pieces, a short story and a play, as well as two brief discussions to fill up the intermissions (*Les Entr'actes*) provided for those readers wishing a break for refreshments or other human needs. As much of this material transgresses on rather combative grounds of opinion, each chapter is replete with quotations from those who have weighed in on these issues. The references provided will offer the reader whose imagination is stimulated by these discussions the availability of further resource material.

Hopefully not necessary to say, but still important to emphasize, the author asks that the reader approach each of the issues in this book with an open and receptive mind. Much of this subject material has previously been trivialized and strait-jacketed into opinions which should be popular or "correct." One of the purposes of writing this book is to offer the reader the opportunity to free oneself from the shackles of these conventions and strike out on unexplored intellectual and behavioral territory. In the course of this exploration one is presented with the possibility of gaining greater insights into the nature of this extraordinary complex creature we call *Homo sapiens.* Bonne route!

Notes

1. Rothman T, Sudarshan G. *Doubt and Certainty.* Reading MA: Perseus Books, 1998.
2. See Lewens T. *The Meaning of Science. An Introduction to the Philosophy of Science.* New York: Basic Books, 2016; Holt J. *When Einstein Walked with Gödel. Excursions to the Edge of Thought.* New York: Farrar, Straus and Giroux, 2018.
3. Davies P, Gribbin J. *The Matter Myth.* New York: Simon & Schuster, 1992.
4. Wilson EO. Evolution and our inner conflict. In: Catapano P, Critchley S. *The Stone Reader.* New York: Liveright Publishing, 2016, pp. 270-274.

1. LOVE

Love, unrequited love, robs me of my rest:
Love, hopeless love, my ardent soul encumbers:
Love, night-mare like, lies heavy on my chest,
And weaves itself into my midnight slumbers!
—*From* Iolanthe (Gilbert & Sullivan)

The French, as usual, have a better way of saying it: *un coup de foudre.* To English speakers it's "love at first sight;" for les Parisiens it's a "bolt of lightning." Which is just what it is. Flash! Boom! Crash! It doesn't much matter if it's "across a crowded room," or "strangers in the night, exchanging glances," or just that you "saw her standing there." It ranks among the most supreme feelings of emotional euphoria that a human being can experience.

Of course, romantic love often comes more gradually, too, in a sense "sneaking up" on one unexpectedly. (In the standard cinematic fare this is predictable by two oil-and-water protagonists at the beginning of the film, who initially detest each other but then…) Thus one, in this more restrained process, "falls in love," so that "on est tombé amoureux." It's interesting here that in both languages this process is considered in terms of "falling," perhaps a bit of insight that will be dealt with later in this chapter.

The reader will no doubt agree that the subject of romantic love has always taken on a rather frivolous flavor. Not serious, somewhat amusing, thanks to Cupid and shooting arrows, tunnels of love, puppy love, love boats, lyrics of popular music, and so on. Add to this the fact that falling in love is often first experienced in the pubertal throes of adolescence, with its naivety, immaturity, and social awkwardness. The past several decades, however, have brought a realization on the part of researchers, psychologists, psychiatrists, and the like, that romantic love is, to the contrary, a very serious business. Falling in love is attended by a suspension of normal social and moral judgements, while rejection and/or termination of a romantic relationship can be emotionally devastating and accompanied by very real risks of non-frivolous matters such as severe depression, stalking, suicide, and homicide. Indeed, in these features—ecstatic pleasure and insupportable nightmare of withdrawal—the entire process of falling in and out of love is not dissimilar to that of narcotic addiction, an affliction considered to be of

much greater import and significance than that of "simply" falling in love with the girl or guy next door.

This chapter will examine what this new research attention has revealed regarding the nature of romantic love. Much of this scientific information has served to simply confirm centuries-old ideas of what it means to fall in love. But some fascinating new concepts have arisen as well, such as the neurochemical basis of romantic love, its similarity to addictive behaviors, why breaking up with a love object is, indeed, "hard to do," and relationships that may exist between emotions of love and hate. All of this is witness, then, to the growing role of science in understanding human behavior. The reader is forewarned, however, that the essential question once posed by the young singer Frankie Lymon—"Why Do Fools Fall in Love?"—will not be likely resolved in any satisfying manner.[1]

(The psychological and philosophical implications of this question presumably were not appreciated by Mr. Lymon when he recorded this song with The Teenagers in 1956. What causes one person to fall in love with another? Does one, in fact, possess free will to *choose* or *not to choose* to fall in love? Based on much of the evidence outlined in the discussions that follow, perhaps the answer to the latter question is "probably not.")

Defining Romantic Love

So what exactly are we talking about here? One could probably devote a full chapter to the various interpretations of the meaning of the word "love." The discussion in this chapter is restricted to that *coup de foudre* kind of falling in love that we'll call *romantic love,* an intensely passionate yearning for another person. The exhilaration on seeing or thinking of the other person can be overwhelming. Sleep is troubled by a constant thinking of the beloved. "Besotted lovers may also compulsively call, write, or unexpectedly appear, all in an effort to be with their beloved day and night. Paramount to this experience is intense motivation to win him or her."[2] In contrast to other forms of love, romantic love is both irrational and unrealistic. The positive features of one's obsession becomes all-consuming, to the exclusion of all negative else. When this torrent of emotional focus is reciprocated, the ecstasy is further compounded.[3]

Two other forms of love have often been considered associated with this kind of romantic love—*sexual attraction* (lust), and the emotion that links married couples, which we'll label *spousal love.* The former is goal-directed with or without emotional attachment, while the latter is a rational bond based on trust and respect that grows from shared emotional, experiential, and physical intimacy. Throughout history many have felt that some

common ground, either simultaneously or, more likely, in temporal succession (i.e. one leading to the other), exists between these three, but, at the same time, it is not difficult to claim certain differences. It would not be expected, for instance, that falling in love at a tenth-grade sock hop would by necessity include a desire for sexual union;[4] certainly a sexually desirable person might be courted with the goal of physical intimacy in mind without the emotional accoutrements of romantic love. Too, these same volcanic emotional features of falling in love, one might confidently suggest, don't exist in the majority of long-term marital love relationships. (To draw parallels to other used terms, spousal love (or its companions, *filial and maternal love*) here is considered as *mature love,* while romantic love—the topic at hand—is *immature love.)* As will be addressed below, recent neuro-imaging studies have substantiated such proposed relationships between the three—overlapping but with distinct anatomic functions.

A number of other features characterize romantic love:

- Experiencing the emotional trauma of a romantic breakup or an unrequited love is common, particularly among teenagers. In a study of 910 Canadian adolescents, Connolly and McIsaac found that 23% had experienced a breakup in the past six months.[5] In somewhat older young adults the number is higher. Baumeister reported that 93% described having been rejected by a passionately-loved other. (Of interest to those who would insist that turn-around is fair play, 95% reported they had served as the rejecting person of someone who was in love with them.)[5]
- While euphoria and happiness are considered the "reward" that transports one into a state of romantic love, such experiences are often marked by periods of emotional distress as well.[6] Similar to manic-depressive (bipolar) behavior, the love-stricken person not infrequently experiences swings in emotional state, with anxiety, depression, and insecurity balancing times of overwhelming ecstasy.
- The emotional forces that put a person "in love" have a limited lifespan. Ultimately, the neurochemical reactions outlined below which drive romantic love run down. For most, relationships built only on romantic love in the end, quite literally, run out of gas. Some have suggested 12 to 16 months as an average.
- Romantic love is a universal phenomenon, recognized in all societies when appropriate investigational methods have been utilized, and is independent of sex. These observations support the conclusion that

falling in love represents a biological rather than a culturally-derived phenomenon.

The Science of Love

An understanding of the nature of love, once confined to the realm of folklore, has been provided a scientific foundation by advances in neuroimaging techniques and insights into cerebral neurochemical pathways. These have revealed that 1) the centers in the brain responsible for the euphoria and other exhilarating features of romantic love are discrete and distinct, but still some cross-over and overlapping functions are observed with centers responsible for sexual attraction and spousal love, 2) when falling in love, separate neurologic pathways act to inhibit rational decision-making and even challenge moral limits, confirming that, in fact, "love is blind," and 3) the neurochemical functions underling the emotional experiences of falling in and out of love mimic directly those of other established addictions (such as narcotics, sex, gambling, etc.).

Neurophysiological Localization

The advent of neuroimaging techniques such as functional magnetic resonance imaging (fMRI) and positron emission tomography (PET scan) has for the first time permitted key insights into brain function. Particularly, these methodologies have identified links between subjective mental processes (i.e., emotions) and anatomic localization. Both of these diagnostic methods work by identifying areas of the brain demonstrating increased metabolic rate, which is associated with neuronal activity. In a typical investigation, then, the act of an individual falling in love is reflected in a "lighting up" on a scan of a responsible brain regions by these techniques.

A number of such imaging studies have been performed in an attempt to link the activity of specific brain regions to the act of falling or being in love. These have quite consistently revealed that one particular area—the ventral tegmental area (VTA)—is activated in individuals involved in a passionate love affair, with close connections to the nucleus accumbens and regions of the cerebral cortex that include the medial insula, anterior cingulate, and hippocampus.[7] The study of Aron et al. is typical.[8] These authors reported fMRI findings in 10 women and 7 men who reportedly had recently fallen intensely (and happily) in love. (As proof of the appropriateness of this cohort, all the subjects reported that they spent at least 85% of their waking hours thinking of the object of their affection.) When viewing a photo of their loved one, augmented activity was observed

in the VTA and caudal nucleus, "regions associated with pleasure, general arousal, focused attention and motivation to pursue and acquire rewards."

Importantly, such scanning studies indicate that areas associated with other forms of love (including sexual arousal and maternal love) may overlap regions associated with romantic love but remain distinct from them. In 2010, Ortigue et al. reviewed the published literature which has described fMRI studies indicating brain regions that are linked to different forms of love (J Sex Med. 2010;7:3541-52). Although all types of love were associated with activity of brain reward systems, this review "demonstrated that different types of love involve distinct cerebral networks, including those for higher cognitive functions such as social cognition and bodily self-representation."

The finding of similar but distinct areas of brain function for different forms of love coincides with observations from common experience. That is, one would not confuse the behaviors surrounding a mother's love or that of a couple on their 50th wedding anniversary with that of a college sophomore experiencing a c*oup de foudre* with his chemistry lab partner. This does raise some interesting thoughts, though, regarding the possible connection of romantic love, spousal love, and arousal of sexual drive, which, again, are emotions which demonstrate distinctly separate, though overlapping, areas of cerebral activity. Specifically, does the former lead to the latter? And, by extension, if so, can we then ascribe an evolutionary basis for romantic love as a kind of "jump start" to more mature, sustained love, sexual activity, and reproductive preservation of the species? Here is what S. Zeki had to say on the matter (FEBS Letters 2007;581:2575-2579):

> "It is noteworthy that sexual arousal activates regions adjacent to—and in the case of the hypothalamus overlapping with—the areas activated by romantic love……This intimacy in terms of geographical location between brain areas engaged during romantic love on one hand and sexual arousal on the other is of more than passing interest. Judged by the world literature of love, romantic love has at its basis a concept—that of unity, a state in which, at the height of passion, the desire of lovers is to be united with one another and to dissolve all distance between them. Sexual union is as close as humans can get to achieving that unity. It is perhaps not surprising to find, therefore, that the areas engaged during these two separate but highly linked states are juxtaposed."

Besides activation of brain areas associated with pleasure-seeking reward systems (see below), falling in love has been observed to trigger a *decrease* in activity in areas of the cerebral cortex which are normally responsible for controlling judgements one uses to assess other persons. This effect accounts for what is typically observed in persons who are head-

over-heels in love—a failure to objectively consider the qualities of the object of their passion. "Here, then, is a neural basis for saying that love is blind. It is not surprising that we are often surprised by the choice of partner that someone makes, asking futilely whether they have taken leave of their senses. In fact, they have. Love is often irrational because rational judgments are suspended or no longer applied with the same rigour." Falling in love, then, is a two-pronged neurological process—"euphoria and suspension of judgement [which] can lead to states others might interpret as madness" (Zeki S. 2007;581:2575-2579).[9]

A Biochemical Basis

Readers owning a pet hamster will be quick to confirm the compulsive wheel-running that these small animals exhibit in their cages, often for hours at a time throughout the night. Why do they do that? The answer is that they are motivated by a "reward" system within certain specific areas of the brain, fueled by the neurotransmitter dopamine and other biochemical agents, which provides a strong sense of "pleasure" (assumed but not reported by the animal).[10] (A similar explanation has been suggested for humans who engage in obsessive distance running.)

Dopamine, an agent chemically related to adrenaline, has received a good deal of popular attention for its reputation as a conveyor of sensory pleasure—the "rush" from your morning coffee, the joy of sexual union, the euphoria of falling in love. This chemical does, in fact, participate in a wide variety of disparate physiological functions, including lactation, vasoactivity of arteriolar walls, cellular immune responses, gastrointestinal motility, and the salt content and volume of urine output (Figure 1.1).

In the central nervous system, dopamine serves to connects signals from one nerve cell (neuron) to the next across a synaptic space. Dopamine-secreting neurons are grouped within the brain in specific areas related to a particular function, although a wide network of connections to other portions of the central nervous system is typically evident. In the ventral tegmental area (VTA), the nucleus accumbens, and other areas of the brain dopamine participates in a "reward system" whereby certain behaviors are reinforced and thereby motivated by providing positive feelings of pleasure.

Some researchers have contended, however, that dopamine does not actually serve as a "pleasure chemical" in this regard but instead is "necessary for 'wanting' incentives".[11] That this differentiation between "wanting" a romantic partner and "liking" an attractive face (or sunset, or Monet canvas) may have a neurophysiological basis was indicated in the fMRI study of Aron et al. noted above. These investigators found that when

viewing an attractive face, study participants activated the left VTA, while when looking at a photo of a love partner, the right VTA became activated.

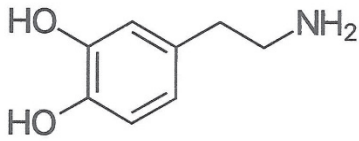

Figure 1.1. So this is love? (Or rather cupid disguised in the molecular structure of the neurotransmitter dopamine?)

This action of dopamine-based reward circuits in the central nervous system has been well-documented as the driving factor in compulsive wheel-running in rodents. Evidence indicates that the same reward system is in play during courting and coupling of animals as well. One faces a difficulty, of course, in interpreting such behaviors in animals as parallels to the different forms of love defined in human beings. Do animals experience the same kind of reward-system euphoria as do humans in the throes of passionate romantic love? One witnesses certain characteristics of courtship in animals, but do these reflect the same behaviors of humans afflicted with a *coup de foudre* (as opposed to sexual or spousal love)? Some authors have thought so. As Fisher et al. have contended:

> "Like humans, all birds and mammals exhibit mate preferences; they focus their courtship energy on favored potential mates and disregard or avoid others. Moreover, most of the basic traits associated with human romantic love are also characteristic of mammalian courtship attraction, including increased energy, focused attention, obsessive following, affiliative gestures, possessive mate guarding, goal-oriented behaviors and motivation to win and keep a preferred mating partner for the duration of one's species-specific reproductive and parenting needs."[12]

A number of studies have examined neurochemical correlates to mating and coupling behavior in animals. The role of dopamine systems has been particularly substantiated. For example, in one study a 50% increase in dopamine content of the nucleus accumbens was observed during expression of mating preference of prairie voles. Subsequent injection of a dopamine antagonist resulted in dissolution of the attraction. Increased dopamine activity in the central nervous system in association with courtship attraction has also been observed in sheep and rats.[13]

In addition, other neurochemical agents appear to be involved in aspects of animal courtship. Mating behavior has been closely linked to oxytocin,

produced by the hypothalamus, and vasopressin. Yong and Wan have suggested that these two agents "facilitate the process of social cues necessary for partner recognition while dopamine plays a reinforcing role by signaling reward."[14]

That the same anatomical areas of the brains of human beings falling in love are activated on fMRI as those associated with the dopamine reward system in animals is strong evidence that these same neurochemical processes account for romantic love in humans. This conclusion is supported by some experimental evidence. Particularly convincing is the study of Takahashi et al. who demonstrated increase in dopamine release within human brains by administration of a dopamine receptor antagonist with PET scanning when subjects were viewing pictures of romantic partners.[15]

Other neurochemicals are involved in inter-personal attraction and coupling in humans that mimic those observed in animals. Falling in love has been associated with depressed brain levels of *serotonin.* Limited research information suggests that oxytocin and vasopressin play important roles in long-term love relationships in the same manner that they trigger animal coupling behavior.[16] It appears likely, then, that the actions of these agents effect coupling and connectiveness, and in humans are probably related more to long-term commitments which reflect mature spousal love with a secure, reality-based emotional union than romantic love. Sexual drive, on the other hand, is linked to a different chemical basis—the actions of the sex hormones, testosterone and estrogen. The combination of neuroimaging and neurochemical findings suggest, then, that the three types of human love—romantic, sexual, and spousal—are distinct in terms of functional brain structures and biochemical pathways responsible for each. How each evolves over time in a relationship, and the extent that these individual forms of love interact and might follow each other "in tandem" remains to be clarified.

All of this discussion of brain chemistry, then, leads to the somewhat discomforting conclusion that falling in love is perhaps nothing more than straightforward chemical reactions within the brain.[17] When you exchanged glances with that stranger in the night standing there across a crowded room your brain became inundated with a tsunamic wave of dopamine and its chemical traveling companions, and—voila!—an extraordinary rush of ecstasy (akin to what has been described in response to, for instance, cocaine). The great mystery—not yet revealed by scientific inquiry—then, is why that particular stranger, in that particular room, on that particularly enchanted evening?

Biological Meaning

The neurochemical mechanisms that likely underlie the process of falling in love have been identified, but many questions remain to be answered: can we confidently transpose animal experimental results to human beings? Which way does the arrow of causation go? Do emotional responses to visual stimuli trigger release of dopamine-based reward systems? Or, conversely, are dopamine and its related chemical agents *responsible* for the emotional reaction? In essence, then, what is responsible for launching one into the throes of falling in love? Studies show that, not surprisingly, visual triggers set it off. But how many strangers have you exchanged glances with across a crowded room without inaugurating this cascade of neurochemical events that would put you in the remarkable mental condition of "being in love"?

If we accept that a *coup de foudre* is basically just a chemical event, we are still left with the mystery of why does one fall in love in the first place? It's a very singular, irrational emotional state that defies common sense, one that will typically self-destruct in a matter of months. And, in more cases than not, that rupture fill one or both parties with pain and depression or even worse. We again have to stop and wonder: why *do* fools fall in love? The siren call of the *coup de foudre* appears to be irresistible, indicating that some particular biological "meaning" is at play.

The traditional, seemingly-obvious Darwinian biological explanation for the experience of falling in love (as defined in this chapter) lies in its support of evolutionary natural selection of reproductive fitness. As Fisher et al. proposed, "romantic love is a …survival mechanism to encourage human pair-bonding and reproduction, seen cross-culturally today in Homo sapiens….Its [evolutionary] purpose may have been to motivate our forebears to focus their mating time and energy on a single partner at a time, thus initiating the formation of a pair-bond to rear their young together as a team. Thus, as products of human evolution, the neural systems for romantic love and mate attachment could be considered as survival systems among humans."[12]

Reproduction and successful child-rearing—the obligate markers of human evolution—require a coupling of humans with subsequent sexual congress and long-term attachment. So, would go the proposal, the magnetic attraction of one person to another via romantic love serves as the initial catalyst which eventuates in these other critical forms of love necessary for propagation of the species. It is difficult to argue persuasively against this idea. Still, a number of thoughts provide some hesitancy—or even a soupcon of skepticism. That euphoric high experienced in the sudden rush

of romantic love has not, by itself, been considered to driven by a desire for sexual relations. Typically, such romantic love is short-lived, and it would be expected that the frequency of a transition to a more mature, committed spousal form of love is not high. That is, romantic break-ups must well outnumber—by multi-fold—those that proceed to marriage. Consider: an experience of romantic love is characterized by emotional instability, irrational obsessions, anxiety, towering feelings, anorexia with weight loss, and insecurity, as well as a suspension of a rational awareness of the qualities of the love object. Hardly, it could be argued, does this sound like a mental state that should serve as a valid basis for coupling in order to maintain the species.

Are there other possible means of providing a biological "meaning" to falling in love? Here's one idea: in the end, despite obsession with another person, falling in love could be considered as a egocentric, self-centered act. That is, the ultimate desire is that this magnetic attraction be reciprocated, that the loved object will respond with love and undying affection as well. In this way, falling in love might be considered as an ego-supportive, self-affirming search to bolster a sense of self-worth. In this sense, the insecure individual with a poor self-image, full of self-doubts, might be particularly vulnerable to falling in love, as displayed by a pattern of repeated attempts at romantic liaisons.

Perhaps a more central question would seek the biological meaning of the dopamine-based pleasure-reward system in the brain itself. In animals, to secure pairing and reproductive success for propagation of the species, yes. But why should the same system trigger obsessive wheel-running by caged rodents for hours at end? The concept that similar reproductive outcomes in human beings via marriage are proffered by this system seems logical. But one immediately runs head on into the fact that the same reward system is responsible for the life-destructive, tragic scenario of drug addiction. Within this spectrum of effects, one's morning coffee habit, not usually fatal, is driven by the brain's pleasure-reward system as a mildly-addictive, pleasurable, but not a convincing Darwinian exercise. The same could be said for other "obsessive habits" driven by dopamine—gambling, eating, shopping, promiscuous sex, and the like. Where would these fit into a drive for reproductive survival of the fittest? It is evident that the dopamine reward system plays out in both positive adaptive and negative outcomes.

In essence, then, the biological meaning behind a *coup de foudre* may not be as straightforward as it would seem. Certainly, there is much to be learned.

Breaking Up *is* Hard to Do

The euphoria and "soaring feelings" of falling in love come with a price. No one who has experienced the spirit-crushing anguish of rejection of unrequited love or break up of a love relationship needs (nor desires) to be reminded. What goes up must come down. Breaking up with a love partner is not only simply hard to do; it is, for all, at least painful and for some, emotionally destructive and even dangerous. Of course, most romantic breakups are survived with eventual resolution over time of the incurred emotional wounds. For some, however, the insult to self-esteem leaves chronic scars of depression and other mental disorders. The frequency of incapacitating, extended emotional distress following a romantic breakup is not known. Anecdotal reports would suggest, however, that the magnitude of such outcomes is grossly underestimated and has been overlooked as a significant mental health issue.

Unfortunately, in some cases the mental disturbance accompanying unrequited love or break down of a romantic relationship can eventuate in homicide, stalking, or suicide. Such tragic outcomes are the stuff of legend, but also, sadly, of the everyday.[18] Romantic breakup is commonly assumed to be responsible for suicidal behaviors, but statistical confirmation of this relationship is hard to come by. In one study of 142 successful suicides among youth 10-17 years in the state of Utah between the years of 2011 and 2015, 37 (26%) were said to be related to "intimate partner problems" or "dating partner problems."[19]

According to the Federal Bureau of Investigation, in a given year around 10% of murders in the United States are committed by the lover of the victim.[20] Excessive jealousy in a romantic relationship may serve as a source of such tragedies, even before a romantic relationship is severed.[21] Many of these, too, are sad outcomes of *stalking,* in which a jilted lover obsessively haunts a former romantic partner. Such situations are not rare, estimated to have affected 8-15% of women and 2-14% of men. As Marazitti et al. have remarked, "the deactivation of cognitive processes that take place when we fall in love (even though this is a short lived process!), may imply a sort of stalker blindness to understand the risks involved and the consequences of his/her behavior, and the misconception that he/she might be able to change the victim's feeling via the persistence, harassment, and constraints."[22]

Is Romantic Love an Addiction?

The similarities between falling in love and substance addiction have not been lost on neuroscientists, psychologists, and composers of popular songs alike.[23] Helen Fisher and her co-authors have nicely described these parallel behaviors (Front Psychol. 2016;7:687):

> "Mean and women in the early stage of intense passionate romantic love express many of the basic traits associated with all addiction. Like all addicts, they focus on their beloved (salience); and they yearn for the beloved (craving). They feel a 'rush' of exhilaration when seeing or thinking about him or her (euphoria/intoxication). As their relationship builds, the lover seeks to interact with the beloved more and more frequently (tolerance). If the beloved breaks off the relationship, the lover experiences the common signs of drug withdrawal, too, including protest, crying spells, lethargy, anxiety, insomnia, or hypersomnia, loss of appetite or binge eating, irritability and chronic loneliness. Like most addicts, rejected lovers also often go to extremes, even sometimes doing degrading or physically dangerous things to win back the beloved."

This parallel between romantic love and drug addiction is supported, too, by the finding that the dopamine-based reward system acting in the brain which underlies these behaviors is similar in the two. At the same time, there exist, it can be readily pointed out, certain differences that distinguish falling in love from opiate addiction. The proposed evolutionary "purpose" of romantic love, a universal phenomenon, as a Darwinian survival mechanism is hardly consistent with the destructive force of narcotic addiction. Unlike the sad outcome of drug addiction, unrequited love, by itself, is presumably not fatal. And people, perhaps abetted by popular culture, seek to fall in love, which is certainly not an antecedent to drug addiction.

Such considerations of the addictive nature of love may bear more than just academic interest. Some authors have suggested, in fact, that given the potential for romantic love to induce serious and destructive emotional disease, treatment is a viable option. "Although one would not normally think of offering 'treatment' to individuals who are in love, once we begin to realize that at least some cases of love and love-related phenomena are similar to behavioral or substance addictions—in form, function, as well as effect—then the possibility becomes worth taking seriously."[24] This might include traditional psychiatric strategies such as cognitive-behavior approaches as well as psychoanalysis, and drug-based therapies could be ethically-appropriate in some situations.

To Be "In Love" Just to be "In Love"?

One cannot leave the topic of romantic love—the "rush" of a *coup de foudre*—without raising the possibility that it's just "being in love" that provides the euphoria, not "being in love with somebody." That is, perhaps romantic love is in reality selfish and intrinsic, sought after for its "kick," rather than being directed at some person (albeit with mythical qualities). We're talking here about "being in love with being in love." Certainly, this idea is portrayed in a raft of popular songs, all on the theme that one is "looking for someone (anyone?) to love." (For definitive evidence of this concept, one need look no further than the movie *When Harry Met Sally,* in which Sally Albright (played by Meg Ryan) confesses to Harry Burns (portrayed by Billy Crystal) that she does not yearn for her recent boyfriend after a break-up, but she does miss the "idea of him.")

Conclusion: Love *is* Strange

In the spectrum of human emotional experience, romantic love is truly unique. Consider: the deal is almost truly Faustian—an exquisite, euphoric, mind-blowing "high" gained in accepting the high risk of an eventual hellish withdrawal payback—except that in this case one doesn't have a choice in the matter. Instead, in falling in love one is at the mercy of yet-unknown, powerful subconscious biological and psychological factors, outside of one's control. Here is a clear violation of any contention of the strength of free will in human beings. "We do not ordinarily *choose* to love someone (at least not consciously) and it would be a hard thesis to defend that we should be held *responsible* for falling in love—even though such an occurrence can have very far-reaching and sometimes destructive consequences for those involved."[25] Falling in love, then, is something that happens to you, for the better or worse.[26] The seriousness of the "worse", it has been contended, has not been adequately appreciated by mental health professionals.

Notes

1. Frank Zappa would not be pleased with this author's employment of lyrics of popular music in discussing romantic love. Zappa felt that such songs of love's joy and lament to vulnerable youth were sadly disillusionary. As the iconoclastic musician expressed in *The Real Frank Zappa Book* (Poseidon Press, 1989), "I detest love lyrics. I think one of the causes of bad mental health in the United States is that people have been raised on 'love lyrics'…It's a subconscious training that creates a desire for an imaginary

situation which will never exist for you. People who buy into that mythology go through life feeling that they got cheated out of something."

That said, it must be admitted that popular music has remarkably-well documented the highs and lows, the ecstasy and the anguish, the futility and inescapability of romantic love. Indeed, a connoisseur of popular music lyrics—particularly of songs written during the early rock 'n roll era—would be well-acquainted with the majority of concepts presented in this chapter. (It would seem that more recently popular music has largely moved on to more mundane themes—learning to fly, consuming margaritas, shooting sheriffs, and the like.)

2. This quote is from Fisher HE, Xu X, Aron A, Brown LL. Intense, passionate, romantic love: a natural addiction? How the fields that investigate romance and substance abuse can inform each other. Front Psychol. 2016;7:687. Helen Fisher, from the Kinsey Institute at Indiana University, is also author of a comprehensive book entitled *Why We Love* (New York: Owl Books, 2004) which provides an excellent overview of this field.

3. Many colorful expressions have described the exhilarating experience of falling in love. Andrew Christy and his colleagues at Texas A&M University noted that many of these involved the idea of physical force—such as love "sweeps us off our feet, causes sparks to fly, and ignites flames of passion." Of course, too, the entire *coup de foudre* is based on attraction of one body to another. According to what is known as *conceptual metaphor theory,* "activating the concrete concept in a metaphor should alter perceptions and judgements related to the linked abstract concept." (Translation:) These researchers performed a study (PLoS ONE 2016; 11:e0155943) in which 80 female college students (78% who were currently in a romantic relationship) held blocks together for one minute which were either magnetized to attract or not-attract each other, followed by a questionnaire seeking subjects' interpretation of their romantic relationship (past or present). They found that, overall, subjects who held the attracted magnetic blocks reported higher levels of satisfaction, attraction, intimacy, and commitment with their romantic partner. One possible explanation for this result, suggested Christy et al., was that "exposure to magnetism may actually have changed participants' experience of romantic attraction in certain ways that led them to report greater satisfaction" in their love relationships.

4. Choukas-Bradley et al. (J Adolesc. 2015;45:112-26) compiled questionnaire data from 18,392 American adolescents ages 12-19 years which asked for their expected desires in a hypothetical romantic relationship. The most common behavioral temporal sequence was "holding hands, going out alone, telling others they were a couple, kissing, saying 'I love you,' sexual touching, and finally having sex." Several other authors have emphasized that individuals having fallen in passionate love are, at least initially, obsessed with an emotional union rather than sexual intercourse. That is, the romantic love being detailed in this chapter would—at least initially—appear to not overtly driven by concupiscent goals.

5. See Connolly J, McIsaac C. Adolescents' explanations for romantic dissolutions: A developmental perspective. J Adol. 2009;32:1209-1223. The study by Baumeister et al. is cited by Fisher et al. (see Note 2).
6. That falling in love is not always simply a happy event has been witnessed in studies of adults (Bajoghli H et al. "I love you more than I can stand!" – Romantic love, symptoms of depression and anxiety, and sleep complaints are related among young adults. Int J Psychiatry Clin Pract. 2014;18:169-74) and adolescents (Soller B. Caught in a bad romance: adolescent romantic relationships and mental health. J Health Soc Behav. 2014;55:56-72; Ha T, et al. The blues of adolescent romance: observed affective interactions in adolescent romantic relationships associated with depressive symptoms. J Abnorm Child Psychol. 2014;42:551-562).
7. For details of this study, as well as list of citations which offer a review of fMRI findings in the midst of falling in love, see Fisher et al. Front Psychol. 2016;7:e687.
8. Aron A et al. Reward, motivation, and emotion systems associated with early stage intense romantic love: an fMRI study. J Neurophysiol. 2005;94:327-337.
9. Brain imaging studies have also been utilized to study other forms of "love." Duarte IC et al. investigated the neural basis of the passion exhibited by fanatic supporters of a particular football team by fMRI (Tribal love: the neural correlates of passionate engagement in football fans. Soc Cogn Affect Neurosci. 2017;12:718-728). They showed 56 participants video clips of winning and losing moments of their loved, rival, or neutral team. The fanaticism of the subject was linked to activity of the amygdala, ventral tegmental area, and substantia nigra, areas recognized for their emotional "rewards" not dissimilar to those engaged in romantic love.
10. See review of experimental studies documenting the function and localization of dopamine-based reward systems in animals in Rowland T. *Biologic Regulation of Physical Activity.* Champaign IL: Human Kinetics, 2017, pp. 45-46. This role of dopamine in reward-seeking behavior and modifying locomotor activity has been observed throughout the animal kingdom, indicating a long evolutionary history for this mechanism (see Barron AB et al. The roles of dopamine and related compounds in reward-seeking behavior across animal phyla. Front Behav. Science 2010;4:e163). That the dopamine-reward system is not confined to hamsters and mice in cages was indicated by a fascinating study performed by Meijer and Robbers, who wanted to determine if rodents would engage themselves in obsessive wheel-running in their natural environment instead (Proc R Soc Brit. 2014;281:1-5). They placed a 24-cm diameter running wheel in an outdoor environment, monitored by camera and motion sensor. To their surprise, "wheel movement was not caused by mice but was caused by shrews, rats, snails, slugs, or frogs," that visited the testing site.
11. See Berridge KC, Robinson TE. What is the role of dopamine in reward: hedonic impact, reward learning, or incentive salience? Brain Res Bran Res Rev. 1998;28:309-69.

12. Fisher HE, et al. Intense, passionate, romantic love: a natural addiction? How the fields that investigate romance and substance abuse can inform each other. Front Psychol. 2016;7:687.
13. References examining central nervous system neurochemical correlates with animal courtship behavior: Gingrich et al. Behav Neurosci. 2000;114:173-183; Fabre-Nys et al. Eur J Neurosci. 1997;9:1666-1677; Wang et al. Behav Neurosci. 1999;113:602-611; Robinson et al. J Neurosci. 2002;10477-10486.
14. Young IJ, Wang Z. The neurobiology of pair bonding. Nat Neurosci. 2004;7:1048-1054.
15. See Takahashi K et al. Imaging the passionate stage of romantic love by dopamine dynamics. Front Neurosci. 201;9:191.
16. Regarding the role oxytocin in the chemical basis of human love, see Wudarczyk OA, et al. Curr Opin Psychiatry 2013;26:474-484.; Algoe SB et al. Psychol Sci. 2017;28:1763-1772.
17. Any enthusiasm here for the use of dopamine as the ultimate aphrodisiac must be tempered by the fact that this agent does not cross the blood-brain barrier. This means, unfortunately, there is no means of introducing dopamine into one's brain either by its ingestion or intravenous administration. So this agent will not make it as a love potion #9 or any others.
18. This discussion deserves at least one tragic example. Carlos Casagemas was a Spanish art student and poet who became close friends with Pablo Picasso, moving with him from Barcelona to Paris in 1901. Casamegas fell madly in love with a model, Germaine Pichet, who, being already married, refused his desperate advances. It was just too much for the love-sick young Spaniard, and in February of 1901, while at a dinner party with friends, he stood up and shot himself fatally through head. (He also fired at Germaine, who suffered only superficial wounds.) The grief of Picasso over the suicide of his close friend was reflected in the somber paintings of his so-called Blue Period from 1901-1904.
19. See Annor FB, et al. Characteristics of and precipitating circumstances surrounding suicide among persons aged 10-17 years—Utah, 2011-2015. MMWR. 2018;67:329-332.
20. Access this information at http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s.-2011/tables/expanded-homicide-data-table-10
21. See Sun Y., et al. Neural substrates and behavioral profiles of romantic jealousy and its temporal dynamics. Sci Rep. 201`6;6:27469.
22. See Marazziti D, et al. Stalking: a neurobiological perspective. Riv Psichiar. 2015;50:12-18.
23. A number of authors have examined the parallels between romantic love and chemical addictions (narcotics, alcohol). Most colorful, however, are the lyrics to Robert Palmer's song, "Addicted to Love," which can be consulted as an authentic, accurately-descriptive source of information.
24. See Earp, B.D. Philos Psychiatr Psychol. 2017;24:77-92; Earp BD, et al. Am J Bioeth. 2013; 13:3-7.

25. Earp BD, et al. Addicted to love: What is love addiction and when should it be treated? Philos Psychiatr Psychol. 2017:24:77-92.

26. Looking back over the discussions in this chapter, the author senses that he may have placed, unfairly, romantic love in not an entirely positive light. What about the positive up-sides of falling in love? In the collection of essays in his book *The Heart of the Humanities* (Bloomsbury, 2016), Mark Edmundson championed the idea that romantic love can serve as a stimulant (replacing coffee) in the process of creative writing. "When you meet the one, or the one who is the one for a while, your [creative] powers are augmented," he wrote, adding a cautionary note that "when love runs its course (a little like a fever) the inspiration disappears with it….[Therefore] the writer who relies for day-to-day inspiration is taking his chances."

    The same might be said regarding the effects of falling in love on athletic performance. Anecdotal reports (and common sense) would suggest that performance should be improved if the athlete is on the exhilarating upslope of a relationship but deteriorated by the emotional angst of the down-side after a romantic breakup or rejection. Kelly Campbell and her colleagues at California State University sought to resolve this issue by interviewing 20 Olympic athletes who confirmed past experiences of romantic relationships (Rev Eur Stud. 2016;8:1-7). Fifteen reported that they performed better while being in love, while the remainder were "undecided." It turned out, though, that despite specific instructions, these athletes were reflecting on the "wrong" kind of love—long-standing relationships or successful marriages (i.e., support from a spouse). So the definitive answer to the effects of falling in passionate love on sports success awaits more successful research efforts.

2. TRAVEL

A man consults a psychiatrist for anxiety over a deteriorating marital relationship. "To relax," counsels the psychiatrist, "I want you to start running, 5 miles a day." The man complies. At the end of two weeks, he telephones the psychiatrist. "Things are greatly improved, and I'm much happier," he reports. "Of course, I'm now 70 miles from home."

Somewhere deep in the human psyche—within the mystical spirit or the lower cerebral cortex (depending on where on stands on the mind-body problem)—burns the insatiable desire to travel. Wanderlust, it's called. To hit the road, jump on a plane to far-off lands, to take the next train to anywhere. Just to *go.* "For my part," wrote Robert Louis Stevenson in *Travels with a Donkey,* "I travel not to go anywhere, but to go. I travel for travel's sake. The great affair is to move."[1]

No passage through youth is truly complete without a backpack trip through Europe. At the other end of life, the first thing newly-retired persons announce is their plan "to travel." In between, one is drawn by any number of attractive college alumni tours to Antarctica and other remote destinations. To travel, in this grand picture, is to live.

The source of this human intoxication with travel is far from clear. Its pervasiveness speaks to some fundamental aspect of human nature. Facile explanations might include a certain inquietude with the "status quo," a desire for escape from the mundane. Or perhaps a yearning to seek "adventure."

I'm sitting here at Gate 39, looking at my boarding pass. Boarding Group 9. I didn't know there was a Group 9. Already boarded are the infirm and the blind, armed services personnel in uniform (two apparently from the Spanish-American War), three suspicious-looking toddlers, the frequent flyers, the suits and the bean-counters, and the people of means. I notice that following the end of the line for Group 6 there is no one remaining. A somewhat dispirited cause for celebration—I, myself, am Group 9.

In recent years, the idea has circulated in the popular media—not substantiated by any solid scientific evidence—that wanderlust has a

genetic basis. In fact, one particular gene, DRD4, has been posited as a possible candidate for accounting for one's desire to travel. This idea apparently arose from the recognized association of a variant of this gene with behaviors of restlessness and curiosity as well as its being linked to individuals with Attention Deficit Hyperactivity Disorder (ADHD). Another variant of DRD4 is said to occur in greater frequency in animal populations characterized by longer migrating distances.[2] The implication here is that some individuals are inherently susceptible to enrolling in once-in-a-lifetime Mediterranean cruises while others are content to stay home and tend the garden. This information is certainly far too sketchy to draw any conclusions on the matter. Still, the ubiquitous nature of the lure of travel in humans suggests some such biological basis. One awaits future investigations to address this idea, and, if valid, to identify some as yet unrecognized Darwinian principle which would provide an evolutionary basis for the hunger to travel.

I settle in to a seating space clearly designed for any of the surviving Munchkins from Oz. It was a bit of a hike actually getting there, since 72C was the next-to-last seat on the plane. OK. If the tail breaks off in flight, I will have the best view of Greenland (on my left), and with a little luck, according to the pilot, a glimpse of the spectacular aurora borealis, an experience which has long been on my bucket list.

I pull out a copy of the airline magazine *Flight Time* and am glad to be enlightened on things to do if I have an extra day in Shanghai. Then there's a nice enthusiastic spread on the hidden tropical paradise of San Somewhere. I've actually myself visited this island of hidden delights twice several years back. It is evident to me that the authors of this piece have forgotten to mention that in the main town you will follow down the street a tourist crowd numbering close to the 110,000+ seating capacity of the Big House in Ann Arbor, all with the goal of saving $7.00 on a duty-free bottle of Gilby's after putting down about three thousand of same (dollars, that is) just to get there. But, ah, they describe that one can find the "world's best banana daquiri" at this particular bar located at the top of the island's small mountain. Do I remember this! On my visit I had read that, too, and with great expectations had rented a jeep and drove to the top, there being told that, "Sorry, mate!", the blender is broken. And, too, I notice that there's no mention that the beach has been largely washed away by an early-season hurricane, and the flies during most months are thicker than, well, flies.

Just when I was beginning to think how unpleasant and destructive of the human spirit this all was, I comforted myself in considering the miracle of being transported between major continents of the Earth in just a fraction of a day's time. Better than a ship in the old days, surely. There were icebergs and other vagaries of the North Atlantic (like rogue submarines). And sea sickness. But just about then we strike a "short period" of turbulence, and I am beginning to re-think the idea: staterooms with big beds and clean sheets, sumptuous dinners, walking on deck among the stars…

This was all cut short by the sudden, unrelenting shrieking of one—well, maybe two—of the previously-mentioned young children two rows up. I say shriek, but what was being emitted was a piercing, high-pitched sound of a nature which I suspect had never before been achieved in the Earth's long history. The only thing with which it might reasonably might be compared with, I suppose, is that feeling of having someone hammer a 6-inch spike into your cerebral cortex when you weren't looking. Captured in this aluminum cylinder seven miles above the Atlantic Ocean with very limited opportunity for egress, the sudden idea of strangling a two-year old child came to mind, tempered only by the picture of the uniformed agents that would greet our arrival in Paris. But, quite probably, there would be a number of grateful fellow passengers who would stick up for me in the old kindergarten gambit—"We really don't who was responsible, sir".

"Conventional wisdom" would hold that travelling is a good thing for you to do. A recent "white paper" from the Global Commission on Aging (commissioned, it should be noted, by the U.S. Travel Association) expressed this sentiment, particularly as travel benefits the elderly population:

> "Travel and healthy aging, the process of remaining as vibrant as possible in body and mind, are in fact closely associated. By keeping us active and engaged, travel certainly promotes well-being. Indeed, the levels of correlation between travel and certain areas of health are remarkable clear. Even more, the data presented in this paper reflect and underscore the common-sense view that travel broadens the mind, refreshes the spirit and contributes to good health—both physical and mental."

Just for once, in the name of fair play, why couldn't the flight attendants begin by serving the meal from the back of the plane? No, once again my meal was delayed by the snail-like progression of these otherwise nice people down the aisle. Of course, the outcome was as I had easily predicted: "I'm sorry, sir, but we've run out of the filet

mignon with roasted new potatoes. But would you like the vegetarian pasta?"

Erudite writers, poets, and philosophers of all ilk have weighed in to support the idea of the wholesomeness—indeed, the spirituality—of the traveling experience. From Danny Kaye to Marcel Proust, from Dr. Seuss to Mark Twain, these quotes and "sound-bites" exude a seeming depth of wisdom, an irrefutable light of truth.[3] Some examples: "Man cannot discover new oceans unless he has courage to lose sight of the shore" (Andre Gide); "Wandering re-establishes the original harmony which once existed between man and the universe" (Anatole France). If by chance you've missed these, be assured they can be found on T-shirts, coffee mugs, Chinese fortune cookies, and posters at your local souvenir or gift shop. Too numerous to be catalogued here, one observes certain common themes:

Travel takes you outside your "comfort zone." The idea is that travel instills confidence and serves to avoid settling into a depressive, non-creative "rut" in life via stimulation from new challenges. There is the assumption here that being in a "comfort zone" reflects personal lack of initiative, characterizing individuals who are mired in a non-expansive life, one that fails to confront those mind-expanding situations that are to some extent uncomfortable. In essence, one needs to be uncomfortable to "feel" life.

Travel confirms your ability to face new and difficult challenges. The well-lived life does not occur in a frictionless existence. In day-to-day living one is assaulted with difficulties, problems, fires "to be put out." Travel provides a training ground—a boot camp, as it were—to face such challenges. All those inconveniences of travel—expense, missed connections, lost luggage, jet lag, bad weather—are thus considered as *benefits* which provide one the opportunity to gain strength in overcoming adversity (Figure 2.1).

Visiting other countries opens one's mind to understand and accept peoples from different cultures. One becomes a better person, by this argument, in gaining tolerance of cultural differences.[4] One becomes a true citizen of the world in achieving an expansive view of humanity which nurtures peace and harmony, if not between countries, at least between individuals. In the Introduction to the travel essay compilation *The Lonely Planet Travel Anthology* (Lonely Planet, 2016), Don George expressed this poetically:

> As I have learned over and over, travel teaches us about the vast and varied differences that enrich the global mosaic, in landscape, creation, custom, and belief, and about the importance of each and every piece in that

> mosaic….Travel teaches us to approach unfamiliar cultures and peoples with curiosity and respect, and to realize that the great majority of people around the world, whatever their differences in background and belief, care for their fellow human beings…The best we can do with our lives is to embrace the peoples, places, and culture we meet with all or mind, heart, and soul, to live as fully as possible in every moment, every day. And it teaches us that this embrace is simultaneously a way of becoming whole and letting go…Travel tests us and teaches us—that we are not alone, that we are resilient, that we can overcome the greatest challenges and forge paths through the most daunting mountains and deserts, literal and metaphorical."

Figure 2.1. The joys of travel.

Travel improves physical and social well-being. Travel for many serves to boost happiness, creativity, and self-confidence, while improving social and communication skills. Claims have also been made that travel is associated with lower mortality rates as well as specific salutary health outcomes.[5] However, these reports typically confuse the benefits of "taking a vacation" with travel per se. Too, it is obvious that the arrow of causality

more likely goes in the opposite direction. That is, people who are more healthy are more likely to travel and take vacations.[6]

Without doubt there are many who have found strength and guidance in these spiritual, health-related, and social benefits attributed to travel. And not in simply putting down a credit card and transporting oneself from one side of the globe to the other. "Travel" in these reflections is serving, indeed, metaphorically as a surrogate for the challenges and benefits that confront us all in our daily lives. The lessons of travel are, these writers would insist, the lessons of life.

So, I'm thinking, this really isn't so bad. I've read a magazine, ate a meal, finished two chapters of David Foster Wallace, watched Tom Cruise in a movie whose dialogue was garbled by the magnificence of the two Pratt-Whitney jet engines just outside my window, generating three zillion pounds of thrust (each). I keep flexing my leg muscles to avoid a clot forming in my legs and traveling to the lungs, which would cause my sudden death. Then I make the mistake of looking at my watch. I had promised myself before that I would not do this. But the temptation was too great. Only three hours have passed. About five more to go. The little airplane on the flight map hasn't moved much since it reached Labrador. I envy other persons for many things, but the ability to sleep in a vertical position on an airplane is probably at the top of the list. I incline my head sideways and am just about there when then guy in the middle seat, whom I had made all efforts previously to ignore, announces that I must stand up so that he can take a trip to restroom. No problem.

After that I must have fallen asleep, for the next thing I knew the flight attendant is announcing that I should fasten my seat belt and replace my tray in its original and upright position, since we will be "landing shortly." Well. First of all, I do not wish that we land "shortly." If we "land shortly" we will all most certainly be killed. Somewhere at the end of the runway would be the more preferred location. Then, I am uncomfortable about this tray business. I read somewhere that the purpose of replacing it in its upright position is that if the plane slides off the runway on landing and strikes a tree, I will not be decapitated. So, okay.

Getting off the plane at de Gaulle at what is actually 2:00 AM Real Persons Time, my state of depersonalization and disembodied spirit causes me to forget, with some embarrassment in response to the customs agent's demand, the purpose of my trip.[7]

I was raised as a Presbyterian but must admit to have gradually lost the thread of religious belief over the years. However, this all was irrelevant as I approached Carousel #4 in Baggage Claim. "If there is a God," I intoned, "let my bag appear here." It was the ultimate test of religious faith. At least 80% of the luggage being spewed from the Portal of Hope onto the moving belt was black and identical to mine. Anticipating this, I had attached to my suitcase a distinctive purple ribbon. The word must have gotten around via social media, though, because it seemed that over half coming down the belt in stately procession displayed similar purple ribbons. My anxiety mounted in inverse proportion as the number of people waiting with me for their luggage dwindled, and, like a bad dream, they disappeared totally. Mine was the last bag. There is a God.

After recuperating my bag, I decided to take a taxi to my hotel, though previous experience had taught me this was not a good idea, given that my flight had arrived precisely, as usual, in the middle of *l'heure de pointe*, or the Paris rush hour. That would have meant being stuck for a couple of hours on the Périphérique in the back seat of a cab with the meter running, while swarms of motorcyclists weaved in an out between the paralyzed cars. Too, the price for such an adventurous journey was high, and one was, in such a depersonalized state, not up to the mental challenge of calculating a 10% trip for the driver. Nonetheless, this was the plan. However, as I approached the taxi stand there was much commotion, lots of frustrated-looking people, and a whole squadron of taxi cabs in the street. Upon inquiry it was explained me that the taxi drivers were on strike, and they had blocked the taxi entrance to and exit from the airport. "Does that mean I am stuck here?" I asked. "If you want to take a taxi you are." Not relishing my stay in France being turned into four days at the Airport Hilton, the decision was then made to switch to taking the RER—the extended Metro—into town, which meant schlepping my bag a mile or so to terminal F on the other side of this enormous airport. This started well, for the train was almost empty at the airport, this being its point of origin. Unfortunately, by the time I reached my stop for the hotel 45 minutes later, the car had gradually filled to the point where riders were standing sandwiched one to another, an enormous coagulated mass, with no means of moving (this being added by a homeless person playing random notes on a clarinet during the extent of the trip as a means of attracting financial contributions). To descend at the proper stop, then, with my 48-pound suitcase became a task of National Football League proportions, but with sufficient effort resulted in my

being spit out just before the doors slammed shut. But now I had to lug same suitcase, refusing aid from a skinny 12-year old boy, up a steep staircase to street level.

There is some established phenomenon, not well-explained, but presumably related to sleep deprivation and prolonged immobility, by which one becomes completely disoriented when popping out of the subway. Consequently, dazed from jet lag, lost, and unable to find my carefully packed map, I was required to rely on the kindness of passing strangers who accepted my half-baked French to direct me two blocks down to my hotel. Now, getting lost may have some spiritual benefits, but jet-lagged in a mental haze at 8:30 in the morning in a foreign country where you don't speak well the native language, it's not. As expected, I was far too early to check into the hotel, where I would have loved to collapse on a bed and disappear from reality for an extended time. So, instead, I left my bag with the receptionist, who told me to come back at either 12:00 or 2:00, I'm not sure which (either *douze* or *deux heures* to the untrained ear).

Is there any scientific support for the many values proposed for travel? Not a great deal, it turns out, but enough to suggest that certain brain functions are favorably altered by the act of traveling. This evidence arises from studies in both animals and humans indicating that novelty—new sensory experiences—are associated with neurotransmitter-based cerebral functions. Particularly implicated is the dopamine reward system in the ventral tegmental area, which the reader will recall was the focus of the drive for romantic love (as well as chemical addiction) discussed in Chapter 1. In 2007, Witmann et al. tested the hypothesis that novel stimuli (as one would suppose serve as a surrogate for travel experiences) might trigger the same reward system. To test this, they utilized fMRI imaging to detect augmented activity in brain regions after subjects were presented novel (i.e., unfamiliar) photographs of landscape scenes. They found that, compared to a familiar image, novelty triggered activity in the substantia nigra and ventral tegmental areas, traditional sites of the dopamine reward system.

The authors concluded that "dopaminergic processing of novelty might be important in driving exploration of new environments." The implication here is that the "rush" one feels when looking at travel brochures of Caribbean beach resorts has a neurochemical pleasure-seeking reward basis identical to that of falling in love, or sipping a morning latte, or, more seriously, forming an addiction to alcohol or narcotics. That is, the "drive" to travel may share obsessive qualities in common with a good deal of other

human behaviors which have at their root pleasure-seeking reward systems in the brain.

Schomaker and Meeger subsequently published a review of other studies which examined the effects of visual novelty on brain function. Besides supporting the earlier findings of Witmann et al., these reports revealed an expanded influence of novelty on a variety of functions, neurochemical substrates, and areas of localization in the brain. Most of such studies have been conducted in animals, but evidence has now expanded to human beings as well. The bottom line is that novel stimuli activate widespread areas of the brain besides the ventral tegmental area, including limbic regions, frontal, temporal, parietal, and occipital areas. In these locations, other neurologic agents as well as dopamine are involved, such as norepinephrine and acetylcholine. Significantly the outcomes of such brain activity in response to novel stimuli includes improvements in visual working memory, augmented perception, drive for exploration, and increased arousal.

Such information is fascinating, but still a long way from providing convincing evidence that human travel is a) driven by a central reward system, and b) that travel provides biochemically-based behavioral attributes. The hints are evident however, that both may be true. Schomaker and Meeter even suggested that such a biological underpinning of wanderlust and the lure to travel in humans might be explained on the evolutionary basis that "exploring new opportunities and environments is a crucial aspect of mammalian behavior. In fact, foraging species must have a drive to explore new environments, in order to survive."[8]

A *café au lait,* purchased for about $7.50 American and with marginal caffeine content and no refills, did little to revive my spirits. I then sat on a bench behind Notre Dame (where you will recall Carla Bruni translated for Owen Wilson in Woody Allen's movie *Midnight in Paris*, except that the orientation of the bench in the film was obviously changed by the director so that the cathedral was in the background). Nothing, it would seem, in reality is the way it's supposed to be. Here I either fell asleep or simply lost consciousness—it was a medical distinction, I suppose, one hard for a lay person to tell which.

Of course, there are much more pragmatic arguments for traveling abroad. For lovers of French wine, art, cuisine, tennis tournaments, architecture, and history there is nothing like visiting Paris to experience the "real thing." True, though, there are at least a couple of excellent French restaurants not too far from home. As well as fine French wines. Likewise,

local museums full of Impressionist art. At the museum of the Barnes Foundation in Philadelphia there are enough tableaux of Renoir and Gaugin covering the walls to make one dizzy. Indeed, one can readily (and with significantly less expense, time, confrontation with hordes of tourists, waiting in long lines, and loss of energy) make a pleasant tour of the treasured holdings of the Louvre from numerous books and on-line. And Roland Garros, one has to admit, is best witnessed on ESPN rather than being baked *bien cuit* in the Paris sunshine.

Philosophically, or even neurophysiologically, how do these latter experiences differ from the "real thing"? We experience "reality" only through our senses. We have no other means of validating the real world. We live our lives full of sensations that give rise to mental "functions"—emotions, decisions, memories—all which we call *experiences.* As you stand, reverently taking in the Sistine Chapel, "your sensory organs—your eyes, ears, nose, mouth, and skin—act as interpreters. They detect a motley crew of information sources (including photons, air compression waves, molecular concentrations, pressure, texture, temperature) and translate them into the common currency of the brain: electrochemical signals….. Everything you experience—every sight, sound, smell—rather than being a direct experience, is an electrochemical rendition in a dark theatre."[9] By what difference can one claim to have gained an advantage or benefit in this process by geographical place? (Such ruminations give meaning to the expression "I had to pinch myself to realize I was actually there!").[10]

I returned to the hotel, to strike a happy medium, at 1:00 and promptly collapsed in bed, planning to take the train to Fontainebleau the next morning. To my shock, when I awoke it was 3:00 pm *the next day.* Incredibly, I had missed not only Fontainebleau but also the not-insignificant cost of a day's hotel stay in an unconscious state.

What it means for a human being to "experience" something has lately drawn the attention of an unusually large variety of scientific bed-fellows (psychologists, philosophers, physicists, neurologists, psychiatrists, physiologists –indeed, the whole band). Much attention has been focused, particularly, on the question of what it means to be, Zen-like, "in the present." That is, what is the meaning of experiencing "now?" It has been proposed, in fact, that "now" does not exist, that, "now," like its geometric counterpart the "point," has no dimension and serves only to connect the future with the past in the flow of time.[11] So, as soon as one says "now," it's already part of the past. The unceasing flow of time does not permit such a stationary reality. As Kai Krause concluded, "Everything is about the

anticipation of the moment and the memory of the moment, but not the moment."

It has been suggested that the same dynamics of "now" and "time" occur during travel as well. That is, the joys of travel may lie in its anticipation and its memories, but not in being able to actually appreciate a "present." Your gaze at the cathedral Notre Dame becomes a memory at the instant you view it. You are incapable, by this idea, of holding on to a "present." The French novelist Joris Karl Huysmans wrote of this in *Against the Grain* back in 1884: "The pleasure of travel, which only exists as a matter of fact in retrospect and seldom in the present, at the instant when it is being experienced."

Whether one subscribes to this idea or not, there would be little disagreement that the anticipation—looking forward with excitement—of an upcoming trip plays a large role in the joy of travel. In *The Joys of Travel,* Thomas Swick devoted an entire chapter to this subject. Well-noted was the observation that "anticipation of travel is always more idyllic than travel itself….Anticipation is to a journey what infatuation is to a romance: an uncritical but crucial prelude to reality. It helps us look past the coming discomforts, frustrations, embarrassments, and disappointments that might otherwise keep us at home."[1]

Memories of a trip often provide great feelings of pleasure—or not, depending on the experiences encountered. For most, a stack (or file) of pictures and travel tales told are a vital part of an enjoyable trip. And veteran travelers know that the most fascinating and impressive stories recalled to a post-trip dinner party are usually those involving the mishaps and things-that-went-wrong. (In this regard, it is not be ignored that current research indicates that one's memories are susceptible to selective subconscious editing. Particularly, Elizabeth Loftus' work at the University of California, Irvine, has indicated that people frequently (and often unknowingly) embellish memories. Based on published studies, Nash et al. contended that almost a third of individuals will "remember" an event that never occurred at all. Wrote David Eagleman, "Our past is not a faithful record. Instead, it's a reconstruction, and, and sometimes it can border on mythology.")[12]

The next day I took the train to Bayeux, with the plan to take a tour of the Normandy beaches. I will not recount the disappointing events of that excursion, now mainly forgotten, but will briefly note a failure to sleep because of the incessant ringing of the cathedral bells just next to the hotel, not to mention the departure site of a road rally where souped-up cars roared their engines and departed at 10-minute intervals throughout the night from the square just in front. Too, I am

vaguely remembering my visit to the Bayeux tapestry, in which I somehow mistakenly ended up with a tour group of German tourists, which led to some major embarrassment when the translated tour audio guides were handed out. At the invasion beaches it was cold and pouring rain, as might have been historically appropriate, but trudging about shivering in squeaky soaked shoes detracted from any emotional response concerning the futility of war and things like that. In fact, more to the point, this experience underscored my belief that rain must be considered the enemy of all tourists, as there is no means of satisfactorily getting your clothes, particularly shoes, dried out in a hotel room in time for the next day's events.

The next night's sleep back in Paris was difficult due to the incessant honking of car horns, drunken cries, and overall ambient nocturnal electricity that surrounding the French having just won the European Cup in some sport or the other. I gave up and watched through the window, just in time to see a comely young mademoiselle being dumped into a fountain down the street by her inebriated male companions, accompanied by happy cries of distress. Difficult to confess, but this might have been the highlight of the trip.

Could it be that wanderlust is nothing more than a myth, at one extreme simply disappointing but at the other perhaps even destructive? A false idol, like fame, wealth, success, sex—things which not infrequently only possess value when you don't have them? The scholar Mark Edmundsen contended (as a great many others have) that "no one ever reads [Jack Kerouac's] *On the Road* all the way through without wanting to take to the highway."[13] Maybe, but this author (the one responsible for the work you are now holding your hands) has read this book three times, seeking such inspiration, only to find instead in this narrative a clear description of the disillusionment, loneliness, and spiritual emptiness when one "takes to the highway" in an attempt to escape "the trudging life." A sad book with a message—the best route to personal satisfaction and happiness in life is not out on the macadam but rather in the attachments that one elects to make in his or her personal life. The lesson by this perspective of *On the Road,* is that the most valid approach to life is not "breaking chains" but rather to "stay attached." Yes, this may appear to defy a certain level of romanticism, but, in the end, such commitments—to vocation, family, social cause, or whatever (it's your choice)—serve as the best means of finding a satisfactory meaning for one's existence. Setting off on the road, looking for "something better," one only discovers, as Ernest Hemingway had a penchant for pointing out, "nada." By one argument, if the persons in Kerouac's novel feel they are being

"liberated," they are guilty of a serious self-deception. To be recognized is the fact that there are other inspirational posters that counsel "Grow where you are planted."[14]

I had wanted very much to make a visit perusing the stacks at Shakespeare & Company, that iconic English bookstore and hang-out for vagabonds and lovers of literature alike. On my arrival, however, I found a long line of fellow bibliophiles waiting to get in. It seems that a system had been instituted that, since this creaky structure could only hold so many persons at a time, a "checker" was stationed at the door, only admitting persons equal in number to those, exhausted of the experience, who were leaving. Akin to your favorite night club on a Saturday night. Anyway, this was too much for me, who hates waiting in lines, being a bit de-humanizing and detracting from the spiritual value of good literature, so I took the Metro to the base of the Champs-Élysées, preparing to stroll up to the Arc de Triomphe. What no one tells you in the travel books, however, that this is actually a *hill,* a steady incline that soon exhausts those not in tip-top physical shape. After 15 minutes of such ascension, I wearied, and as the Arc in the distance did not appear to be getting any closer, I repaired to a café for a second *café au lait,* with a price that had risen to $8.50 American.

This turned out to be a mistake, because as I sat sipping my coffee, the street became filled with a long parade of demonstrators, shouting slogans, waving flags, blowing horns, and the like, to gain attention to some social cause or another. They were not only loud and passionate, but also numerous, and the parade continued for many blocks, without an end or interruption in sight. So here I was, trapped on the north side of the Champs-Élysées with no egress back to my hotel in the opposite direction. I could, suppose, have barged through the parade to the other side of the street, but I had this vision of my being swept up in the demonstration and being dragged off by the gendarmes who were intently (and holding disturbingly-real-looking automatic weapons) looking on. This situation was compounded by the fact that I was stricken by a certain *urgence,* which is the French polite way of saying I had to pee like mad. The restroom in the café where I sat was *"desolé, en panne"*—broken down. Decorum holds that I will not relate the rest of this part of the tale, except to say "God bless McDonald's," which provides a clue as to a second theological conversion which transpired during this trip.

And, finally, there's this: Your 767 has landed in a far-away city. You debark, passport in hand. On a high note, you are about to broaden your horizons, immerse yourself in a new culture and cuisine and language, see things you've never seen before, maybe even experience a spiritual awakening and self-realization. On a low note, you are now—the word must be used—a *tourist.* And "the worst thing about being a tourist is having other tourists recognize you as a tourist" (a quote attributed to Russell Baker). Much of your next week, in all likelihood, will be spent trying to avoid people like yourself.

The tourist. In its worst incarnation, loud, rude, English-only, in Bermuda shorts and Yankees baseball cap, camera around neck. For the locals, someone considered with bipolar emotions—a source of income, to be tolerated. The purists would say that it is important that such a "tourist" be distinguished from true "a traveler." Ilan Stavans and Joshua Ellison wrote on this is an op-ed piece in the New York Times and followed it up with a book entitled *Reclaiming Travel (Duke University Press, 2015).* Tourism, they claimed, is "inauthentic, choreographed, sterile, and shallow"—tourists are "merely content with escapism, thrill seeking, or obsessively snapping photographs." They argued that, instead, travel "should be an art through which our restlessness finds expression—a search for meaning not only in our own lives but also in the lives of others. It is not about the destination; rather, travel is about loss, disorientation, and discovering our place in the universe."

How does one get over this existential hump? A number of suggestions have been made: Before your trip, read up on the history and customs of your destination, talk to people who have been there, and gain at least a rudimentary knowledge of the native language. Try to envisage a realistic rather than romantic picture of the journey ahead. During your visit, the key word is *engagement*—social interaction, curiosity, no fear of getting lost, courageously partaking of the cuisine, acting at all times with (quiet) respect. It helps if you have a social contact there. Also, that you are not excessively shy nor afraid to make a fool of yourself.

In his Introduction to *The Soul of a Great Traveler (*Traveler's Tales, 2017*),* Brad Newsham recounts a story that perhaps places the whole issue in proper perspective. A woman is telling a group of fellow travelers around a café table of "having recently survived a nervous and thirsty and reportedly quite stinky month trapped aboard a broken-down train in the middle of war-torn Sudan. She seemed astonishingly unimpressed with her newly acquired, conversation-stopping credential: 'After a while,' she told the awestruck rest of us, 'you realize that, everyone on this planet, we're all tourists here.'"

I headed back down to the banks of the Seine, eager to enjoy a *déjeuner* in a restaurant in the Palais de Chaillot which my sister, a Francophile who knows about these things, had recommended as "absolutely superb." Unfortunately, two burly guards (without sidearms) at the door convinced me this would be impossible, since the restaurant was closed for renovations. They smilingly reassured me that in three months it would be completed and that I should return then. I nodded acquiescence, then walked out on the terrace in front, where I was immediately confronted by an extraordinary view of the Eiffel Tower across the Seine. What was surprising was that it was seemed monstrous, about three times normal size. It suddenly struck me that I'd seen a photograph of Adolf Hitler viewing the *tour Eiffel* in 1940 from the exact same spot where I was standing. This was a deflating thought. Besides some ruminations on the triumph of evil in the world, I was beset with a number of troublesome realizations. I've seen images of the Eiffel Tower hundreds of times—in movies and books and photos. Here it was "for real." But could my brain feel any difference? The image of the structure passed from the lens of my eye to the retina in the back wall (upside down, as it were). The picture was then transmitted electronically in the brain to a viewing "center," where the electronic signals were reconstituted into a "picture" (right side up this time) in my consciousness. I doubted that my brain could not interpret any differences between all my previous images of the Tour back home and the one that was "real" sitting in front of me. What was so special that I was actually *there*? Altogether, what is the importance of *place?* Does it have a *value*?[15]

The discussions in this chapter suffer, without doubt, from a great number of obvious over-simplifications and generalizations. There is no question that the experience of travel should be expected to be very different by an elderly couple in a two-week group tour cruising the Danube and that of a 25-year old who has ditched life savings, educational prospects, girlfriend, and what have you, to set off on a three-month solo excursion backpacking across the Kyrgyz Steppe. And the experience of a New Yorker traveling for a week in San Francisco will be very different than if he is headed for Calcutta. Too, one assumes that the experience and value of travel is very much related to one's personality structure—travel, with its balance of challenges and rewards, will be faced very much differently from one person to the next. Fortunate are those who can find their personal horizons enlarged through travel; equally lucky are those who find happiness and satisfaction in their own backyards.[16]

Notes

1. According to Thomas Swick in his book *The Joys of Travel (*Skyhorse Publishing, 2016), Stevenson's quote is engraved on the floor of the Providence, Rhode Island, railway station. Swick was not impressed, commenting that "No statement could have been less appropriate for the people waiting for Amtrak. We were all traveling to go somewhere—New Haven, New York, home—and the great affair was to get there. None of us was a traveler in the spirit of Stevenson."
2. See Dobbs D. Are you an orchid or a dandelion? New Scientist. 2012;213:42-45.
3. It should be remembered that all these inspirational quotes, in the end, reflect just one person's opinion. Others, whose ideas have failed to appear on T-shirts, have been less enthusiastic. For instance, in *Don Quixote,* Cervantes wrote that one might as well, "journey all the universe in a map, without the expense and fatigue of travelling, without suffering the inconveniences of heat, cold, hunger, and thirst."
4. Such an assertion would be difficult to prove. But perhaps one could somehow perform a study in which one would attempt to determine if the American passengers getting off Delta flight 32 from Paris to New York were "better people" than those embarking onto flight 33 from JFK to Paris.
5. As well, one shouldn't ignore here the health *risks* of travel, which depend, of course, to a good extent on one's destination. In their review, Cossar et al. found that 36% (over one out of three) of over 13,000 travelers returning to Scotland since 1977 had become ill during their trip (J. Infect., 1990). Gastrointestinal disorders headed the list of causes, and frequency of disease was positively associated with those taking package holidays, inexperienced travelers, smoking, and younger age (20-29 years).
6. Typical is the report by Chikani et al. in which mental health and marital satisfaction were compared between women who only took vacations every 2-6 years compared to those who took time off from work two or more times per year (Wisc Med J. 2005). They found that "women who take vacations frequently are less likely to become tense, depressed, or tired, and are more satisfied with their marriage. These personal psychological benefits that lead to increased quality of life may also lead to improved work performance."
7. Those sensations of fatigue, headache, disorientation, and general lassitude that mar your first couple of day in Paris, just to remind you, are your own fault. You've crossed innumerable time zones, deranging your natural physiological body rhythms which are normally attuned to day and night hours. These are called *circadian rhythms*, which means that they fluctuate on a regular phasic basis over a day's time. All biological functions participate in these daily periodic swings, even down to the level of the activities of individual cells. The problem becomes when one disturbs these rhythms. When you landed at de Gaulle at 9 AM in the morning it was really 2 AM back home, where most of your body's rhythms were at an ebb. Now, you've caught them unawares, asking your brain, heart, stomach, lungs,

kidneys, and all the rest to break into action in the Paris daylight. When so disturbed, they retaliate, and you experience symptoms of "jet lag." You can only be grateful that you are not defending your French Open singles title that day nor negotiating an arms reduction treaty with a wily political adversary.

8. Read about the effects of novel visual stimuli on brain activation and subsequent behavioral outcomes in Wittmann BC, et l. Neuroimage. 2007;38:194-202; Schomaker J, Meeter M. Neurosci Biobehav Rev. 2015;55:268-279.

9. See Eagleman D. *The Brain. The Story of You.* Vintage Books, 2015.

10. These comments represent only an iceberg tip of a metaphysical dilemma that has troubled philosophers for centuries—is "reality" an objective phenomenon, independent of the limits of human perceptual awareness, a true reality that exists "out there"? Or is "reality" defined only by that information provided human beings by their senses, a reality which exists only in human experience, one available through the limited port hole of sensory input? In one sense, "to travel" provides a good model for the debate. By heading off for a two-week visit to Bangkok, by actively creating a change in one's input of the visual, smell, taste, feel, and sound, is "reality" altered? And more to the point of this chapter, does such a change proffer some value to the individual? It's your call.

11. Of course, it should be recognized that Einstein's Theory of Relativity shattered the Newtonian belief, supported by everyday experience, that the march of time is absolute, flowing in a constant stream from future to past. But, in thinking about the experience one obtains from travel, it is obvious that normally this does not occur at extraordinary high velocities, such as those approaching the speed of light, which is where the relative nature of time holds sway. Too, one can ignore even more abstract concepts of time at the subatomic level, where, in the wacky (but altogether true) world of quantum mechanics, anti-particles are those moving backwards in time and where the distance a particle moves over time (its velocity) cannot be assessed at the same time as it location. For the purpose of thinking about "now" during one's trip to Paris, then, the old-fashioned truth of the Newtonian model to which one is accustomed in daily life works fine.

12. For more on the fallacies surrounding just how you recall that magic trip to Cancun, see Eagleman, D. *The Brain. The Story of You.* Vintage Books, 2015; Loftus EF. Make-believe memories. Am Psychol. 2003;58:867-73; Loftus EF, Davis D. Recovered memories. Annu Rev Clin Psychol. 2006;2:469-98; Nash RA, et al. Misrepresentations and flawed logic about the prevalence of false memories. Appl Cogn Psychol. 2017;31:31-33.

13. Edmundson M. *The Heart of the Humanities.* New York: Bloomsbury, 2018, p. 223.

14. The sceptic might argue that the drive to travel reflects the erroneous supposition of the greater verdure on the other side of the fence, that by a change in place there is offered an escape from one's problems, that "we've got to get out of this place" is the mantra to a happier life. That "wherever

you go, there you are" is to be considered a misplaced sentiment. Somewhere there was printed a cartoon (with apologies to its artist) of a man standing on his skies at the top of a chair lift, looking up at an airplane pulling a banner that says "Go home and face your responsibilities."

15. The author attests, by waxed seal, that this tale is autobiographical, having personally experienced all of the events in this discourse (although not during the same trip).
16. Mark Edmundson (see note 13) wrote that it "cultivates sensitivity; it augments imagination; it teaches tolerance, in the act of self-discovery… putting one on the threshold of the spiritual life… enlarging the mind, the expansion of consciousness." Sound familiar? Except that he wasn't referring to travel but instead to settling in to enjoy a good book, or even to write one.

3. JEALOUSY

To fly is everything.
—Otto Lilienthal

But to fly!

Oh! I have slipped the surly bonds of earth,
And danced the skies on laughter-silvered wings;
Sunward I've climbed, and joined the tumbling mirth
Of sun-split clouds, —and done a hundred things
You have not dreamed of—Wheeled and soared and swung
High in the sunlit silence. Hov'ring there
I've chased the shouting wind along, and flung
My eager craft through footless halls of air…

Up, up the long, delirious, burning blue
I've topped the wind-swept heights with easy grace
Where never lark or even eagle flew—
And, while with silent lifting mind I've trod
The high untrespassed sanctity of space
Put out my hand, and touched the face of God.

No words beyond these penned by the 19-year old aviator and poet John Magee in 1941 could more beautifully portray Mankind's obsession to take wing, soar into the skies, to finally be loosened from the bonds of an earthly existence.[1] *Powerful thoughts, indeed. Of course, such romantic notions today escape those daily thousands who, in long lines clutching tickets and photo ID, pass through scanning devices, sit through a two-hour flight delay, then step into a tunnel which leads to a long living room with tight leg space, where they wedge themselves, strapped to a belt, earphones in place, and watch classic movies. read electronic books, or sleep, the shades drawn, until it is time to disembark. Reader, forget them for a moment. The story of the efforts of human beings, dating back into the dim historical past, to "slip the surly bonds of earth" is by no means made less extraordinary. Any book of aviation history is replete with the exploits of these early pioneers of flight, those daring young men and women who through courage, and ingenuity, and inventiveness, and perseverance brought*

reality to a long-held fantasy. And behind these brave souls, men and women of science cannot be forgotten as those who revealed the physical principles that made it possible for these flying machines to take wing. These were individuals who one might suspect had no intentions of creating the modern world of aviation but rather were driven by perhaps an even loftier ideal—simply the immense joy of finding things out.[2]

This is the true story of one of those men. On one hand, it is a tale of the usual inspirational variety. A creative genius whose efforts brought to light an understanding of how the physical world works. A story that speaks to the dignity and greatness of the capacity of the human mind, and by that, as well, our importance in the grand scheme of things. But be forewarned that it is also a cautionary tale, tainted by the dark side of human behavior, the inescapable demon of envy.

Once upon a time (1723), in a land far away (Switzerland), there lived a bright young man by the name of Daniel Bernoulli. Having reached an age of 23 years, yet lacking any means of self-support, he had continued to live in his family home in Basel with his two brothers, Niklaus and Johann II. David had been born in the Netherlands, but when threatened by persecution of the Huguenots, his father Johann (more about him later) had moved the family to the more comfortable surroundings of northern Switzerland. Basel was at that time a commercial hub in Europe and home to the prestigious Basel University, where Johann assumed the post of professor of mathematics vacated by the death of his brother Jacob.[3]

Given the Bernoulli pedigree, Daniel's early passion for science and mathematics was no surprise to Johann and his wife Dorothea. Johann had become a dominant voice in these fields in embracing and supporting Gottfried Leibnitz in his dispute with Isaac Newton over the credit due for the "invention" of calculus. He published extensively on differential calculus, astronomy, and optics. Upon the death of Isaac Newton in 1727, Johann was, in fact, considered Europe's leading mathematician.[3]

Jacob Bernoulli, Johann's brother, was equally renowned for his important contributions in mathematics, astronomy, and physics. Early on, before their relationship turned sour, he worked in collaboration with his brother, particularly in developing applications of the new calculus. The two, regarded as the "Bernoulli Brothers," were at the pinnacle of their careers when Jacob passed away from tuberculosis in 1705.

Little has been written to help today's reader understand the personal nature of these two mathematical geniuses. There are some clues, though, that all was not well. Over the years, their relationship was marked by increasing jealousy and competitiveness, each trying to outdo the other.

Johann, it has been suggested, was particularly envious of Jacob's position at Basel University. Soon they were publishing written attacks on each other, and by 1697 things became so vitriolic that they were no longer even on speaking terms.[3]

Just how all this poisonous wrangling affected Johann's disposition around the family dinner table is difficult to say. Except for one thing—the worst was yet to come.

Father-son relations did not get off to a good start. Daniel voiced his strong desire to study mathematics, but his father nixed the idea, claiming that a career in business would prove more remunerative. Then Johann switched to insisting that his son engage in medicine (for the same reason). Daniel went along with all his father's demands, eventually obtaining his doctorate in medicine in 1720. He then travelled to Venice to open a practice, but there re-awakened his earlier dream to work in mathematics. His subsequent works in probability, hydrodynamics, geometry, and time-keeping (the design of an hour glass that would not be disrupted by the pitching of a ship at sea) were the beginnings of a long series of important works in applied mathematics and physics.

In 1734 Daniel submitted some mathematical approaches to astronomical problems to the Paris Academy for its Grand Prize competition, and this is where the trouble started. It turned out that a) Johann had also entered a work in the contest, and, b) as luck would have it, both Johann and his son were named co-winners, sharing the prize. What would one expect here—parental pride or something worse? Try the latter. Johann was infuriated that his son had been judged his equal, and this resulted in a complete rupture of their relationship. In fact, Johann threw Daniel out of the family house in Basel (fortunately he had his own residence in St Petersburg at the time). It has been suggested that it was at this point that Daniel lost all enthusiasm for mathematical research.

Daniel's investigations in physics continued, particularly in collaboration with Leonhard Euler, who had been a student of Daniel's uncle, and significant contributions were made in the areas of mechanics, conservation of energy, and hydrodynamics. But the one that concerns us here is one of the most important, a concept that we know today as *Bernoulli's principle.* It provides an explanation for how a 300-ton Boeing 747 can fly through the air, and a baseball pitcher can fool a batter with a deadly curveball to strike out the side, and from the baseline a tennis player can crush a tennis ball that still lands inbounds across the net. Here's how it works:

Bernoulli's principle is an expression of the relationship between flow of a fluid—be it liquid or gaseous, like air—and its pressure. Put most simply, it states that the faster the flow of a fluid, the less its pressure. By a

more profound interpretation, this principle is derived from the dictates of the law of conservation of energy. In a stream of moving fluid, this law demands that the total amount of energy—kinetic, potential, and intrinsic—is constant at all points in the stream. If the velocity of the stream is increased, thereby augmenting kinetic energy, there must be a compensatory fall in the static pressure as created by potential and intrinsic energy to maintain a constant sum of total energy. Bernoulli's principle can also be read in reverse: when a fluid flows through a locus of lower pressure its velocity will increase.

This can be most easily visualized by examining how the cross-sectional shape of an airplane's wing provides for lift, defined as the upward force that is perpendicular to the direction of the flow of air. That shape is termed an *airfoil,* in which the upper edge is curved in comparison to the straight inferior border of the wing. As the aircraft is propelled forward, the air passing over the curved upper edge moves faster than that on the straight lower edge. Daniel Bernoulli calculated that this would create a differential in pressure—greater on the bottom than on the top of the wing—which would result in lift. And *voila!* Your Airbus 320 lifts off the runway with no complaint. (One must pay a silent homage to Daniel Bernoulli at this point on your next flight.)

Baseball pitchers assumedly do not routinely contemplate this, but a curveball only works thanks to Bernoulli's principle. When throwing a curve, the pitcher imparts a twist to the ball with his fingers which creates topspin. That means that, if the ball is moving from right to left toward the batter, it is spinning counter-clockwise. That is, the top of the ball is moving forward in the direction of the pitch, while the bottom is circling backwards. A small layer of air attached to the seams on the ball encounters the air as the ball is projected at some 80-90 mph, slowing the air (in a head-on collision) above but increasing its velocity below. As Daniel Bernoulli would have predicted, the differential in air velocity above and below the ball is reflected in a dissimilarity in pressure which causes the ball to deflect downward on its flight to the plate.[4] (By the pitcher's imparting the spin laterally on the ball, the pitch will be expected to curve from one side to the other as it crosses the plate.)

In tennis it's the same thing. Sweeping the racket face up and over the top of the ball creates topspin. And following the scenario above for the curveball, with the boundary layer of air sticking to the fuzz of the ball, the pressure differential causes it to dive rather than follow a straight path. That the ball will land short of where gravity would normally dictate permits the player to strike a more powerful return shot that will still land safely

inbounds. Thanks to Bernoulli's principle, the "power game" dominates today's tennis world.

Of course, this was all 165 years before the Wright Brothers, and Daniel had no images of winged flying machines in mind. But his principle is what governs not only aircraft in flight, but, as well, the operation of airplane propellers, kites, sailboats, helicopter blades, and wind turbines. They're all simply airfoils, obeying Bernoulli's principle. Without an understanding of how the wings of an aircraft must be designed, the builders of flying machines could have never fulfilled the age-old dream of human flight.

Daniel Bernoulli included his innovative ideas underlying the velocity and pressures of fluid flows in a 1738 book entitled *Hydrodynamica,* which also included new insights into matters such as the kinetic theory of gases and functions of hydraulic pumps. His scientific credentials would have been well-established by this work, except that… Once again, the ugly demon of jealousy reared its head. Daniel's father, true to form, felt his own reputation insulted by the success of his son. The next year Johann published a book with the title of *Hydraulica,* in which he plagiarized many of Daniel's ideas, then back-dated this work to make it appear that it had been published prior to Daniel's seminal book. All in the effort to discredit the work of his own son. He, the famous professor of mathematics at the prestigious Basel University (presumably lacking an in-house Ethics Committee), would take credit.

What then ensued is not made clear in the historical record, but it is entertaining to speculate just how this all might have played out when Johann was called upon to present and defend "his" ideas before the Paris Academy:

INTERROGATOR: Professor Bernoulli, in your book you speak of pressure differentials across a material of certain geometric shape that would cause an upward displacement of that object. What practical good do you see coming from such a premise?

JOHANN: But isn't this obvious? It's like a bird's wings. Wings, you see! We could build flying machines. Man could finally fly. My idea would be the most revolutionary anywhere! It explains what keeps kites aloft, and how we can design winged carriages that will fly over the ocean and at regularly scheduled times between small cities.

INTERROGATOR: Hmmm. Let me see if I have this right. This "wing," you say, should be curved over the top, and flat on the bottom. The air will go faster over the top than the bottom edge, and this will cause a greater pressure pushing up from the bottom. And this will cause the wing to rise.

JOHANN: That's right. Just like a bird!

INTERROGATOR: But, Professor, one thing is not clear. Why does the air go faster over the top, curved border of the wing?

JOHANN: That's easy. The stream of air below and above the wing must meet at the trailing edge of the wing. Because the air has farther to go on the top edge (because it's curved, you see), it has to move faster.

INTERROGATOR: That might make sense to you, Professor, but, in fact, it isn't true. My colleague Professor Windstedt has studied bird wings in the University wind tunnel and found that, in fact, the two streams of air above and below a wing shaped like yours do not meet at all.

JOHANN: Uh, I didn't know that.

INTERROGATOR: Professor Winstedt thinks that the air traveling faster above the wing has to do with the fact that this air, moving above a curved surface, is compressed into a narrower stream. The velocity of flow therefore increases as this stream is narrowed. This effect is opposite to the widened air stream below the wing. I'm surprised you weren't aware of that.

JOHANN: Well, I do sometimes get behind in my journal reading.

INTERROGATOR: I have a question, Professor. If your theory is correct, how is it that birds can fly upside down. Wouldn't they fall out of the sky if they did that. Would your "flying carriages" be able to do this?

JOHANN: Let me think about that for a moment.

INTERROGATOR: Professor, how do you propose that this wing of yours be propelled through the air? Some magic energy machine maybe? And what if that machine suddenly stops working when you're a mile up in the air? You would drop like a rock! I can even calculate the time it would take you to crash into the earth: $S = gt^2/2$, where S if 5,200 feet, g is the acceleration of gravity, and t is the time to your unfortunate impact.

JOHANN: Uh, I hadn't considered that.

In what might be considered an Epilogue to this peculiar tale, Johann did, in fact, get eventually some form of come-uppance. While he was being tutored by Johann in mathematics, Guillaume de l'Hôpital published a book on infinitesimal calculus, in which he openly appropriated the original ideas of his teacher. Johann, well-acquainted with such literary antics, complained bitterly, but it was his student who received the credit. (Guillaume, meanwhile, claimed innocence, having openly acknowledged the "inspiration" of his mentor in the book's preface.)

The remainder of the story of Daniel Bernoulli's life is one filled with prodigious scientific achievements (Figure 3.1). He was appointed chair of the physics department at Basel in 1750, a post he served for the next 26 years. He was awarded the Grand Prize of the Paris Academy on 10 occasions for his work in astronomy, nautical physics, magnetisms,

harmonics, and calculus, and he was elected as a Fellow of the Royal Society in 1750. He died in 1782 in Basel.

Figure 3.1. Daniel Bernoulli.

Thought Exercises

What insightful lessons might the reader take away from this tale? For those participating in graduate seminars at prestigious universities, the following discussion points are offered for consideration.

The Bernoulli story as a parable

The whole Bernoulli saga comes across like an ancient Greek morality play—moments of intellectual brilliance—the expansive, noble reaches of the human mind—conflicting the destructive irrepressible force of human emotions—greed, hatred, aggression, jealousy. It's a story of two sides of a coin, on one the grandeur, on the other the ruin of human ambition. In this manner, the true story of filial abandonment in the Bernoulli household serves as a forerunner to a long line of written accounts of the dual nature of the human condition (Robert Louis Stevenson's *The Strange Case of Dr. Jekyll and Mr. Hyde* comes quickly to mind[5]). A dual nature, yes, a seemingly precise description. But still only a description. What lies beneath? One might label it as "the unfathomable mystery of human nature" and retire in confidence.

Writing as if he had the Bernoulli saga in mind, the Australian psychologist Thomas Suddendorf has noted that "The Darwinian perspective on life, with its emphasis on survival of the fittest, appears to suggest that humans, like other animals, should be inherently selfish. In various situations an individual's interest is in conflict with the interests of others, and humans evidently are sometimes willing to hurt each other...We punish violations of our social norms as we try to uphold a polite and civil society; our culture and morality help cultivate less aggressive and more socially compliant behavior. Still, our primitive heritage cannot be denied."[6]

The reader may have noticed that in this historical drama there are no recordings of human emotion. It's like on the stage the actors are wearing painted masks. What were all these people feeling? How did Daniel react when he discovered that his own father was out to destroy his life's work? And, you, the reader, how would *you* feel and what would you do if you were to replace Daniel in this story? And what about Daniel's mother? She's nowhere mentioned. She obviously was witness to the evil doings of her husband with her son and brother-in-law (and one presumes with other colleagues as well). Did she abandon her maternal responsibilities? Where are the tears? The angst? The recriminations? Objects thrown in anger? We are, regrettably, from our distant temporal vantage point left with a drama for which there is no record of any drama.

While his personality remains enigmatic, there exists evidence that Daniel, rather than enraged by his fathers' unseemly behavior, continued to actively attempt reconcile differences between the two. With filial devotion, he had acquiesced to his father's request that he study business, then, medicine, setting aside his own passionate desires to pursue other directions. He in fact collaborated with Johann in a number of important works and

sought out his father has a tutor. In the opening to his *Hydrodynamica,* in fact, Daniel identifies himself as "Daniel, son of Johann."[3]

The Biblically-knowledgeable reader may have by now sensed a certain familiarity here with the parable of the prodigal son—but in reverse. For those not *au courant,* this story (in Luke 15:11-32) involves a father and his two sons. The younger, the profligate one, leaves home after squandering his fortune and wastes his life in "riotous living." He returns, expecting the scorn and punishment from his father, but to his surprise finds a warm loving welcome and a major feast being prepared in his honor. "Unfair!" reasonably exclaims the angered older son, who has behaved well. The father replies that they should be grateful that the younger son has returned with a contrite spirit, and that love should conquer behavioral perfection. To forgive is divine.

In the Bernoulli household it would appear that the forgiving shoe was on the foot of a loving son, who filial devotion outweighed the crass acts of his father. How the brothers (either Daniel's or Johann's) felt about this, and whether, too, there was any consumption of a lipid-laden calf, is unknown. But the readers who might consider themselves deprived of proper paternal love and attention in their lives could extract some valuable lesson from the Bernoulli story.

The Bernoulli story as an exploration into the genesis of human emotions

If the real-life story of the Bernoulli's speaks to an intrinsic dualism—the good and the bad—in the hearts of all *Homo sapiens,* why should this paradox exist? By what explanation can such diametrically opposed beneficial and self-destructive tendencies be ingrained as seemingly inherent, pre-determined behavioral characteristics? Can we look to our genetic heritage as the culpable agent? Or is our cultural milieu to blame?

For biologists, such questions are traditionally submitted to the scrutiny of a Darwinian perspective. That is, characteristics of human beings, be they physical, physiological, psychological, or whatever (maybe even moral?)—should be evident, by accepted biological dogma, as the outcome of a selective process through millions of years, preserving those features that offer a benefit to survival and perpetuation of the species. No problem here assigning this explanation for social altruism, confidence, optimism, love, philanthropy, and so forth. But, one quickly runs head-on into it—how could jealousy, hatred, egotism, and cheating provide for any "survival value"? Most particularly for the topic at hand, what would be the selective

advantage of any early ancestor to act in jealousy by stealing the works of others?

It might be quickly suggested that such an act would be simply akin to the value of thievery. If you don't get caught, it works to your advantage. Indeed, to become a thief is to "enter all the elements which go to form art—vocation, inspiration, fantasy, inventiveness, ambition, and a long and arduous apprenticeship to the science. From it is absent virtue alone…"[10] Daniel's father would gain in his scientific prestige by appropriating authorship of his son's valuable work. But here one has to explain how a father could be so dastardly as to steal from his own offspring. It would seem there must be a deeper pathology at work in this story.

Much has been written in the psychological literature regarding the origins and nature of jealousy.[7] One can read of studies of romantic jealousy, as well as sibling rivalry and jealousy in the workplace, but the jealousy of a parent towards a gifted son seems to be uncharted territory. Laith Al-Shawaf and colleagues at the University of Texas have written about the restraining effect of guilt that should have been expected to be operant in the Bernoulli story. They note that "The more valuable another individual is to oneself, the more weight one places on that person's welfare" and that guilt acts to mitigate any negative feelings toward such an individual (supposedly that would include one's own offspring).[8]

The most popularized explanation for the adaptive evolutionary value of human jealousy lies in the realm of the relationships between the sexes, specifically, that such an emotion bears different selective advantages for males and females. This concept proposes that men react with jealousy in response to sexual infidelity while females more likely become jealous when confronted with evidence of emotional betrayal. In the former case jealousy would serve an adaptive advantage by defending against a competitive lover who might "expend his scarce resources on genetically unrelated children, thus making his own Darwinian fitness plunge. Hence natural selection shaped the male brain to respond specifically to sexual infidelity with intense jealousy—an emotion that would motivate actions to defend against cuckoldry."

In the latter, female jealousy would serve to maintain a family unit (the threat is that the cheating husband might divert his attentions to another mate). That is, the ancestral woman "was not under the same selection pressure to respond to sexual infidelity…Because human children require years of care, [the resources provided by the male] were supposedly critical to her inclusive fitness."[9] The female, then, cared more about commitment than wayward sexual behavior on the part of her mate. (This may have a familiar contemporary ring to it...)[11]

While a good deal of controversy swirls over this idea in evolutionary psychology circles, it would seem to have little bearing on explaining the Bernoulli story. More critical here might be the emotion of insecurity that would potentially motivate Johann to overcome any sense of paternal responsibility in the name of shoring up a defective ego structure. Indeed, some have viewed such self-doubt as an inherent burden of the human condition. They would claim that the acquisition of creativity, intelligence, and imagination as *Homo sapiens* moved away from their primate ancestors on the evolutionary tree six million years ago has bestowed upon them the alternative blessing and curse of self-awareness. And the price of this self-awareness is self-doubt—an insecurity rooted in the face of the struggle to find a personal self-worth or purpose in the universe.[12] Lofty words, but not an escapable possibility.

The Bernoulli story as a milestone in aviation history

The foibles of human behavior notwithstanding, this tale of Daniel Bernoulli stands as a monument to the first efforts to provide a scientific understanding of how mankind might escape his earthly bounds. Not unexpectedly, early attempts at human flight sought to mimic the flight of birds, and early drawings and photographs document a whole series of passionate men flapping wildly some winged apparatus as they launch themselves—often disastrously—off buildings, rooftops, and scaffoldings in front of cheering crowds.[13] As early as the late 15th Century, however, Leonardo da Vinci contended, correctly it turned out, that the idea that birds gained lift by flapping their wings was all wrong. He reasoned instead that such oscillation of the wings was responsible for *propelling* the bird forward, not for creating lift. This was an important observation, for it meant that it would be possible to construct a flying machine that would have a fixed wing.

Daniel Bernoulli, and subsequently others (including his colleague Leonhard Euler) provided the aerodynamic principles by which this could be accomplished—construct a wing in the proper shape of an airfoil. At this time, however, there was little communication between the daring souls who were trying to build flying contraptions and those in the world of theoretical aerodynamics, who had little specific interest in the development of aviation. The German Otto Lilienthal was the first to construct a heavier-than-air glider in the 1890's that would support a man with wings shaped (cambered) as an airfoil. Lilienthal studied the flight characteristics of wings with different shapes and made over 2,000 flights by 1896, when he died tragically in a crash of one of his gliders.

A number of problems remained, and the general skepticism that human flight in a flying machine was physically impossible persisted. First, these gliders had no means of propulsion through the air. Attempted innovations had included clockwork mechanisms, steam engines, and even—for large models—rubber bands, none truly work-able. Second, passengers would nowadays be reluctant to board an aircraft that had no means of controlling the direction of flight. And, then, more lift was needed to transport machine and a human into the air.

It remained for the Wright Brothers to solve all these problems, which eventuated in the first human flight in a power-driven, heavier-than-air machine on December 17, 1903. The power for that first 12-second, 120-feet flight was provided by a light-weight gasoline engine that the brothers had designed and built themselves. They recognized that the amount of lift was governed by not only the degree of camber of the wing but also its angle of attack in facing the oncoming air flow. From their own wind-tunnel experiments they established the optimal design on both counts. But what about lateral control? The brothers realized that this required adjustment of *yaw* (side to side motion) which could be controlled with a rudder but also necessitated *roll* (tipping of the flying machine). The latter was achieved by an ingenious device that twisted the wings such that one wing met the air flow at a greater angle than the other. This created different levels of lift in the two wings, causing the aircraft to bank. (Today's aircraft create the same effect in a stationary wing by the movement of an *aileron,* a small flap that lifts or descends in the opposite direction of the aileron in the other wing to provide differential lift and banking of the airplane.)

Notes

1. With terribly tragic irony, Magee, an RAF pilot, was killed shortly after having written this poem when his Spitfire collided with another aircraft at 1,400 feet altitude. His grave can be found in the Holy Cross Cemetery, Scopwick, in Lincolnshire, England.
2. As the eminent physicist Richard Feynman said in a 1981 BBC television interview, "The prize is the pleasure of finding things out, the kick in the discovery..." Find the entire interview in Feynman RP. *The Pleasure of Finding Things Out.* Perseus Books, 1999.
3. An account of the life of Daniel Bernoulli written by John J. O'Connor and Edmund F. Robertson can be found at http://www-history.mcs.st-andrews.ac.uk/Biographies/Bernoulli_Daniel.html The father-son disputes of Johann and Daniel are summarized by Fye WB. Johann and Daniel Bernoulli. Clin Cardiol. 2001;24:634-635. Jeanne Pfeiffer, as well, has written about the disputes between the brothers Bernoulli (htt://www.jehps.net/Novembre2006/Peifferanglais3.pdf).

4. A major league pitcher can fire a curveball that drops or is deflected in its flight path by as much as seventeen inches, but the degree of that curve depends not only on Bernoulli's principle but also factors such as the radius of the ball, the amount of spin, the speed of the pitch, and the density of the air. Because the latter decreases with altitude, it is harder to throw a curveball at Coors Field in Denver than in Yankee Stadium, and, as contended by the National Aeronautics and Space Administration, almost impossible at the top of Mt. Everest (https://www.grc.nasa.gov/www/k-12/airplane/btraj.html).

   An understanding of the physics governing a pitched curveball has a convoluted history, nicely summarized by William Allman (see Allman W. Pitching rainbows: the untold physics of the curve ball. In: Schrier EW, Allman WF (eds). *Newton at the Bat. The Science of Sports.* New York: Charles Scribner's Sons, 1984, pp. 3-13). Originally, despite the vehement and insistent testimony of baseball pitchers and hitters, scientists claimed that that a "curve ball" did not actually curve at all. That it was simply an optimal illusion. Eventually some better research studies settled the matter, and the scientists gave in. Yes, it really does curve. But then arose another controversy—*where* in its trajectory does it curve? The players have different opinions on this, but most consider that it drops a small number of feet before it gets to the plate. Once again, the scientific community disagrees. When a pitcher throws a curve ball, researchers claim, it curves in a continuous arc from the time it leaves his hand to when it crosses the plate. Again, it's an illusion for the batter that it "suddenly breaks" before reaching the plate. As Allman points out, "If [a ball] travels sideways and there were no gravity….a curveball would form a circle with a more than 2,000 foot diameter, circumnavigating Baltimore's Memorial Stadium and parking lot." That a curveball seems from the batter's standpoint to suddenly drop beneath his frantically swinging bat may be explained by the change in the image of the ball from a focus in the central to peripheral vison of the batter's eye as it nears the plate (Shaprio A, Lu Z-L, Huang C-B, Knight E, Ennis R. Transitions between central and peripheral vision create spatial/temporal distortions: a hypothesis concerning the perceived break of a curveball. PLoS 2010; doi.org/10.1371/journal.pone.0013296).

5. The comparison of the Bernoulli story and Stevenson's masterpiece is not altogether spurious. In the latter, one reads of the respected man of science and medicine, an "admirable humanitarian," whose alternate self enacts unspeakable evil doings. Here the author offers up the duality of human nature in a chilling tale (some have queried whether it was Stevenson's intent to convey a philosophical message or rather simply to recount an entertaining story). As opposed to the Bernoulli's, however, the inseparable good-and-evil here coexist in the same individual. In her Introduction to this story, Laura Levin cites G.K. Chesterton: "The real stab of the story is not the discovery that one man is two men, but in the discovery that the two men are one man" (Levin LV. *The Strange Case of Dr. Jekyll and Mr. Hyde.* New York: Barnes & Noble Classics, 1995.)

6. Read about the defining characteristics that define human beings in respect to the animal world in Suddendorf T. *The Gap. The Science of What Separates us from Other Animals.* New York: Basic Books, 2013.
7. Darwin himself wrote extensively on the subject of the evolutionary basis of emotions. In his 1872 book *The Expression of the Emotions in Man and Animals* he relied heavily on the facial expressions of animals to make the point that emotional states were adaptive throughout the animal kingdom. Observations in the behavior of dogs (at least as viewed by their owners) today seem to bear this out. But some have not been so quick to accept an evolutionary basis for human emotions like jealousy. Christine Harris wrote that "Jealousy could certainly be an innate and adaptive emotion, but its form may be better explained by social-cognitive approaches." (Harris CR. The evolution of jealousy. American Scientist 2004;92:62-71). Vilayanur Ramachandrian and Baland Jalal agreed, calling searches for an adaptive value of emotions like jealousy a "game" which calls for "making observations of human psychology that initially seem surprising, counterintuitive, and apparently non-adaptive and then go on to show there might be a hidden evolutionary agenda" (Ramachandran VS, Jalal B. The evolutionary psychology of envy and jealousy. Front Psychol. 2017;8:1619. Doi.3389/fpsyg.2017.01619). Confusing the matter, others have pointed out that what might have served as a positive adaptive behavior in the Pleistocene Period might be very different from that in today's society.
8. See Al-Shawaf L, Conroy-Beam D, Asao K, Buss DM. Human emotions: an evolutionary psychological perspective. Emotion Review 2015; doi: 10.1177/1754073914565518.
9. These quotes are from Harris CR. The evolution of jealousy. American Scientist 2004;92:62-71. Read more on proposed sex differences in the evolutionary origins of jealousy in Erica Goode's article "Jealous? Maybe it's genetic. Maybe not." in The New York Times, October 2, 2002.
10. This quote is from Aleksandr Kuprin's Russian short story "The Outrage—A True Story," in which the spokesperson for the "Association of Thieves" is extolling the admirable features necessary for becoming a thief (*Great Russian Short Stories*. Minneola NY: Dover Publications 2003).
11. This issue of sex differences in jealousy surrounding mating behavior bears more than just theoretical importance. A jealous spouse (lover, high school boyfriend, etc.) is a potentially dangerous individual, as folklore, popular music, operatic libretti, and an extensive literary canon can attest. It has traditionally been considered that men commit more murders than women out of sexually jealousy. At the same time, males commit more violent crimes than females, and studies in which overall rates of murder are considered, those committed out of sexual jealousy come out to be equal between the sexes (Harris C. The evolution of jealousy. American Scientist 2004;92:62-71). There presumably exists some take-away message here.
12. See Rowland T. *A Philosophy of Tennis. Or, You Kant Be Serious.* The Hague: Kemper Conseil, 2018.

13. The aerospace engineer John Anderson has provided a comprehensive, very readable story of this history of in his book *A History of Aerodynamics and its Impact on Flying Machines (*Cambridge: Cambridge University Press, 1997.

4. MEANING

A SHORT STORY

The more the universe seems comprehensible, the more it also seems pointless."
—Steven Weinberg

"I'm here, Robert. I'm here."

I gently stroked the back of his hand, feeling the cold. The chilly cold of death. He tried to raise his head, but the weakness was too much, and he could only slowly turn his yellowed visage toward me. A body and mind—once a vibrant father, son, husband—were fading into the obscurity of nothingness. His lips slowly formed a faint rictus of a smile. Like soft sighs his breaths came whispered in shallow bursts. I bent forward to take in his final words.

"My friend…I am leaving you." He stopped, searching for my face. "There is just one thing that I regret."

"Wait! Don't tell me," I uttered. "You regret not having spent more time with your family. More time smelling the roses. More time engaging with your life."

"No, no. *Pas du tout.* Come closer." The words were barely audible. "I want to tell you so much. So much that is important. But there is no more time."

I leaned closer to his fading words. "I want you to promise me." What would this be? "Tell my story. Don't let it be forgotten. Let my life be worth something."

I gazed into his half-closed eyes, now clouded with death, but I'm not at all certain if he ever heard or saw me. He had breathed his last. "I will," I promised.

Later that evening in the sad quietude of my room I reflected on Robert's final words to me. Yes, I thought, he was right. In fact, something particularly tragic about a person dying—besides the obvious—is that there rarely is an opportunity given for what one might call a "summing up."

You have this guy who is out playing tennis, or sitting in a jacuzzi, or whatever, and suddenly his heart comes to a stop and he's found cold and lifeless out at the baseline, or floating on the surface, or wherever. He was *there* and then just suddenly he's *not there.* For 72 years he was present, and now for eternity he's not. Just like that, he no longer existed. Meanwhile, at home there are bills to be paid. A dentist appointment for Thursday not kept. Dinner with the Johnsons for which he would fail to appear. A yard that sorely needed mowing. No, just *vitae interruptus*. Done.

There was never a chance to sit down with him for maybe just a half hour or so and ask him some important questions. What did he feel made the "meaning" of his life? In the end, what things were of value and which were not? After all those years he must have formed some ideas. What stories did he have to tell? What secrets had he kept for decades that should now be divulged? How can anyone's life be considered worthwhile without passing along this kind of information? If not, it's just *gone.* Wasted. What did he live for, anyway? So, required, it would seem, should be some kind of *exit interview.* Yes, that exactly it. An exit interview.

Robert's funeral was scheduled for 2:00 in the afternoon to accommodate the concert of the Hampden Chamber Music Society which had been, by a secretarial error at the church, set for 3:30 pm. Unfortunately, that did not provide sufficient time for the musicians to warm up, so the second half of the funeral service was accompanied by the excruciating strains of Bela Bartok's String Quartet No. 4 emanating from the church's social hall next door. (I say "excruciating" not necessarily to demean Mr. Bartok, but rather the deplorable cellist, somebody from upstate named Victor Strumpel, I believe, who was a last-minute stand-in and badly out of tune.)

During the funeral I was charged with providing a eulogy, and when my time came and I strode solemnly to the front, I did an unusual thing. Instead of standing and addressing the audience of mourners, I turned instead and lay my right hand on the polished mahogany (fortunately closed) casket lying next to the lectern. Then, as would later be critically noted, with just a bit of over-theatricality, I spoke directly to the deceased.

"My friend" (dramatic pause here). "Robert, my good friend," I intoned. Now, the experts contend that there exists no such thing as absolute silence, that there always exists some noise around us, even if it's just the sound of blood pulsing through our ear drums.[1] These experts were not there. At that moment, under the dark vaulting ceilings of the First Presbyterian Church on Superior Street, I can assure you, there was absolute silence. Only 10 minutes later did Bartok commence.

"You have left us," I continued. "But you are not gone. Your laugh. Your funny bow ties. Your love of pizza on Friday night. They will never leave me. You are here within me for always."

At this point, as I was expressing these heart-felt sentiments to the deceased, I could not help noticing out of the corner of my eye, sitting attentively in the front pew, a small boy. Maybe 8 or 10 years old. Horn-rimmed glasses. Freckles. A little red birth mark above his left eye. His sandy-brown hair was slicked down, neatly parted and he, too, was wearing a black suit. His gaze caught mine. His thoughts were clear.

"So, you think the deceased is inside the casket?"

I turned to stare at him. "Yes," I sent back.

"How can you tell if he is alive or dead?"

"I can assure you he's dead."

"But how can you tell until you open the casket and look inside?"

"I tell you, he's dead."

"But until you actually lift the cover and look inside, he *could be* either alive or dead, right?"

"What are you talking about, kid?"

"In fact, your looking inside would *determine* which of the two states he actually is in. Dead or alive. But only until you look."

"He's dead. Trust me."

"No way to be sure from where you're standing, mister. Your opening up the lid of the casket and looking is going to define if he's alive or dead. Until the moment you look, he could be either. In advance, right now, his status is uncertain. That is, so to say, in limbo. Only by your choice of making a direct observation can you establish which of the two alternate conditions is reality."[2]

"Dead, I say, kid."

"But before you open the lid to the casket, the chances he's alive or dead, I would say, are exactly 50-50. Right now your friend is in two superimposed states—dead or alive—and only by observing him—by measuring—with your eyes and your brain will you resolve him into one state over the other."

"But that's ridiculous. Of course, I will see him dead—and so he will remain, unequivocally, dead." It struck me here, with not a small amount of alarm, that I was arguing quantum physics with an 8-year old.

"Maybe. A 50% chance, I'd say. And even then you'd be making this judgement based on a an observational apparatus—your senses and central nervous system—as being a reliable measure of reality. But is this always true?"

"I've always thought so. In any case, it's all I've got to go on."

"Then you might just be being fooled. The hard fact is that your brain provides us with only a tiny window of vision in the electromagnetic spectrum. And you hear only a small fraction of the frequencies of vibrations of the air molecules around us. The bottom line is that we are aware of only a tiny portion of any objective "real" world.

What this means, then, is that our reality can only be defined by what our senses tell us. And in defining this reality—your friend as dead or not dead—you're working with a very limited tool."[3]

"He's dead. Really dead. Get over it, kid."

I looked back at him. He was no longer there.

How sad is death! A terrible thing. Not for the departed, who at this point could care less, but for those unfortunates left behind to grieve. And not just for the irrevocable loss of a cherished loved one, no, but for the soul-wrenching realization that life—particularly one's own—is finite. That's why funerals are better, in my mind, than weddings. At funerals one is painfully forced to face the reality of one's humane-ness in the big picture. In our quotidian existence, how often does this happen? Weddings and marriages are something else, less certain.

The reception following the service down in Bailey Hall was unfortunately cut short due to the line of impatient concert-goers who were waiting outside. In an annoying fashion, the strains of the Bartok being practiced next door quite drowned out the bits of conversation over lukewarm beverages and traditional wishes of condolence.

You will recall that Mr. Bartok composed his fourth string quartet in the summer of 1928 in Budapest, a bit of musical departure from traditional major and minor keys, this being an unfortunate error in judgment which has kept him ever since on the outskirts of popular appreciation of classical music. Indeed, it was not clear exactly why this piece of music had been chosen for the concert that afternoon, since the four members of the Indiana University School of Music who make up the complete extant assemblage of those who actually appreciate this composition, were clearly not in attendance, instead sitting home suffering remorse after the Hoosier football team had dropped their sixth straight defeat and were mired in the bottom of the Big Ten (which was actually now, or at least at the time of this event, the Big Fourteen. But who's counting?).

Anyway, during the rehearsal/ funeral reception there was clearly a good deal of disagreement among the musicians, as is not infrequently the case even among professionals, regarding the appropriateness of certain tempos that should be taken. This was most evident somewhere in the first 10

measures, probably at letter A in the score, where the music next door would suddenly stop, a good deal of verbal wrangling could be heard, and when the words "…dumb shit!" were distinctly audible at least twice, which really disturbed, as might be expected, those attending the funeral reception.

Indeed, it was all clearly too much for Agnes Derosiers, the widowed octogenarian and long-time church deaconess, who was serving the coffee (decaffeinated, unannounced) and began softly crying at her appointed post. [Agnes was, needless to say, extraordinarily fragile, not only from her advanced age but from a rather tragedy-prone life that she had borne with courage up to that point. Most particularly, at age 18 she had given birth after a particularly precipitous 20-minute labor to an infant who was quickly, at the time of the delivery, noted to lack a right eye and the central part of the nose on that side as well. Agnes then did what any unmarried pregnant teenager would have done. She wrapped the child, still known only as Baby Boy, in a blanket, and placed him, in typical Biblical fashion, in a straw basket purchased on a Friday night sale at Walmart ($4.95), then set him adrift in the upper end of the Charles River just where it crosses I-95 (previously known as route 128) next to the Marriott (see Figure 4.1).

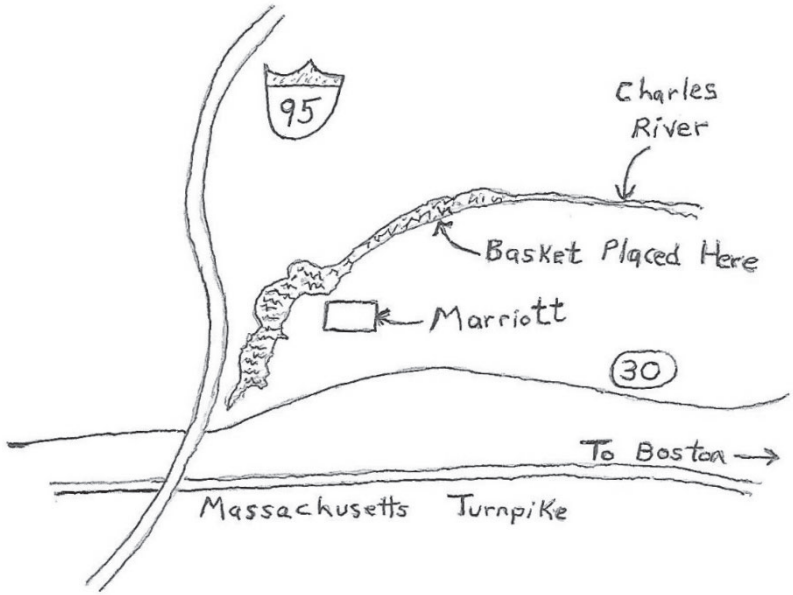

Figure 4.1. Map indicating location where Baby Boy's basket was placed in the Charles River.

There the story departs from the traditional biblical narrative in that, floating downstream, the baby was happily saved from being chopped into many small pieces by the Northeastern University varsity eight, out for an early morning row, when Alfred Krossczek, the alert sophomore coxswain, spotted the baby-in-a-basket and yelled out "Whoa, there!", which experienced rowers know is the signal to cease rowing and look sharply downstream for any floating bodies and/or raw human waste. The rest, as they are wont to say, is history. Baby Boy, who kept this assigned name, went on to play first class goalie for the Harvard soccer team before the Ivy League opponents finally recognized the missing eyeball and started to fire, mercilessly, from his right side, and, well, that was the end of that.]

There he was again. But, yes, different. He now appeared to be altogether older, a young man, maybe just out of college, still impeccably addressed. But, how could I doubt it? The same horn-rimmed glasses, the same parted, slicked down hair, and that birth mark. How could this be? I looked quickly around, but no one else seemed to notice him. He sat alone in a folding chair at the rear of the hall, one of Mabel Hildreth's small cinnamon cakes and cup of coffee perched on his lap. He looked up with those same penetrating eyes, the same challenging look, just the hint of a mocking grin.

"Do you really think you're going to find any 'meaning' to his life?" He fired the question at me quietly, but it arrived like a gentle slap, a challenge to a duel.

I was taken off guard. Just who was this guy? "Uh…well,…yes. I have to fulfill a promise that I made to my friend at his dying bedside. I'm going to tell his story to find the lessons, and maybe, yes, in fact, a meaning of his many years. It just has to be that a person's existence on this planet must have some purpose, that when we pass on that somehow our lives have *mattered.*"

"That's ridiculous."

"Say again?"

"Face it. To any reasonably-intelligent person with a solid elementary school education there is no obvious, objectively-verifiable purpose for a human's existence. None whatsoever. Consider this."

Here he handed me his napkin, upon which he had neatly scribbled the following list:

- Human beings have inhabited this planet for over four million years, yet each of us is here for about 80. And billions of persons just like

you and me have already—and will continue in the future—to share this grand comedy.

- What are the chances that two persons (your mother and father) would encounter each other and procreate? Now multiply this by similar odds of 160,000 couples doing the same thing (that's the ancestor pairs in your personal lineage).
- Hubble has taught us that beyond our own galaxy there exist 100 billon galaxies, and each of these is composed of billions of stars. Experts think that there are probably six billion planets just around the stars in our own galaxy.
- Then there is the disturbing fact that the "you" you're trying to find a meaning for is but a vague shadow of the you that was in existence 10 years ago. Virtually all the body's trillions of cells (neurons in the brain are one exception) die and are replaced on a regular basis. In a decade it's almost a total make-over. So, who are "you" really?

Astonished, I could only stare, speechless. This was a great deal more than I expected to encounter at the reception at the First Presbyterian Church on Superior Street for my deceased friend.

Taking back his list, he continued, staring into my face. "The standard argument for individual meaning when faced with such immeasurable odds holds that destiny (or Destiny) has selected *you* as a very precious special person. But, come on. That's like saying that when a golfer strikes the ball down the fairway, it's going to land on a particular blade of grass, one among maybe millions. 'Wow!' says the blade of grass, 'One out of a million. I am really special!' No, the ball *had to* land on a particular blade of grass. It was just a matter of chance that, young blade, it was you.

"So, how do we confront this otherwise unacceptable meaningless? We create a temporal, immediate 'meaning' within the construct of our own short stay here, one filled with human relationships, satisfaction of work, and those activities that provide us pleasure. Here are few ideas that have been used." Here he handed me back, I swear, the same napkin, but which now quite remarkably contained a different list:

1. Good job, spouse, children, well-kept lawn
2. Almighty God, Jesus Christ, the Pope, others
3. New England Patriots
4. Building houses for the poor in Haiti
5. Drinking. whoring, etc.
6. Philately, oenophile, badminton, other hobbies

Taking back this list, he tucked it into his shirt pocket and slowly rose. "You know, it really doesn't matter at all which one you use. Some do this better than others. They are called the 'happy' ones. Maybe your friend was one of those. Who knows? But, in any event, it's all a façade to keep us sane. Just a small piece of community theatre. A very short play, not particularly well-written." And, then, he walked away and simply disappeared. Finally, I found my words. "But what about God?" I yelled at his disappearing back. A couple of people at the reception turned to stare. "And, and… love? And the human spirit?" But I don't believe he heard me.

The lugubrious notes of the opening measures of the Bartok and the impure shouts emanating from the members of the quartet combined with the presence of death itself and the growing darkness of the late winter afternoon, such that the limits of emotionality had not only been reached but exceeded, as the needle on the gauge of mental angst in that church hall had now crossed far over the Red Line. The uncaffeinated attendees made a quick search for their coats as Agnes broke out into loud sobs, which seemed to actually have a calming effect on the string players next door.

Silence. In the shadows of the gathering gloom only Agnes alone, sobbing. Truly Bartokian.

Regrettably, I must report that I never got around to writing Robert's story. It was, admittedly, more of challenge than I would have thought. He left little written record of his life. He penned few, if any, letters. He did not keep a diary. Robert lived through 25,557 days. In not a single one of these did he discover the cause for cancer, interpret an "unfathomable" mathematical theorem, circle the globe in a balloon, save a drowning person's life. He seemed, at least, to have lived pretty much within the lines, an average existence. Was there, I ended up asking myself, really a "meaning" behind this man's life?

Needless to say, the challenging words of the prim young man at the funeral reception have clung to me, unrelenting. Was he right? Was my failure a proof, a confirmation of his sardonic words? Is it all just a sham? Highly intelligent beings full of self-conceit who are simply let loose for a very brief time on a playground of physical reality? Beings who are insufficiently endowed with a means of understanding the essential truths of the real world? How are we to know the answer? To whom—or what—do we turn?

It should be noted—and maybe I can find solace in this excuse—that in seeking those who could provide me with any insights regarding a "meaning" for Robert's life, an unexpected number were hesitant to come

forward. Some more than others, including seven first-degree relatives who refused to be interviewed (including three who did not actually know that Robert had died), and another two (including Nellie, one of his sisters) who refused to acknowledge that they knew him at all. And then there was Frances Norfwell, my editor at Blackstone Books, whose repeated use of the word "sophomoric" in her reviews of my initial chapters concerning Robert's life struck me as particularly dispiriting.

I felt a certain disappointment, if not existential emptiness, at being unable to finish my account of Robert's life. I will beg the reader's indulgence here in providing as an addendum, so that they are not entirely wasted, the first two chapters that I actually accomplished. Perhaps in these two interviews one can appreciate the challenges involved in truly attempting to a get a grasp on the essence of one person's existence here on planet Earth.

Phyllis Redd, M.D., Neighbor

Robert McGregor was born after an uneventful labor and delivery on April 2, 1943, at Brookside Hospital in Marquette, Michigan, the first child of Sandra and Horace McGregor, shortly after the couple had installed themselves in a small gray clapboard house on the lower end of Eastside Avenue. The couple had rapidly become close friends with Dr. Redd, their neighbor to the immediate north, a divorcee whose busy urologic practice was located just two blocks distant. Besides serving as the first female urologist in the Upper Peninsula, Dr. Redd's life had been marked by two curious events. First, at Brookside, the code for the presence of a fire in the hospital was the announcement over the public address system of "Paging Dr. Red, paging Dr. Red." Predictably, then, when she had first arrived on the scene, and until the problem was satisfactorily rectified, every page for Phyllis caused the entire building to be evacuated. The difficulties this presented hardly need recounting, but consider, for a quick example, the plight of Dr. Evan Samuelson, thoracic surgeon, who was, on each occasion, 35 minutes into cardiopulmonary bypass during a coronary artery graft procedure. (This served particularly vexing to the good doctor, since one week previously the smoke from a neighboring house fire had somehow infiltrated the hospital's intake vent, causing the operating room to fill with a gritty smoke, consequently limiting the descending visibility to 3 feet and obscuring his (Dr. Samuelson's) direct vision of both the patient and the now rather agitated anesthesiology resident whose attending physician had just gone for coffee.) Secondly, the widely-circulated story went that Dr. Redd had provided, as an undergraduate at Brown, an oral

sexual service to not one but actually two members of the Sigma Chi Epsilon fraternity on that building's back porch on the same evening. This was never confirmed true or false, but it made no difference, for, unfortunately, the stigma clung to Dr. Redd for the remainder of her life.

The wall of the urinary bladder is composed of a two-layered muscle called the "detrusor muscle." As urine collects in the bladder, it (the bladder, that is) stretches, and when the pressure rises sufficiently (up to 100 cm H_2O), excitatory parasympathetic nerves originating in the sacral region of the spinal cord and the hypogastric plexus fire to cause this muscle to contract—that's called the "micturition reflex". Meanwhile muscle guarding the exit of the bladder, sphincters normally in a constant state of tetanic contraction, relax, and—*voila!*—a steady of stream of urine flows out the urethra.

I tell you all this because it's important to know in appreciating the event of my first meeting with my new neighbor Robert. He was just four days old at the time, and the McGregors had invited me over to view the new arrival. As I entered the living room, ready to express joyful gushes as I approached the bassinette, I fell back in amazement as there suddenly shot from within, straight up, like out of a fireman's hose, a powerful jet of yellow.

"Holy s—-!!" exclaimed Mr. McGregor.

"Gee whiz!!" said Mrs. McGregor.

Ah, Golden Elixir of Life!! Someone else let out a shriek, but the general sense of emotion in that living room was one of dumbstruck awe. Detrusor City! (It was later claimed, when this event was recounted predictably at each of future family gatherings—particularly at Robert's 40th birthday party—that this geyser of urine had actually reached the ceiling, leaving an ugly, Rorschach stain. This was actually claimed to represent, by one raconteur, two pygmies dancing or maybe in some questionable embrace, but by others as the confluence of Tigris and Euphrates at high tide. Heavy arguments have ensued over this issue, but I was there, and, no, I can confirm that this magnificent spout attained a height of about eight or nine feet in altitude, but the ceiling had been spared. Just for a bit of comparison, I later had this event re-played in his privacy by a 60-year old male acquaintance of mine, who, reportedly free of prostatic restriction, informed me that even after a bladder-distending evening of four beers, two coffees, and sitting in 28-degree weather at a November high school football game he could only achieve a height of approximately 18 inches. That seems about right to me. Male readers may wish to discretely verify this on their own. Please contact me if you find my friend's report to be spurious).

As I then gazed at the Pamper-less young Robert lying on his back I swear he looked me in the eye and then actually emitted a sly grin. In the usual four-day old infant this might attributed to a bubble of gas trapped in the splenic flexure of the colon, or maybe reflex facial muscle contraction, but I knew better. This blast, this eruption from the unfettered bladder was young Robert first purposeful, glorious, in-your-face, unfettered expression of personal freedom.

Warren Kimball, high school basketball coach (AKA teacher of twelfth grade science).

Warren Kimball coached the boys' basketball team at Eastside High for 35 years, which included two 13-2 seasons in the mid-60's and a runner up finish each of those years in the state Class AA tournament. Coach Warren was famous for showing movies to his science class of the previous Friday's game when interest in the neuroanatomy of the common earthworm grew thin. He relished, particularly, explaining to the class the nuances of his diamond-and-one zone defense (see Figure 4.2). But even more renowned were his locker-room pre-game pep talks that had quickly achieved an iconic reputation. Typically, as surreptitiously transcribed by reserve forward George Cliffe, they went like this: "Okay, guys, listen up. I want to you play hard out there tonight. Play like you really mean it. Watch the ball. Don't run without dribbling. Jump for rebounds. Got it?" The team nodded solemnly in unison. "And guys, this is important." Here he paused to stare meaningfully into the eyes of each individual player. "I Want You to Have Fun. Because it won't be too long before you're out in the real world. Out where it's not fun. You'll get married, have three kids, buy a 3-bedroom colonial out in East Rockaway. There'll be a mortgage, bills to pay, a boring job. And, then, late one night you'll look yourself in the bathroom mirror and you'll ask yourself, 'What's the meaning of all this? What value is my life?' And you won't have a good answer. You'll get depressed, disillusioned, and then you'll start drinking, avoiding your wife, missing PTA meetings. Eventually, one day there will come a crisis point, probably over something fairly minor, like you take the Connecticut Commuter Rail into the City to visit the Guggenheim, only to find the line for tickets is a block and a half long. You will be found sobbing hysterically in the middle of the street, 'Is this all there is? Is this all there is?' Anyway, have fun out there tonight. And remember, guys, it's only a game."

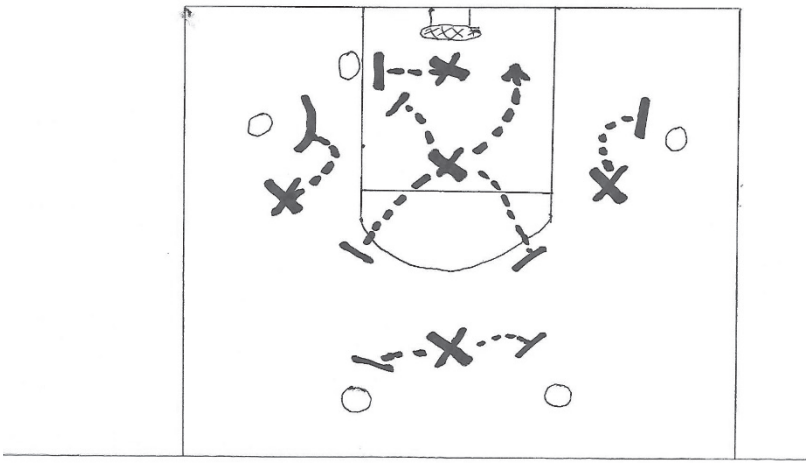

Figure 4.2. The famous diamond-and-one basketball defense.

Ah, yes, Robert McGregor. Who could forget? Probably the best little guard I ever coached in all my time at Eastside High. A keen sense of the game. Great hands, quick moves. A hard worker. Our top scorer. He'd stay after practice and shoot free throws for hours. A real team player. And then, one day, something happened. I didn't understand it then, and I still don't today.

It was during a home game against Owosso High. A particularly bitter cold February night. We were leading at half time by a score of 38-32, and it was all because of Robert. He was incredibly hot, having scored 30 points in the first two periods. Sometimes four or five baskets in a row. I tell you, I've never seen anything like it! Jump shots from the key, three pointers from two feet beyond the arc, hook shots, even two-handed set shots from the corner. He just couldn't miss.

At half time I tempered my usual emotional pep talk because what I really wanted to say (but, of course, didn't) was, "Just feed Robert the ball and we'll win!"

As the team exited the locker room to take on the second half, one player remained, seated motionless, head down on the bench, a towel around his head. It was Robert.

"C'mon Robert, time to take on the second half!"

There was a long pause. Only the drip, drip, dripping of the shower faucets.

"I can't go out there."

"Uh, why not?"

"Because existentialism is dead."

"What?"

"It's dead. All that stuff about being responsible for your own fate, of being able to create your own future, of having the freedom—and the responsibility—for your own actions, your own pathway in life. It's just bogus."

"Bogus?"

"Our minds are just driven by electricity and chemical reactions, you know. All those MRI studies show that that it's just centers of metabolism in the brain that control our thoughts and actions. Things which are established by our genes and molded by our culture. It's all out of our control. Our will has nothing to do with it. There is no mind-body dualism. We're just fooling ourselves if we think we have a separate mind, or spirit. I just can't go out there and face the hypocrisy. The game's outcome, how many points I score—it's all been pre-determined. I'd be just playing a role in a movie, already filmed. My destiny is not under my conscious control."

"But maybe your destiny includes a full basketball scholarship ride to places like Duke, and Kentucky, and Kansas?"

"Blue Devil, Wildcat, or Jayhawk—it would make no difference. I would only be an automaton, bereft of spiritual meaning."

Well, Robert never played the second half, and we lost by a dozen points. I don't think he ever touched a basketball again.

Notes

1. Whether or not there exists a condition of absolute, total silence has long troubled scientific experts. If so, this would mean a total cessation of patterns of vibrations in the molecules of the air reaching the ear and auditory apparatus of the human brain. (This, of course, presupposes a resolution of the classic conundrum of when a tree falls in a forest with no human presence, does it make a sound?) George Michelsen Foy, in his book *Zero Decibels. The Quest for Absolute Silence* (Scribner, 2010), provides an exhaustive exploration into issue. At a point five pages from the end, a conclusion is reached: our brain does not permit the existence of silence. "For the brain, there cannot be an environment without danger or prey, or void of the sound that flags them. In the absence of objective outside sound, therefore, the brain turns up the gain on its own amplification system until the buzz of our organic capacitors fills the wiring and gives our auditory sensors the input they crave….On some profound stratum the body knows that hearing is not only a tool for survival, it is a signal of life. To hear something is to be alive, to make sound is to live. To be perfectly silent is to be perfectly dead."

2. The boy in this story is a sly stand-in for a young Erwin Schrödinger, the Austrian physicist who, in 1925, took leave of his wife and travelled to the Swiss mountains for a Christmas holiday with his mistress. There, assumedly among other pleasures, he shook up the physics world with a wave-particle equation which served as part of the foundation for the new wacky subatomic world of quantum mechanics. This eventuated in a thought experiment involving a cat in a closed box who is described as being simultaneously dead or alive, depending on the unpredictable nature of a radioactive atom which would (or would not) cause the release of hydrocyanic acid and kill the cat. The point here, a bit tongue in cheek, is that this scenario involves a simultaneous contrary existence which is resolved into two discrete realities—dead or alive—which we are familiar with in our macroscopic world of every day existence. But in the domain of quantum mechanics things are not that neat, and in that bizarre world the cat's fate is a "blurred reality," which, as Schrödinger himself wrote, is "smeared out in equal parts." Confused? You're not alone. "Interpreting quantum mechanics is one of humanity's greatest challenges" wrote Robert Crease and Alfred Goldhaber in their fascinating book *The Quantum Moment* (W.W. Norton & Company, 2014). And then there's always the quote attributed to Niels Bohr, "Anyone who is not shocked by quantum theory has not understood it." For those readers needing assistance, try Crease and Goldhaber as well as Michael Brooks' concise discussion in *The Big Questions. Physics.* (Metro Books, 2010).
3. Our young heckler here is channeling the Eighteenth Century German philosopher Immanuel Kant, who contended that "we can't really know how the world is, that all we can know is how we perceive it…We only have access to how things appear to us. How things are in themselves is something we cannot know." Much more recently, the neurobiologist Dean Buonomano spoke to this in respect to a single issue, the understanding of the nature of time. "Our ability to answer questions pertaining to time is constrained by the nature of the organ asking them. Although the gelatinous mass of 100 billion brain cells stashed within your skill is the most sophisticated device in the known universe, it was not 'designed' to understand the nature of time" (*Your Brain is a Time Machine.* W.W. Norton & Company, 2017). One is skeptical as well that the human brain will ever be able to conceive the extraordinary intricacies of the inter- and intra-system relationships that constitute complex systems in living beings (e.g. the title of a 2000 editorial in the journal *Nature*: "Can biological phenomena be understood by humans?"). Contemporary thinkers have become convinced, too, that the human brain is, in fact, capable of subconsciously *creating* a reality which is independent of "how things a really are," even as they appear to our cognitive minds. Can we be fooled by our own brain? The problem here is that in trying to resolve this question we are utilizing as a tool the same mechanism whose very veracity we are questioning! That, how would we be able to tell?

Entr'acte I

Créativité et Le Petit Déjeuner

It might be said that the fact that human beings are distinguished from other members of the animal kingdom by their superior intellectual capacities serves as the centerpiece of the "human condition," and this provides the basis for uniquely human behavior. This means that we—or at least most of us—possess self-awareness, the ability to reason, recognize faces, make decisions, form thoughtful opinions, learn, calculate, and so on—all abilities that far exceed that of the even the most advanced sub-human primate. The question of just *why* we are so endowed makes for fascinating speculation. In particular, is this sticking point: from a Darwinian standpoint, how are some of these qualities to be explained? That is, what might constitute the survival or reproductive value of, to take some obvious examples, completing a *New York Times* cross word puzzle, playing "The House of the Rising Sun" on folk guitar, or memorizing the value of π to 10 decimal places? Your average gibbon cannot do these things. Why can you?

Too, there exist certain problematic disadvantages of human self-awareness that one could easily interpret, to the contrary, as serving as evolutionary pitfalls. Human beings are the only animals that walk around all day aware that within a foreseeable date in the future they are going to die. We are ephemeral creatures, and, sadly, within two hundred years' time no one will even remember us. The unpleasant realization is that, inescapably, we will no longer exist.

Along the same lines, it has been suggested that human self-awareness exists at the cost of a penetrating sense of self-doubt. Such lack of self-confidence, that one is just a useless fraud, can be crippling, even when there exists objective evidence to the contrary. That's been labelled "Imposter Syndrome,"[1] a phenomenon which is proposed to affect, to some degree or other, a majority of our species. In any event, these downsides to possessing the human intellect can pose serious problems of unhappiness, depression, and risk of suicide.

But, back to happier thoughts. The pinnacle of human intellectual capacity is man's inventiveness, his ability to create. Indeed, the advances

and even survival of our species would have been impossible without imaginative minds figuring out how to avoid climatic extremes, form cooperative communities, prevent and treat illness, and provide for communication. In the arts, equally obvious, the expansion of imagination in painting, music, and literature has pushed successively over time the boundaries of expressing and interpreting human emotional experiences.

But how does this creative process by the human mind work? At the time of this writing, no one has figured it out. Most investigations on the subject have simply analyzed the mind-set, life experiences, and personalities of highly creative individuals, but no consistent theme has emerged. For every highly-introverted, neurotic artist there exists an example of a warm, loving, happy genius. Some had happy childhood experiences, others cold distant parents. And so on.

There has accumulated in this literature, however, an identification of certain means for best stimulating imaginative thought. Much of such inspiration appears, in fact, to appear "out-of-the blue" and has been suggested to reflect the heavy input of the human subconscious, or, if you wish, a benevolent *muse.* For sure, "creativity goes on in varying degrees of intensity on levels not directly under the control of conscious willing."[2] So, just how should one unlock that creative genius that lies behind the cognitive scene? Here are some suggestions.

Seek solitude. As the Nobel-Prize-winning physicist Richard Feynman contended: "To do high, really good physics work you need absolutely solid lengths of time, so that when you're putting ideas together which are vague and hard to remember, it's very much like building a house of cards and each of the cards is shaky, and if you forget one of them the whole thing collapses again. If you're interrupted and kind of forget half the idea of how the cards went together, it's easy for [the house of cards] to slip. It needs a lot of concentration and a solid time to think."[4]

Focus intensely on a creative problem, then seek distractions to allow time for the muse to work. "Unconscious insights and answers to problems that come in reverie do not come hit or miss. They may indeed occur at times of relaxation, or in fantasy, or at other times when we alternate play with work. But what is entirely clear is that they pertain to those areas in which the person consciously has worked laboriously and with dedication."[2]

Avoid marriage. "It could reasonably be argued that if [Kant, Wittgenstein, and Newton] had had wives and families, their achievements would have been impossible. For the higher reaches of abstraction demand long periods of solitude and intense concentration which are hard to find if a man is subject to the emotional demands of a spouse and children."[3] (But, a cautionary note here: "[Isaac Newton] was avoidant of personal relationships,

protective of his work as his primary source of self-esteem and personal fulfilment. In addition, he suffered overt mental illness."[3])

To these suggestions the author, based on personal experience, begs the reader to consider yet another key to unlocking the creative imagination—the enjoyment of a good breakfast. One confesses that such a mechanism is not well-explained. "Just how such a breakfast should stimulate creative juices is not altogether clear. The research literature is not large. One might accept simple explanations such as replenishment of carbohydrates, the biochemical effects of caffeine, or presence of a good morning companion. There is reason to suspect, however, that more sophisticated mechanisms are at play: a triggering of central neurotransmitters by maple syrup, of example, or a preference by the Muses for Swiss cheese omelets."[5] Based again simply on personal experience, the author is willing to divulge one particularly effective breakfast restaurant where a sleeping, or at least reluctant, muse might be awakened.

Sylvester's Restaurant is located on Pleasant Street in Northampton, Massachusetts, just before you get to the main town intersection. Here delicious specials like almond cranberry banana walnut French toast and artichoke and cheese omelets are served up by a smiling and efficient wait staff in an ambience both warm and welcoming. Smith College is just down the street, so the clientele is highly academic, and serious conversations regarding pivotal philosophical issues can often be easily overheard.

So, the setting is perfect for even the most reticent muse. But, this particular restaurant has something additionally going for it besides a hearty breakfast. It has a ghost. Yes, a ghost, and you'll be enjoying your helping of pecan waffles in what was once his living room. Here's the story:

The restaurant, as indicated by its name, occupies a building that was previously the home of Sylvester Graham, an eccentric Presbyterian minister and outspoken lecturer and author in the mid-1800's who promoted vegetarianism, temperance, and the consumption of home-made bread made from coarsely-ground whole wheat. (You guessed it—the latter became the graham cracker.) Graham was a zealous reformer, but his vociferous promotion of simple eating habits angered the butchers and commercial bakers of the day, who suffered financially from his preachings. Others were put off by his conviction that sexual desire was an irritant to the body and created disease. (Graham was emphatic, in fact, that masturbation was a cause of blindness.)

Graham moved to Northampton in 1823 after having being kicked out of Amherst Academy (now Amherst College) after being accused of sexual assault on a female student. Some have felt, however, that this was just a ruse to get rid of this arrogant, contentious character described by a

newspaper account as "a greater humbug or a more disgusting writer never lived." There were rumors, too, that despite his forceful advocacy of extreme dietary moderation that he would not infrequently sneak off to indulge in a beef and mutton meal at a Northampton hotel.

Whether Sylvester Graham was a genius or humbug, then, remains open to question. But, the presence of his ghost as one indulges in a rapturous breakfast in his former living room (or even just a graham cracker sandwiched with chocolate and marshmallows) might just provide the best hope of awakening one's creative impulses.

Notes

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5. SUICIDE

There is but one truly serious philosophical problem, and that is suicide.
—Albert Camus

On August 11, 2014, sometime in the nighttime hours, Robin Williams walked into his bedroom closet, tied a nylon belt around his neck, and killed himself.

The immediate thought, why? How can one make sense of this terrible act by such a beloved comedian and actor? In the days and weeks that followed, the social, written, and video media engaged in an outpouring of rumination: Just what underlay this human tragedy? Was it overwhelming depression? Or a matter of drugs and alcohol? The dangers of Parkinson's disease? Or, as many saw it, was the comedian's suicide the classic example of the "sad clown"? The guy who hides his despair behind the mask of merry-making. A façade that belies a tormented soul. An unfettered mind that explodes in mirth but can't control his own self-cannibalistic demons.

Well, maybe. The "sad clown" makes for a good story. It lends a certain credence to what otherwise would be a most disturbing unexplained event. Random inexplicable tragedies threaten our sense of security. We are comfortable (even if saddened) only in what makes sense. We search for a comforting reply to the question of "why." A re-assuring explanation. Otherwise life is a dark threatening place. There really are monsters under the bed. There are demons that might force us, as well, to self-destruct.

We all need rationality in life. And the sad clown story would seem to be a conveniently credible one. But how can one be sure about that? According to the people who occupy themselves with knowing such things, the same week that Robin Williams reached his end there were 900 others in this country alone who elected to die at their own hand.[1] The information is not available, but one could reasonably guess that it wasn't likely that there was another comedian, or a clown, among them. The point is that we shouldn't be too quick to accept our pre-conceived notion of things, to grasp at facile explanations.

No matter. He was gone, and it was a terrible thing. And as frequently happens, the self-inflicted death of a famous individual brought into focus bigger, unanswered questions regarding what it means to voluntarily bring

an end to one's own life. To make a glorious—if by this one means "shocking"—exit.

Think about it a minute. Here was a choice *not to exist.* Ignore for a moment all the other possible options that one's death might bring: a) in a posthumous fashion one arrives at an elysian utopia not dissimilar to an upscale weekend in Palms Springs, or b) a re-incarnation, perhaps as an alternative life form, or maybe c) a *Ground Hog Day* kind of eternal recurrence popularized by Nietzsche in which one keeps living the same life, over and over again. Face it, these are really highly unlikely. (Indeed, if you are a God-fearing person, the first option is particularly untenable. Ever since St. Augustine, Religion has contended that suicide is an act of the Devil, a defiance of God's laws, and you know where that gets you.) No, these bits of fanciful thinking can be readily dismissed and the hard facts of the matter confronted: You were nothing at the start and you turn back into nothing at the end.

Now, there's no question that it takes a conscious, concerted effort to commit suicide. One needs to know the train schedule, be aware of the depth of the water, be able to locate an ammunition store that's open on a Sunday afternoon. In my house I know it would be difficult to immediately find a stool of the appropriate height, not to mention a belt of sufficient strength. So, all this means a conscious premeditated effort…but to become nothing? I mean, it's not like when it's over that you're going say to yourself "Whew! Now *that's* better!" No, simply, *vous n'existez plus.*

So, the overwhelming odds are that in ending your own life you would simply become, well, *nothing.* But what does this mean, *nothing*? The question has been hearty fare for thinkers since antiquity. Let's start with this experiment. We'll pause for a moment in this discourse to give you a chance to try to picture in your mind this *nothingness.* Let's see if you can mentally image your being nothing after you "pass on." Go ahead……

Right. It's really quite impossible. Goethe said this. One's mind simply cannot comprehend its own non-existence. Granted, that does not necessarily prove a post-death nothingness. As Jim Holt has pointed out, one should not "mistake a failure of imagination as an insight into reality" (that's called the "philosopher's fallacy").[2] And there are, of course, those people who feel that the soul (or maybe the mind) is a separate entity from the organic materials and biochemical reactions that contribute to the function of your brain and the rest of the body. And that, by consequence, the former can continue to exist, holed up somewhere else after your body ceases to function at the moment of death. But, really, lacking any truly

verifiable evidence of any communication with these exiled souls, this all seems rather far-fetched.

That at death the body moves on to nothingness, but the soul moves on to better things? One would be on pretty shaky grounds with that idea. No, sorry, but, basically, instead, it would seem obvious that the electricity is just turned off. You become nada. Zip. Nothing.

But, to persist with the query, what exactly *is* nothing? Thinkers have long been disturbed over the issue. It doesn't immediately seem that this would be so difficult. After all, *nothing* is the absence of *something*, right? (Reference Macbeth, who concluded that "nothing is, but what is not.") But maybe it's not that simple. For example, it has been argued that "nothing" is a noun, and as one is trying to define "it" that "nothing" must be "something." And just try finding a clear example of "nothing." Outer space is almost all "nothing," but in fact is replete with energy, fields of attraction, and, in Einsteinian terms, is part of a space-time continuum which involves warping of a fourth dimension (hard to argue that…). And the interior of the atom, again almost completely "empty"—but with the same kinds of "contamination". How about a vacuum? No, always some particles there.

In fact, it could be argued that human death is the only possible true expression of nothingness. As Holt emphasized with such entrancing pessimism, "our existence issues from the abyss of nothingness and ends in the nothingness of death."[2]

The person who commits suicide has "elected" to hasten the process. Why? Holt goes on to ask "What if your life contains no goods? What if it's a life of unremitting agony or unendurable tedium? Isn't non-existence then preferable"? Again, maybe. But, again, it's hard to reconcile the fact that there is no "advantage" to nothingness, to not existing. And, so, there is no answer to the question. Unfortunately, the only people who could provide first-hand insights into the dilemma are not available for interview.

This is all an interesting way of beginning to think about the "rationale" for committing suicide. But perhaps there exist deeper layers of explaining away the act of ending one's life. And, as we shall see, there is growing evidence that biological factors, including those driven by genetic mechanisms, may predispose to suicidal behavior.

Losing the "Meaning" of Life

Everyone feels a need to think that everything in life, including life itself, and our existence in it, has a meaning. A purpose. An *explanation.* Without meaning, it's a terrifying place. That would be unbearable. But, setting aside ideas of destiny, faith in a divine controller, and other similar forms of

wishful thinking, one must face certain realities. The reader encountered these earlier in this book in chapter 4 but such realities bear repeating here.

First, there is the fact that our time "on stage" is extraordinarily brief. Over the 4 million years in which persons resembling human beings have inhabited this planet, each of us is here for about 80. A quick calculation reveals that if the history of human beings on Earth lasted the equivalent of one day, your lifetime would flash by in about 1.3 seconds. Consider, too, that already billions upon billions of individuals have already—and will in the future—play similar bit parts in this grand comedy.

And then there is the issue of your unique heritage. What was the chance that two people (in this case, your father and mother) would meet, fall in love, get married, and decided to have children? That they, by chance, would attend the same party, sit next to each other in grade school, catch the same a bus on a certain Sunday morning, and so on? Now, to those slim odds have to be added those of the 160,000 other couples (the total number of your ancestor pairs since humans first walked the Earth) with the same incredibly small odds. The chance of your parents having *you* occurred that many times before. Incalculable odds, to be sure.

If those odds are not staggering enough, consider this. Information from the Hubble telescope peering into the far reaches of outer space indicates that there exist 100 billion galaxies in the known universe, and each of those contain hundreds of billions of stars. And based on observations at the time of this writing, it has been estimated that there exist around six billion planets the size of Jupiter around these stars just in our own galaxy. The statistical chance that you would happen to inhabit a particular one of these that provided you the right milieu of respiratory gas, temperature, and solar energy—in a "Goldilocks" orbit just the right distance from the sun—is beyond comprehension.

The statistical odds of your existence at this time in history, then, involves so many decimal places that to consider your brief presence, among that of the many billions of others, has some inherent "meaning" would seem to be a supreme expression of human conceit. The reasonable person with only a moment's reflection would have to conclude that, given these realities, it would be incredibly egocentric to conclude that a certain person's life on Earth has a "purpose." Face it, the blunt truth is that a human's life has no intrinsic meaning or purpose.

This is not just this author's opinion. A goodly number of the world's greatest intellects have shared this conclusion. Take Edward O. Wilson, the eminent biologic scholar, for example. He contended that

> "We were created not by a supernatural intelligence but by chance and necessity as one species out of millions of species in Earth's biosphere. Hope and wish for otherwise as we will, there is no evidence of an external grace shining down upon us, no demonstrable destiny or purpose assigned us, no second life vouchsafed us for at the end of the present one. We are, it seems, completely alone. And that in my opinion is a very good thing. It means we're completely free."[3]

In saying so, Wilson was echoing the sentiments expressed earlier in history by Albert Camus in his essay "The Myth of Sisyphus":

> "I don't know whether this world has a meaning that transcends it. But I know that I do not know that meaning and that it is impossible for me just now to know it. What can a meaning outside of my condition mean to me? I can understand only in human terms. What I touch, what resists me—that is what I understand. And these two certainties—my appetite for the absolute and for unity and the impossibility of reducing this world to a rational and reasonable principle—I also know that I cannot reconcile them. What other truth can I admit without lying, without bringing in a hope I lack and which means nothing within the limits of my condition?"[4]

And, quoting the Bard himself

> "What a piece of work is a man! How noble in reason! How infinite in faculty! In form and moving how express and admirable! In action how like an angel! In apprehension how like a god! The beauty of the world! The paragon of animals! And yet, to me, what is this quintessence of dust?"

And so forth.

So, all these authorities are in agreement. The blunt truth is that our existence on Earth, to all evidence, is totally meaningless. But they are also in accord that this is not all that bad. Don't despair!, they say. In fact, it's to our advantage, since we are thereby granted the freedom to create a meaning of our own choice, not one designated by the dictates of some grand universal design. Indeed, Camus was of the opinion that the failure of explaining human existence by any recognizable greater universal purpose was to be met with *optimism*, since "[life] will be lived all the better if it has no meaning." That is, by man's conscious will he can formulate his own purpose, forge his own destiny, not by the whim of something somewhere but by his own volition. And, according to Camus, "can" is not the correct word here, but, instead, the true man is "obliged" to create his own meaning in life (Nietzsche thought so, too). Since the world is meaningless, he said, we are free to become whatever we wish. To construct our own purpose for

being. That act, which Camus perceived as a "revolt" against the inherent absurdity of the universe, "gives life its value…it restores majesty to that life."

So, with this question of the intrinsic meaningless of life now settled, we can move on. How do we deal with this? Here's what we do. We (or the culture that surrounds us) seek to construct our own individual sense of purpose, of value. And we accomplish this by identifying those activities and functions with bring us *pleasure.* Pleasure brings meaning to our lives. Now, immediately it must be stated that this is not the hedonistic pleasures of the flesh that the term might immediately come to mind. No, here "pleasure" means something that provides you happiness, a feeling of accomplishment, that gives one the impression that his or her life is worthwhile.

For some it's belief in a righteous God. For many it's the love and commitment to family. For others it's the satisfaction of good work. Or the passion for contributing to the welfare of others. There exist many possibilities. But the point is, each of these intrinsically has no value, no meaning, except in the pleasure they give to individuals who chose them. None are "better" than the other. Jack Kerouac or Ozzie and Harriet—it's up to you. In a world that is intrinsically meaningless, you create your own meaning, making your existence meaningful, by finding what—to shamelessly employ a well-worn nautical expression—"floats your boat."

[Granted, such choices may not commonly be "active" ones. If you're an average American, you grew up in a family, were inculcated to its values, fell in love, got married, had children, pursued a career, took on the responsibilities of home ownership, contributed to meaningful charities, and so on. *Le voila!* Self-packaged "meaning." And for most, that's sufficient. Good! But that doesn't mean you weren't free to take other pathways toward establishing a sense of purpose for your life.]

Now people are generally successful, for the most part, in maintaining a sense of self-worth through such choices. But, as film-makers, playwrights, and authors have often fed upon, most people are left with a gnawing sense that there is "something else," a feeling of a lack of fulfillment, of not having attained a true understanding of the meaning of life. But, as Ernest Hemingway clued us in, it's in truth a false myth. Beyond what we have is really "nada."

So where does the suicidal person fit into this picture? Maybe he or she sees through this "self-deceit" on the part of the rest of us to construct these contrived means of creating a meaning for our lives. "It's all fake!" he cries. The path to suicide may lead in a painful awareness an absolute truth—we live our lives in a meaningless universe—or at least, in the artificialness of

a self-created one. Failing to achieve the latter, one is faced with the unacceptability of the former. Suicide is a construction problem—at a price. What we have here is a failure, at least in the eyes of the suicidal, to satisfactorily fabricate a self-convincing purpose.

It is commonly stated that persons who commit suicide has "lost meaning in life." Perhaps that's correct, in the sense that these people have failed to create a satisfactory meaning of their own. But, in truth, there is no meaning to be "lost," only the inability to successfully create one for one self. A failure in construction, then, is sufficiently terrifying to seek an end to the pain of meaninglessness. In Camus' opinion the suicidal act as an apparent revolt against the meaningless of life was the exact opposite of the kind of revolt that the true individual should make. The essence of being human, he thought, was the expression of a conscious revolt against his existence as being part of a universal absurdity. It's this kind of revolt that gives life its value. It takes courage, but one has the freedom (and, in fact, responsibility) to do this. The suicidal person has denied his gift. "It is essential to die unreconciled and not of one's own free will," he said. "Suicide is a repudiation….[the true person] knows that in that day-to-day revolt he gives proof of his only truth, which is defiance…[Suicide] follows revolt—but wrongly. It is just the contrary by the consent it presupposes."

So, the bottom line—you're free to pick your meaning. But do pick. Without a self-constructed meaning, the demons are waiting.

Here's another perspective on this. The ability to create a satisfactory meaning for one's life could, in fact, be viewed as a kind of Darwinian survival mechanism. Without this capacity, a meaningless existence would become unbearable, leading to—suicide. The person who commits suicide could then be explained as suffering from a kind of "mutation," one that causes him or her to be lacking in this ability, which is, for most of us, an intrinsic outcome of an evolutionary process. If we did not possess this capacity for a kind of self-deception, this ability to create a satisfactory value for living, we would all be overcome by overwhelming anguish and a drive to self-destruction. So, goes this thought, by a Darwinian mechanism, the great majority of us are equipped with the capacity to create a meaning for our lives as a survival mechanism. (But, the astute reader is quite to observe, if this were true, all such persons who were incapable of self-constructing a purpose in life would soon die off, and, consequently, the "mutation" and suicide would disappear.)

Depression

What else? Certainly, there's *depression.* People are expected to commit suicide in the throes of, or as a consequence of, serious levels of depression. But what *is* depression? Already from the start we have a difficulty here, since even the experts aren't entirely clear on this. "Let us make no bones about it," wrote Andrew Solomon. "We do not really know what causes depression. We do not really know what constitutes depression."[5]

So we use our words: people who are depressed are oppressed by feelings of sorrow, hopelessness, despair, despondency—a lack of energy for life. At any dinner party, the depressed person at the end of the table might be likely to be emotional withdrawn, sad, emotionally empty. He or she will suffer from poor sleep, lack of appetite, social isolation, an inability to function. In fact, while lacking a precise definition, every reader of these words has some sense of what depression means. That's because each of these same readers has themselves experienced feelings of depression, at least transiently, in the mood swings of daily life. Like the weather (now soft and sweet Spring mornings, then violent tempests, later oppressive heat) our humors change. We all "get the blues now and then."

Sometimes this is triggered by a disappointing event (the 22-year old new employee is unexpectedly named assistant office manager, jumping over you on the corporate ladder). Sometimes such feelings seem to occur just in the normal ebb and flow of one's mental state ("You're in a great mood today, John" in the film *American Graffiti*). Some people think that these moods—happy, sad, enthusiastic, phlegmatic—are in some way related to the concentrations of certain chemicals called *neurotransmitters* in the brain. These are agents like serotonin and norepinephrine and dopamine which facilitate the communication of electrical impulses from one nerve cell to another. The idea is that when they're in abundance, you're "up," and when levels fall, you're "down". And, so, your mental outlook as you face the day may just reflect the normal day-to-day fluctuations in these chemical transmitters. (Perhaps it's been obvious to you, as it has been to me, that the euphoria of falling in love is not dissimilar to that experienced after having consumed two cups of coffee—they're both such the consequence of the same surge of cerebral biochemical agents).

In the past, clinicians held to a traditional concept that depression could be divided into two forms: a) that which is a reaction to a sad event or loss in one's life, and b) feelings of depression for which no specific trigger is obvious. The former was considered usually transitory and non-threatening, while the latter constituted true psychiatric disease, with more portentous meaning and sinister outcomes. But now this is model is rather passé,

having been largely replaced by the idea that depression occurs in a continuum of severity and clinical importance rather than as a dichotomy. By this concept, the natural course of depression is often one of recurrent episodes that begins with some negative life event, maybe even a trivial one, which is followed by a series of escalating bouts of depression. With each recurrence the situational explanation for the depression lessens, eventuating at the far-end of the continuum over time of crippling depression that is irrational. At the termination of this morbid progression, at a point of insufferable pain, then, lies suicide.

There have been, of course, many observed cases in which the act of suicide seems to have evolved in this fashion, witness Sylvia Plath, Virginia Woolf, etc.. The sad death of the author David Foster Wallace, in which a self-inflicted hanging followed years of futile medical and psychiatric treatment for depression and multiple suicide attempts, stands out as among the most recent. If the model of progressively increasing levels of depression predicts a suicidal death, though, hope would lie with prevention. That is, if such depression is detected early, and treatment options employed, suicide may be logically prevented. Indeed, in the case of Robin Williams' suicide, it was assumed by some that he must have camouflaged overwhelming depression (in the guise of manic comedy), and that failure to detect and treat this depression led to this his sad death. Again, is it a reasonable story? Or simply a convenient explanation of an otherwise inexplicable event?

What is the origin of this depression that gets out of hand? No one really knows. Some have explained such depression on an evolutionary basis, that such despair arises from an overwhelming sense of self-doubt. According to this idea, *self-doubt is an inherent burden of the human condition.* As we've moved up the evolutionary tree from our primate brethren, we acquired marvelous qualities of creativity, intelligence, imagination—and self-awareness. And, as a price for this self-awareness came self-doubt. Self-doubt about the importance of one's existence. "…from these melancholy dispositions" wrote Robert Burton, "no man living is free…. Melancholy in this sense is the character of mortality".[6] And Andrew Solomon: "Depression cannot be wiped out so long as we are creatures conscious of our own selves…..Pain is the first experience of world-helplessness, and it never leaves us."[5]

Some would discard this evolutionary concept of depression and suicide in favor of one incriminating the ravages of a biochemical imbalance within the brain. They would say that those same neurotransmitters that established our mood go haywire and their imbalance triggers what are basically exaggerated moods—despair, hopelessness, and the like. This is not a novel

thought—depression as a chemical "disease"—supported by evidence that medications designed to promote availability of neurotransmitters in the brain are often highly effective in treating depression. The "demons" that are often brought out to colorfully explain deep depression and suicide, by this reckoning, may be nothing more than a group of covalent bonds that hold together a rather small molecule that transmits electrical activity in one's grey matter.

On the other hand, the skeptic could point out that already here one is beginning to ascribe "deranged" thinking (at least by somebody's definition) that leads to suicide as an Aristotlian disturbance of body humours. And as Elliot Valenstein at the University of Michigan has noted, "God knows what's really happening in the brain."[7]

One novel perspective would hold that escalating depression that eventuates in suicide, or at least severe functional incapacity—is an expression of a neurochemical chemical addiction, similar to the chemical addiction to substances like heroin and cocaine. Consider:

- Both chemical substance abuse and depression share the nature of being *re-inforcing.* The more one succumbs to its drive, the more severe the recurrences.
- Both are compulsions, out of cognitive control. In the clutches of heroin addiction and depression there is no volition involved.
- Both are related to disturbances in the brain of the same chemicals—those neurotransmitters. The substances of abuse and depression are similarly characterized by depletion of serotonin, dopamine, and the like. That's true even if a stimulating agent (like cocaine) acutely provides a rush associated with a blast in the brain of these chemicals.

This concept, though, would seem to beg some credulity. After all, narcotic addiction is driven by reinforcing positive feelings of well-being; depression is all negative. How could one be addicted to such mental pain? The argument might be that both are examples of a biochemical stimulation of mood or emotion. Certainly, one triggers euphoria, happiness, a sense of well-being, while the produces dark emotions of despair and hopelessness. But in both cases it's a matter of a *heightened awareness* which is a biochemical effect, an electrical event. And such recurrent stimulation engenders habit. It's why we get hooked on horror movies and distance running. And it's why we can't stop tonguing a sore tooth. The biochemical stimulation that effects depression is just that—a stimulation. Even if it's engenders negative emotions.

Others have suggested this. In *The Anatomy of Melancholy*, Robert Burton said this: "This melancholy…is a habit, a chronic or continuate disease, a settled humour, not errant, but fixed; and as it was long increasing, so now being (pleasant, or painful) grown to an habit, and will hardly be removed."[6]

And, maybe, as Burton implied, it may not be all negative. It has been suggested that heightened mental awareness of depression can be accompanied by certain sense of being truly "alive." As Solomon wrote about his own experience, "I hated being depressed, but it was also in depression that I learned my own acreage, the full extent of my soul…The experience of pain is one of the surest signs of the life force."[5]

There is a general opinion which holds that the incidence of depression is on the rise, and that this is a consequence of our contemporary life styles. "The climbing rates of depression are without question the consequence of modernity," claims Andrew Solomon. "The pace of life, the technological chaos of it, the alienation of people from one another, the breakdown of traditional family structures, the loneliness that is endemic, the failure of systems of belief (religious, moral, political, social—anything that once gave meaning and direction to life) have been catastrophic."

A good number of people believe that. But, still, there's no way to really prove this proposition. Certainly depression is not a new phenomenon. In the guise of *melancholy,* despair has been an affliction of human beings as far back as recorded history goes. I've already cited above Burton's iconic oeuvre on this subject, *The Anatomy of Melancholy,* which was written almost 400 years ago. This is really a remarkable book, wildly popular at the time, that went through five editions. Burton, who was a librarian and bibliophile at Oxford, said he wrote it as a means of combating his own depression. In the 547 pages (of my edition) he combines the citations of observations, myth, science, and hearsay to provide insights into the nature, causes, and treatment of melancholy. This does not exactly sound like reading for the beach. But, in fact, it's written in a most engaging and entertaining manner that if it wasn't for the length, one would not be able to put it down. As Holbrook Jackson wrote in the Introduction to the 1932 Edition, this "is the most sententious book ever written, yet it reads trippingly as a novel. It is packed with common sense and uncommon nonsense."

There is so much intriguing information in this definitive work, including ideas on suicide, that one is tempted to digress completely and fill the remainder of the allotted space here with its wisdoms. For now, though, we might best simply restrict ourselves to one topic, the ideas expressed on the *causes of melancholy*. Besides the obvious (the wrath of God, the

workings of the Devil, disturbed body humours, the positions of the planets), Burton identifies factors which are still considered to hold true today—solitariness, the weather, air pollution, one's parents, old age, chronic disease. In addition, he enumerates a number of inciting causes of melancholy that probably would not have immediately come to your mind, such as the ravages of excessive sex and resistant constipation, as well as a list of foods, the consumption of which in the year 1620 were highly suspect, including meat (pork, venison, rabbit), fowl (pigeons, ducks, geese, swans), milk and other dairy products, all fish, cabbage, melons, carrots, spices, beans, wine, beer, cider, fruits (cherries, pears, apples, plums), bread, nuts, and, not to forget, lampreys.

But one digresses. Returning now to the original question, is serious depression a causative substrate for suicidal behavior? Certainly, the popular impression would be "yes." Suicide is normally regarded as an act of a mentally ill individual. There is no question that serious emotional disturbed individuals are more likely to commit suicide than happy, content individuals. Research statistics bear this out. Still, that depression is a major *cause* of suicide is difficult to confirm.

Gustavo Turecki at McGill University in Montreal reported that the estimated rate of serious depression in a suicidal population is approximately 40%, and if one adds those individuals with other emotional disease, such as bipolar disorder, the percentage rises to 60%. Other studies have supported this magnitude of associated mental disorders with suicide.[8] Two observations here: First, if these figures are generally correct for all populations, that leaves somewhere around half of suicides *lacking* significant depression. And, second, which way does the arrow of causality go (if, indeed, there is causality instead of simply association)? Perhaps those who are suicidal are more likely to become depressed. (Figure 5.1).

A Biological Basis for Suicide

The suicidal individual is commonly depicted as one deprived of a meaning for living or beset by overwhelming depression, who elects non-existence as the preferred option to sustaining a painful, intolerable life. This, however, may not reflect a totally accurate picture. Indeed, there exists increasingly compelling evidence that some persons who commit suicide do so under the influence of genetic, neurochemical determinants outside their willful control. That is, some people who accomplish or attempt suicide may be, *by their nature,* suicidal.

Figure 5.1. The relationship between depression and suicide remains to be clarified.

Genetic Studies

It has long been recognized that suicides occur more commonly in families. Up to a third of suicidal persons are members of family in which another has attempted suicide or suffered from serious emotional disorders. That this observation is not simply a matter of communal household exposure to psychological angst is indicated by studies of identical and fraternal twins as well as adopted individuals which indicate that almost one-half of suicidal behavior reflects a genetic influence.[9]

Such findings have prompted a search for specific genes which might be responsible. These investigations have focused on genetic determinants of the serotonin system in the brain, the derangement of which may serve as the neurochemical underpinning for mental disorders including suicidal behavior. Autopsy studies have revealed that persons who have committed suicide demonstrate a decrease in presynaptic serotonin sites, an increase in serotonin receptor sites in the prefrontal cortex of the brain, and lower levels of metabolites of serotonin in cerebrospinal fluid. These results would suggest that serotonin activity is diminished in individuals who have committed suicide.

In fact, recent studies have implicated a number of gene loci which are associated with reduced serotonin system activity in individuals with

suicidal behavior (specifically, allele variants in the tryptophan hydroxylase gene, serotonin transporter (5-HTT) gene, monoamine oxidase gene, and serotonin 2A receptor gene).[10] That these gene loci are *responsible* for suicidal behavior, however, is far from confirmed. Studies attempting to link gene action and suicidal acts have provided conflicting results. Too, as Souery et al. have pointed out, these investigations are hampered by a number of methodological issues, including small sample size, inconsistent definitions of suicidal ideation and behavior, and variations in ethnic composition of studied populations.

Epigenetic influences might well play a role in establishing vulnerability to suicidal behavior. These non-genetic factors control the *expression* of genes and can triggered by physical and chemical environmental variables. Recent studies in animals indicate that epigenetic mechanisms can also alter gene expression in response to influences from the social environment (specifically, adverse early-life experiences).[11] Indeed, a plausible (though non-tested) hypothesis might hold that social circumstances (loss, hopelessness, etc.) might promote, by epigenetic means, the activity of suicide-related genes.

Neuroimaging Studies

The advent of neuroimaging studies such as functional magnetic resonance imaging (fMRI) and positron emission tomography (PET scans) has permitted localization of brain areas responsible for specific neurological functions. Individuals who have attempted suicide have been found to demonstrate diminished volume of gray matter in several brain regions, including the fronto-striatal-limbic network, rostral anterior cingulate, orbitofrontal cortex, and parahippocampus.[12]

These initial findings certainly do not establish an anatomic/functional cerebral process for driving a person to suicide. However, they do provide a potentially important puzzle piece in completing a picture of biological determinism for some individuals who commit suicide.

Biochemical Findings

A number of serum biochemical findings have been reported which are characteristic of suicidal compared to non-suicidal persons. Peng et al. described a significant decrease in total cholesterol, triglycerides, and free thyroxine in 69 depressed individuals who had made suicidal attempts. Wu et al. provided a systematic review and meta-analysis of 65 studies which described serum lipid levels in suicidal persons (defined as “ideation,

attempt, threats, or completion"). Significantly lower values of total cholesterol, low density lipoproteins, and triglycerides were found in suicidal versus than non-suicidal persons. In this analysis "compared with the highest serum total cholesterol level category, a lower serum total cholesterol level was associated with a 112% higher risk of suicidality, including a 123% higher risk of suicide attempt and an 85% higher risk of suicide completion."

The mechanism for these lipid changes in suicidal persons is uncertain. Wu et al. suggested that "it is possible that low peripheral cholesterol in individuals with psychiatric disorders accompanies (by a common regulatory mechanism) the cholesterol changes that may occur in specific synaptic lipid rafts, which could cause the hypoactivity of serotonergic communication, and, in turn, lead to impulsivity and violent suicidal behavior." On the other hand, the lower lipid levels in suicidal patients could simply reflect a diminished dietary caloric intake associated with the anorexia of depression.[13]

An Attempt at Synthesis

So maybe that shadowy image which is leaping off the bridge has been incapable of defining for him- or herself a satisfying meaning or purpose for life. Or, perhaps, the act expresses the sad denouement of a series of progressively severe depressive episodes that are now considered intolerable. Our popular notion of suicide certainly would conform to these ideas. But, still, there are some observations which are a bit troublesome on this point:

First, a good number of suicides seem to "come out of the blue." Totally unexpected. The first reactions: "We never would have thought that…" People do themselves in all the time who by all external appearances have succeeded in what we'd think would be meaningful achievements in life—fame, fortune, popularity, professional success, and so on. Suicide here seems to occur *in spite of* what would seem, at least from the outside, to be a very purposeful existence.

Then there is the question of depression. Certainly, it is not uncommon to witness severely depressed persons ending their own lives. But, as described earlier, the connection between the two may not be as convincing as expected. As Solomon has noted, it has been observed that there exists no strong relationship between the degree of depression and the likelihood of an attempted suicide. The timing of suicidal act is not often predictable by moments of depression. In fact, patients often commit suicide *after* having come out of a bout of depression. And, of course, not all—nor even a majority—of depressed people commit suicide.

Too, it is often stated that suicide is often precipitated by a negative life event. Maybe true, but that event is often, as you and I would view it, of minor or limited little consequence. You break up with your girlfriend, you are accused of cheating on your income tax, the value of your stock portfolio takes an unexpected dive. Perhaps 99.95% will be able to handle this; 0.05%, or something like that, will be drawn to suicide.

This speaks to a particular *vulnerability* toward suicide in certain individuals. The growing evidence for a genetic/biological basis for suicide provides a biological source for this tendency for suicidal ideation and acts.

Suicide, by its nature, defies Darwinian logic. For millions of years, the human body and its functions have been finely tuned toward survival. The end result is hundreds, no, probably thousands of control mechanisms all devoted to the sustenance of life—the constancy of body temperature, level of tissue acidity, water content, blood sugar level, and so forth—all which have been "selected" for their capacity to assure survival of our species. That in this process the pressures of evolutionary change would provide a means by which this incredible human machine could self-destruct is, for the biologist, unconceivable. Nature is not always kind, to be sure. And it kills people—through illness, natural disaster, accidents. But why should it construct a mechanism by which it could purposefully destroy itself?

So what are we to say here? Do we truly have *any* handle on what causes people to destroy themselves? It would seem that suicide (a) often defies common sense, (b) is contrary to biologic evolutionary pressure, (c) in some persons may be biologically destined, and (d) is not clearly connected with any particular mental disorder.

One means of putting this together is to start with the conclusion that in most cases suicide must be considered an irrational act (i.e. not controlled by cognitive reason). (We ignore here what has been termed by some as *rational suicide,* those cases in which a person takes his or her own life who is suffering the unbearable pain of terminal bone cancer, or the 90-year old husband who has just lost his wife.) That is, many people who commit suicide or attempt to do so, are, well, *suicidal,* and they commit such an act irrespective of sensical thinking and the biological drive to survival. Being suicidal, by this reckoning, can be an *affliction,* no different than a brain tumor, an arthritic knee, or a large tapeworm (these being, one will note, from the standpoint of the affected person, irrational, imposed, and destructive).

Solomon, writing from his own experience, came to the same conclusion:

> "Suicide is not the culmination of a difficult life; it comes in from some hidden location beyond the mind and beyond consciousness. I can look back now at my own little para-suicidal period: the logic that seemed so abundantly reasonable to me at that time now seems as alien as the bacteria that gave me pneumonia a few years earlier. It is like a powerful germ that entered the body and took over. I had been hijacked by strangeness".

Let's suppose for the moment that you, the reader, are in agreement that some acts of suicide should be viewed thusly, as an aberration of thinking afflicting an individual, out of his or her control, a kind of insanity. A manifestation of an involuntary physical or chemical misadventure within the brain, if you will. Consider how that viewpoint might influence some typical contemporary issues surrounding suicide:

1. Is committing suicide *ethical*? This question becomes nonsensical. It would be like asking, is having a stroke ethical?

2. Should one have the freedom to commit suicide? Same answer. If suicide is an involuntary affliction, one never "decides" to commit suicide, so self-determination here is hardly at question.

3. How can suicide be prevented? About 45,000 people die at their own hand in the United States every year. That's like an entire sell-out crowd at Fenway Park being wiped out before the first pitch. If suicide was a contagious disease, we'd all be wearing surgical masks, hiding in basements, and restricting our children from bathing in public swimming pools. Yet at present for this scourge we have no firm idea of cause or successful means of prevention.

The hope would be that in the affliction model there would be means to identify those who are vulnerable (in the infectious disease analogy, those with low immunity levels). And already there is some initial progress in this regard. Brain scans have identified specific areas of abnormal function in persons who have attempted suicide. It may be possible to perform biological tests that will demonstrate derangement of neurotransmitter activity. There might even eventually be a means of identifying certain genes that would reveal a propensity for suicide.[14]

It's not outlandish to suggest that maybe we will never know the source within the depths of mind that drives one to commit suicide. As Walter and Pridmore wrote, "Given that not all suicide is the result of mental illness, and that, even if it was, not all mental disorder is (or can reasonably expected to be) detected or effectively treated, the eradication of suicide by clinical means is unlikely….Perhaps like sex and war, suicide may not be fully preventable."[14] Of even understandable. To repeat Elliot Valenstein's insight, "God knows what's really happening in the brain."[7]

Notes

1. In their article "Molecular genetics in the analysis of suicide," Daniel Souery and his colleagues in Brussels (Ann Med. 2003;35:191-196) cite publications which have provided a demographic picture of suicide:
   - Each year, throughout the entire world, almost one million people commit suicide.
   - The rate of suicides varies markedly from one country to the next, from 3.6 per 100,000 persons annually in Greece, to a rate almost ten-fold greater reported in Hungary (33/1000,000).
   - Means of committing suicide also vary by country. In the United States the most popular method is via firearms. In Great Britain poisoning is most frequently chosen by men and hanging oneself by women. In Denmark the reverse is true.
   - The annual rate of suicides in adolescents in the United States has increased five-fold since 1950. In the U.S. suicide ranks as the third leading cause of death in the teenage years. However, the majority of suicides worldwide occur in the elderly.
   - Men are four times as likely to commit suicide as women.

   Also, the Centers for Disease Control reported that in the year 2016, 45,000 persons in the United States over the age of 10 years committed suicide. Only approximately one-half of these had a history of mental disorder.
2. The source for many of the ideas about "nothingness" in this section are gathered from Jim Holt's take on this subject in his excellent book *Why Does the World Exist?* (Liveright, 2012). Many would agree that in the search for an example of true "nothingness," the extinction of the existence of a human being at the point of death might serve as the most clear-cut example. Others, most surely, would disagree.
3. Wilson EO. *The Meaning of Existence.* New York: Liveright, 2014.
4. Camus A. *The Myth of Sisyphus and Other Essays.* New York: Alfred A. Knopf, 1955.
5. Solomon A. *The Noonday Demon. An Atlas of Depression.* New York: Scribner, 2015.
6. Burton R. *The Anatomy of Melancholy.* New York: New York Review of Books, 2001.
7. Valenstein ES. *Great and Desperate Cures.* New York: Bantam Books, 1986.
8. Read about the link of suicides with mental illness in Turecki G. Suicidal behavior: is there a genetic predisposition? Bipolar Disord. 2001:3:335-49; Manoranjtham S et al. Risk factors or suicide in rural south India. Br J Psychiatr 2010;196:26-30; Zhang J et al. Mental disorders and suicide in young rural Chinese: a case control psychological autopsy study. Am J Psychiatr. 2010;167:773-781.; Li X et al. Risk factors for suicide in China's youth: a case control study. Psychol Med. 2008;38:397-406.

9. For information regarding the epidemiological aspects of the genetics of suicide, see Baldessarini RJ, Hennen J. Genetics of suicide: an overview. Harv Rev Psychiatry 2004;12:1-13; Statham D et al. Suicidal behavior: an epidemiological and genetic study. Psychol Med. 1998;28:839-55; Roy A, Segal N. Suicidal behavior in twins: a replication. J Affect Disord. 2001;66:71-74; Miterrauer B. A contribution to the discussion of the role of the genetic factor in suicide, based on five studies in an epidemiologically defined area. Compr Psychiatry 1990;31:557-65.
10. A full discussion of candidate genes that might contribute to susceptibility to suicidal behavior can be found in Souery D et al. Molecular genetics in the analysis of suicide. Ann Med. 2003;35:191-196; Arango V., et al. Genetics of the serotonergic system in suicidal behavior. J Psychiatric Res. 2003;37:375-386.
11. Read about epigenetic factors and suicidal behavior in Turecki G. Epigenetics and suicidal behavior research pathways. Am J Prev Med. 2014;47 Suppl 2:S144-S151.
12. Two recent publications have provided a discussion of neuroimaging findings in suicidal individuals: Martin PC, et al. Magnetic resonance imaging markers of suicide attempt and suicide risk in adolescents. CNS Spectrums 2015;20:355-358; Serafini G, et al. Understanding suicidal behavior: The contribution of recent resting-state fMRI techniques. Front Psychiatry 2016;7:69.
13. Read about the serum lipid findings in suicidal persons in Wu S., et al. Serum lipid levels and suicidality: a meta-analysis of 65 epidemiological studies. J Psychiatry Neurosci. 2016;41:56-69, and Peng R., et al. Lower serum free thyroxine level is correlated with lipid profile in depressive patients with suicide attempt. Psychiatry Res. 2018;266:111-115.
14. Can suicide be prevented? Read Walter G, Pridmore S. Suicide is preventable, sometimes. Australasian Psychiatry 2012;20:271-273; Guintiyano J,et al. Identification and replication of a combined epigenetic and genetic biomarker predicting suicide and suicidal behaviors. Am J Psych 2014;171:1287; Lippard ETC, Johnston JAY, Blumberg HP. Neurobiological risk factors for suicide. Insights from brain imaging. Am J Prev Med 2014;47:S152-S162; Mann JJ, et al. Can biological tests assist prediction of suicide in mood disorders? Int. J. Neuropsychopharmacol 2006;9:465-74.

6. ETERNAL RECURRENCE

It was déjà vu all over again.
—Yogi Berra

(The story you are about to read is a true one. Well, in one sense, at least, a true one. It concerns a fictionalized conversation, via a conference telephone call, between individuals who have addressed an engaging issue of our time—that of eternal recurrence*, which holds that we continue to live the same lives, identically, over and over again. The meeting is fictional, as are the conversations, but the ideas expressed by these persons are not. The author has contrived this situation to best hear them out. Attention! This chapter, designed as a serious academic discourse, may in fact represent nothing more than an elaborate piece of science fiction. Parental discretion is advised.)*

OPERATOR: Professor Nietzsche has joined your conference call.

MODERATOR: Friedrich! So good to hear your voice. It's been a long time!

NIETZSCHE: About a hundred and fifty years, I suspect.

MODERATOR: Hard to believe. Time flies. Anyway, thank you for joining us. We are looking forward to hearing your ideas about eternal return. Or is it "recurrence"?

OPERATOR (interrupting): Professor Gödel is now on the line.

GÖDEL: I apologize for my tardiness. I was just putting the finishing touches on my incompleteness theorem during an overpriced *croque madame* when it became obvious that the chef had planned to poison me with a bad egg. It took some time to settle the matter.

MODERATOR: ….Well, we're glad you can participate.

GÖDEL: After the gendarmes arrived I was asked to leave the premises, which I did with some haste.

MODERATOR: I believe we now have everyone on board. No doubt, you all know each other, but let me quickly list the contributors to this conference call: the philosopher Friedrich Nietzsche; the logician Kurt Gödel; Alexander Nehamas, a leading Nietzsche scholar who is Professor of Philosophy and the Humanities at Princeton University; the actor, comedian and film producer Woody Allen; and James Spence, who teaches philosophy at Bowling Green University in Ohio.

So, can we start? Professor Nietzsche, since your name has most commonly been associated with the idea of eternal recurrence, could you please give us a brief overview?

NIETZSCHE: The way most people have interpreted this idea, eternal recurrence is the idea that we continue to live the same life, over and over again, in an endless cycle. It's like the same film at your local movie theatre that's played every day, always the same, forever. Every moment, every action, every consequence in your life recurs in perpetuity. There's nothing you can change. The script is fixed.

MODERATOR: If I understand this correctly, we should make a clear distinction that eternal recurrence is not the same thing as re-incarnation. Is that right?

NIETZSCHE: That's right. Eternal recurrence has to be considered in the context of that Big Question of "what happens next"? as your casket is being lowered slowly into the ground. We're talking here about *options.* When one reaches the end of his or her worldly existence, for instance, maybe nothing happens. You're just gone, done. The electricity has been shut off and you simply cease to exist, in any form whatsoever. It's like during your routine colonoscopy the anesthesiologist miscalculates the flow of gas and you never wake up. A depressing thought, but one that is not unpopular with modern day neuroscientists. Another option is the once-traditional one that holds that after death your soul ascends to a halfway point where the balance between your earthly deeds of good and bad are assessed and a judgment is made regarding whether you receive either a posthumous reward of a full ascent to the glory of heaven or a descent into a hellish overheated existence of perpetual torment. Theatrical, yes, and not as much in vogue as it once was. (This is not to say, however, that it's necessarily wrong.). Re-incarnation, on the other hand, is the concept that

following death one is re-born in a *different* physical body, so, unlike eternal recurrence, one is not stuck with the same life but comes back in a new one.

GODEL: Could I interrupt here?

MODERATOR: Professor Gödel?

GODEL: To be consistent with my reputation for matters of completeness, I must point out that Frederick's definition here is far too narrow. He's talking about eternal recurrence and its implications for human beings. But, in fact, the cyclical nature of reality encompasses the entire universe, a recurring birth and death that involves all of creation.

MODERATOR: Yes, I realize that you've been a prominent supporter of this view of the evolution of the universe. It's an important point you bring it up. But let's explore Professor Nietzsche's concept of the meaning of eternal recurrence in human beings first. Then we can come back and consider your proposition on recurrence on a grander scale in more detail.

NIETSZCHE: There are two points I'd like to make here. First, although this idea of eternal recurrence somehow became identified with my philosophies, it's in fact a very old idea. The ancients, including the Egyptians and then the followers of Pythagoras, and the Stoics—they all had ideas surrounding the cyclical nature of time, that everything in the universe will recur over and over again. The idea is seen in Indian religions, and the Mayans and the Aztecs also embraced the concept of a recurrence of time.

GÖDEL: For these peoples this made solid sense. "Reality" for them was manifest by the events in the natural world they observed around them. And that natural world consisted of repetitive cycles—the tides, the coursing of the heavenly bodies across the skies, the seasons. There was no reason to expect that life itself, being part of nature, would not be cyclical and repetitive as well. As I will discuss a bit later, this concept of a cyclical universe might not be so far off the mark as one might think.

NIETZSCHE: The idea of eternal recurrence had pretty much died out, however, until one summer day in the year 1881, as I walked along the shores of a Swiss lake, when the concept struck me as critical to defining how one should approach conducting a meaningful life. Which leads me to my second point. Contrary to popular opinion, I did not actually propose

that eternal recurrence exists as a reality. No, instead, I constructed it as a thought experiment, one that would encourage humans to think in a certain fashion about how they should best conduct their lives. Here is how I wrote about this in *The Gay Science:*[1]

> "How, if some day or night a demon were to sneak after you into your loneliest loneliness and say to you, 'This life as you now live it and have lived it, you will have to live once more and innumerable times more; and there will be nothing new in it, but every pain and every joy and every thought and sigh and everything immeasurably small or great in your life must return to you—all in the same succession and sequence—even this spider and this moonlight between the trees, and even this moment and I myself. The eternal hourglass of existence is turned over and over, and you with it, a dust grain of dust.'"

MODERATOR: And what lesson, what philosophy, did you wish to impart by proposing this scenario?

NIETZSCHE: Put most simply, it comes down to how, given this eternal recurrence, would you react? As I went on to write:

> "Would you not throw yourself down and gnash your teeth and curse the demon who spoke thus? Or did you experience a tremendous moment when you would have answered him, 'You are a god, and never have I heard anything more godly.' If this thought were to gain possession of you, it would change you, as you are, or perhaps crush you. The question in each and every thing. 'Do you want this once more and innumerable times more?' would weigh upon your actions as the greatest stress. Or how well disposed would you have to become yourself and to live to *crave nothing more fervently* than this ultimate eternal confirmation and seal?"

MODERATOR: What we seem to be concluding here is that eternal recurrence is, rather than a reality, a model of thinking that directs us to live life in a most beneficial way. Is that right?

NIETZSCHE: Yes, that's the basic idea. Human beings flounder along without any guidelines as to how to conduct our lives. We are provided a backdrop of roles and examples by which to imitate a "good" life—family, peers, the socialization of schools, even movies, books, and plays. But being forced to face an infinite recurrence of our lives, the gauntlet is thrown down—we can (or, in this case, we must) decide for ourselves the best way to plan our lives. And if you're going to have to do it over and over, forever, you would be well advised to choose your behavior carefully.

> "The practical maxim of the eternal recurrence in the anthropological sense simply involves living in a way that one would want to live again. The recurrence is neither a future event nor a mere recurring again and again of the same, but a *will to a rebirth,* to a new life. The good will toward life that characterizes the anthropological teaching of recurrence blocks the road to escapism of all sorts, including metaphysical backworlds or suicide. The doctrine of recurrence overcomes the nihilistic, absolute skepticism that says nothing is new and everything is permitted. The emptiness of nihilism gets replaced by the iron necessity and redemption of self-made law."[2]

MODERATOR: So, then, eternal recurrence is in reality just an abstract idea? Sort of a "what if…?"

NIETZSCHE: That is the way I was thinking of it. But do not get me wrong. The proposition is a very serious one. It provides one with a construct, an outcome, if you will, that would direct us toward embracing life, of living with a positive attitude, or loving one's fate. If you knew that your life would recur, over and over again an infinite number of times in the manner that you approached it, human existence would be become fulfilling and pleasurable. And even if eternal recurrence does not actually occur, one's response to living "as if" it was real would provide the most beneficial way of conducting one's life.

MODERATOR: A good number of critics have provided extensive analyses of your concept of eternal recurrence as well as other of your philosophical constructs. A common concern appears to be that your ideas are often ambiguous and contradictory, frequently a struggle to understand, and typically open to the individual reader's interpretation.[3]

NIETZSCHE (*laughing*): I always thought that's what philosophers were supposed to do!

MODERATOR: Regarding eternal recurrence, even accepting this as entirely allegorical, a common criticism has been, as the Australian philosopher David Rathbone has written, "In a world of deterministic repetition, there can be no real evolution…for the very idea of evolution entails the creation of genuinely new forms of life, the likes of which have never before been seen."[4] The French philosopher Pierre Klossowski carried this concern further in somewhat dizzingly fashion:

> "Eternal Return is a necessity that must be willed: only he who I am now can will the necessity of my return and all the events that have led to what I am—insofar as the will here presupposes a subject. Now this subject is no

> longer able to will itself as it has been up to now, but wills *all* prior possibilities; for by embracing in a single glance the necessity of Return as a universal law, I deactualize my present self in order to will myself in *all the other selves whose entire series must be passed through* so that, in *what I am in the moment I discover* accordance with circular movement, I once again become *what I am in the moment I discover the law of the Eternal Return."*[5]

NIETZSCHE: I'm not sure this is at all clear to me.

NEHAMAS: Certainly, one has to agree that the actual reality of eternal recurrence is highly dubious and by all good arguments is logically impossible. But I agree with Professor Nietzsche that this is not the point to be made. We should not be concerned with the metaphysical validity of this concept but rather its application to psychological consequences. Eternal recurrence is not a theory of the world but a view of the self. The lesson that Nietzsche is providing us is not that one's life *will* continue to be replayed in perpetuity but rather that we should elect to live our lives as if such were the case. Eternal recurrence provides us the framework for conducting an ideal life.[6]

MODERATOR: This leads us directly to the question, what kind of life *should* we elect if our existence kept on repeating itself? Just what is this "ideal life?"

NEHAMAS: Well, we'd all love to have the answer that one, wouldn't we? I would see one thing that doesn't work—remorse for things we wish we would have done in the past. We probably all suffer such regrets –life would have been better, if only…I would have taken that job. Or stayed in school. Or married that girl. Or treated my parents better. Professor Nietzsche, I know you agree with me that such wishing is useless. One's self is fabricated by the totality of one's actions. If something had occurred differently in my past, I would be a different person. My life could not have been different without eliminating the person I am now. The way I see it, eternal recurrence is not simply an endless repetition of one's life but rather the inseparability of the past from the present and the present from the future. Eternal recurrence offers a choice between either accepting or rejecting one's life in its entirety. The good with the bad. And there is no waffling here. If anything is different, everything is different.[6,7]

MODERATOR: Prof. Nietzsche, it is rather striking that in all your writings you provide us with no description, no set of instructions, on

exactly how to live "properly" that you say is offered to us by a hypothetical eternal recurrence. As Prof. Nehamas has noted "it is not only Nietzsche's model that is literary. In a serious sense his product is literary as well."[7]

NIETZSCHE: This is true, not by oversight or even lack of literary courage but rather the stark reality that no such ideal life so prescribed exists. My ideal life would be one in which the individual fashions his life by taking everything that has happened to him and shaping it into a work of art. "The perfect self is like the perfect narrative or the perfect literary character. Nothing is inconsequential. Every detail of our lives has a purpose. Every event is fabricated into the wholeness of our existence."[6]

MODERATOR: At the same time it has been well-recognized that your proposal for the "what if" of eternal recurrence is based upon your feelings regarding the immediacy, the sanctity, of human fulfillment as we live out our brief stay on this planet. Could you describe this for us?

NIETZSCHE: I have proposed that human beings should embrace a happy and fulfilling life based on a "what if" construct of eternal recurrence. It is important to recognize that this entire concept is predicated on the supposition that life is to be enjoyed in the here-and-now of daily existence during our lifetimes here on Earth. The life you have, it's all there is. Take full advantage while you can. It's a life-affirming, ego supportive outlook. This, of course, runs contrary to traditional Christian dogma that holds that life is a trial, one to be endured with the expectation of an eternal reward when it's over. By this measure, our existence is one of woe, saddled with guilt from Original Sin, wrong-doers who must be forgiven, carried through the torments of life by Faith. But, in the end, it's all worth it. Paradise and Eternal Bliss. If we can just hang on. This concept is not, one dares say, life affirming.

SPENCE: We have always interpreted Prof. Nietzsche as contending that Christian doctrine is a denial of the importance of this life, insisting instead that our existence on Earth is not really meaningful, and that spiritual union with God, the true value, occurs only after we have died. So what Nietzsche is offering is an alternative view, one that says, to the contrary, this life is the only one we have, and that assumption creates a critical viewpoint of eternal recurrence. "What if, rather than death being a chance to enter Heaven, we relive this life again and again?…Should we turn away from this life while hoping for a bigger prize? Or will we embrace the thought that there is nothing more than this life, and we will have to endure

it again and again?.....[According to Nietzsche] it is a person who loves himself and life because it gives him a chance to choose an ideal and work to perfect himself according to that ideal…The challenge presented by the thought of eternal return, then, is this: Are you strong enough to freely choose and live according to an ideal, an ideal that is appropriate for you as an individual (and therefore not appropriate for everyone) and that has no metaphysical basis (such as God or heaven)?"[9]

You have two choices—you can take the path that says "yes" to "life in all its terrifying chaos and complexity, or you can choose the path of the Crucified in rejecting life in favor of an imaginary beyond."[9]

MODERATOR: It's an atheist's outlook, to be sure. Prof. Nietzsche, are you saying that religion, that belief in God, should play no role in how we decide conduct our lives?

NIETZSCHE: My reply is stronger than that. I can only conclude that God is dead, and I mean by this that anyone with even limited intellectual capacity can see that there exists no overall intelligent director controlling how the universe operates. Christian dogma is false and represents an enemy to leading a fulfilled life. The true reality exists in nature, not a controlling, omnipotent god. I propose that we need to take control of our lives instead of being driven lemming-like over cliffs that are destructive to human existence. Viewing one's existence as a recurring story is one way of gaining that dominion over the course of one's life. So, you see, considering eternal recurrence of one's life serves as a psychological tool for fulfilling that control.

MODERATOR: Your ideas have shocked a good many people, particularly your insistence that "selfishness, including evasion, distrust, and a love of dissembling and irony, is a sign of health—it is the people who are always after some pure and objective absolute (whether in religion or philosophy) who are the sick ones…Human beings have a natural and healthy urge to be creative and powerful, and morality [including the 'equality of rights' of a democracy] only suppresses and distorts this."[10]

NIETZSCHE: Some have questioned whether these startling concepts, along with many of my self-contradictory and obscure ideas, were only a product of the mental illness that ended my productive life. But that nervous collapse only occurred much later than these writings.

MODERATOR: Let me switch now to a different question. Is there any evidence that eternal recurrence is actually real? Some people have suggested so. That, in fact, we *do* continue to live the same life over and over again? Mr. Allen?

ALLEN: I certainly hope not. Nietzsche, with his theory of eternal recurrence, said that the life we live we're going to live over and over again the exact same way for eternity. Great. That means I'll have to sit though the Ice Capades again. It's not worth it….Eternity, it's long. Particularly towards the end.[11]

NIETZCHE: I myself pondered a bit as to whether eternal recurrence could actually exist. I even had entertained the idea of attending classes in physics at a university to examine whether there might be a scientific basis for eternal recurrence. But I never followed up on this plan.

MODERATOR: Let me tell you a story. When I was a young man, my family grew vineyards in California, just north of Santa Rosa. Twice a week it was my responsibility to drive up to the fields, which were about 45 miles north of where we were living, to start up the different water irrigation lines. Each of these had been named after a Big Ten football team (my father's heritage!), and with each trip I had in my pocket a card that read something like "Indiana. Purdue. Michigan State. Northwestern." This list had nothing to do with the success of their team on the football field but was simply to tell me which vineyards needed watering the most. One day, it was a Friday, I distinctly remember, as I was arriving at the fields I was suddenly stunned at what I saw before my eyes. That curve in the road, that tree shading a far fencepost, the sunlight glinting off the hood of the car, the towering cumulus cloud off to the right. I had seen this all before! The image lasted so long, maybe half a minute. I had experienced *déjà vu* in the past, but this was just so vivid! I swear I had been in this exact scene before. I couldn't shake the powerful impression that I was re-living a part of a life from before. It was so real. I was truly shaken—whether it was exciting or harrowing, I'm not sure. But it came as an emotional shock that stayed with me for days after.

SNO: Herman Sno here. Are you implying from this tale that you actually received a "glimpse" of a moment of your life during a previous "round?"

MODERATOR: I'm not sure. It just seemed to be so real, so familiar that it would not be difficult to claim that.

SNO: This was certainly a case of *déjà vu*, a fascinating phenomenon which has long puzzled scholars and lay persons alike.[12] For certain it's a very common experience, always described in the same terms of a sudden striking sensation of having witnessed a scene before (thus the French "*déjà vu,"* or "already seen"*)*, something experienced in the past. Because this is an entirely a subjective experience, it's been a most challenging one to study in any scientific way. Even reports of its frequency have varied, typically between 30% and 96% of healthy individuals.

MODERATOR: I've heard that *déjà vu* is more common in young people. That's been my own experience. As a young person I used to have such an experience maybe every couple of months, but now in my mature years, it's been a long time since.

SNO: Yes, and there is a general impression that such events are more common in males than females. Of interest, *déjà vu* occurs more frequently in patients with certain psychiatric and neurological conditions, particularly temporal lobe epilepsy and migraine. Neuroimaging studies in these patients indicate activation during such experiences of certain brain regions, including the hippocampus, parahippocampal gyrus, and the temporal neocortex. In fact, direct electrical stimulation of such areas has been demonstrated to trigger *déjà vu* events. In healthy individuals with *déjà vu*, less neurophysiological information is available. Brazdil et al. described less brain grey matter volume in certain regions in individuals with *déjà vu* than those without.[13] It is interesting to note that there have been a few anecdotal reports of individuals experiencing *déjà vu* during certain drug treatments.[14]

MODERATOR: But even this scant research literature surrounding mechanism does not address *why* we should experience *déjà vu.* The very high frequency of these experiences in the population speaks, does it not, to some biological explanation?

SNO: Well, nobody knows the answer to that question. Pašić et al speculated that "*déjà vu* could be nothing more than a by-product of evolution, a survival mechanism that once served a purpose, and is nowadays simply a vestigial remains, like an appendix, somewhat of a 'glitch' in the function of our mind."[15]

MODERATOR: Somehow that seems like a bit of a "cop out" in explaining such a ubiquitous mental phenomenon.

SNO: Maybe. But as a psychological "glitch", a "mental aberration" is generally the way most have considered episodes of *déjà vu.* As Spatt put it, some argue for "a false activation of connections between mesiotemporal memory structures and neocortical areas directly involved in the perception of the environment."[16] Indeed, that *déjà vu* represents a mental "delusion" is transmitted in the many discussions that posit such experiences as "characterized as a subjective *inappropriate* [italics mine] familiarity of the present with an undefined past."

MODERATOR: Is there anybody who has been courageous enough to suggest that *déjà vu* experiences actually reflect a past experience, a previous life identical to the one currently being lived?

SNO: Back in 1884, the American psychiatrist Henry Osborn studied cases of déjà vu and proposed that "the rationale of most elusive recognition, then may be found in present analogies to the lost mental records of an actual past life…"[17]

MODERATOR: Aha! Eternal recurrence!

SNO: In such considerations, eternal recurrence has often been misstated as reincarnation. As I have noted before, "In the psychiatric literature, a possible relation between the *déjà vu* experience and reincarnation has been suggested by various authors, be it generally not seriously. However, parapsychologically oriented authors can be quite convinced that the *déjà vu* experience is based on memories of an earlier life."[18] Among the many literary descriptions of *déjà vu* which I have collected, however, a number of serious authors seem to have opened the door to speculation that these experiences might actually reflect a previous life.[18] For instance, Charles Dickens in the novel *David* Copperfield:

> "We all have some experience of a feeling which comes over us occasionally, of what we're saying and doing having been said or done before, in a remote time—of our having been surrounded, dim ages ago, by the same faces, objects and circumstances—of our knowing perfectly what will be said next, as if we suddenly remembered it."

And the first lines of Rossetti's poem *Sudden Light*:

> "I have been here before,
> But when or how I cannot tell.."

And in in *Jechidah and Jachid,* a short story by Isaac Bashevis Singer:

> "After while Jechidah said: 'I have a strange feeling I have experienced all this before.'
> 'Déjà vu—that's what psychology calls it.'
> 'What do you mean?'
> 'Maybe we've known each other in some other world.'
> Jachid burst out laughing. 'In what world? There is only one, our earth."

A number of authors have considered the role of the subconscious mind in the explanation for déjà vu experiences. Freud, for instance, contended that déjà *vu* is a recollection of a subconscious fantasy or wish, which cannot be consciously remembered. This is not far from the idea of eternal recurrence, of course, since any recollection of previous rounds of the same life would have to be filed away in the subconscious rather than the conscious mind.

MODERATOR: The bottom line here is that it is a very "far reach" to think that episodes of *déjà vu* are evidence of a reality of eternal recurrence—an intriguing thought, but impossible to verify. If it *were* true, all arguments of human free will versus determinism would be for once and all extinguished. The "script," in fact, would be eternally fixed.

NIETZSCHE: This, of course, brings up a whole other subject. But we will save this for another time.

MODERATOR: Professor Spence, I believe you have interpreted the 1993 film *Groundhog Day,* starring Bill Murray, in respect to Nietzsche's eternal recurrence. Could you tell us about this?

SPENCE: That's right. In a book portraying how movies depict philosophical issues, I contributed a chapter entitled, entitled "What Nietzsche could teach you: Eternal return in *Groundhog Day."*[8] In this essay I tried to demonstrate how this film brought into even sharper focus how the "what if" of eternal recurrence bears importance for human beings. Let me give you a brief summary of what I wrote there. First, though, for those who are not familiar with this film, a quick description of the plot: Phil Connors, a Pittsburgh TV weatherman played by Bill Murray, is weary and bored with his life, and dreams of a better job, moving up the professional ladder. On assignment to cover the annual Groundhog Day event in Punxsutawney, Pennsylvania (actually, in the film, Woodstock, Illinois), he gets caught in a time loop in which he lives the same day, over and over again. While

initially dismayed, he begins to take advantage of the situation (he could eat anything he wants, easily seduce women, die by any adventure—all with impunity). After a while, though, the novelty wears off, and he has to come to grips with the bleak prospect of having no future, and that he is stuck reliving the same day over and over again, without end, among people he disdains in a town he dislikes. It is not until he discovers how to appreciate and love the life he has that the eternal recurrence is broken.

MODERATOR: I love this movie. Apropos to our earlier discussion, one of my favorite lines is when Phil asks the housekeeper at his hotel whether she has ever had any déjà vu, to which she replies with confusion, "Ah, ah, I'll have to ask the chef."

SPENCE: Of course, this isn't exactly Nietzsche's eternal recurrence (occurring in cycles of one day instead of a lifetime, for instance). But in this film the "what if" is portrayed in terms that can be interpreted as a realistic analogy to our daily lives. Do we not all feel in the day-to-day constancy of our lives—the same job, the same commute, the same acquaintances, the same food, the same entertainment—akin to the dilemma of Phil Connors, mired in his endless repetition of days in Punxsutawney? Are we not all looking forward, anticipating "something better"? *Groundhog Day* and Neitzsche would tell us to reflect on this. We have a choice as to how to regard our repetitive days—resignation and resentment, or passive acceptance, or, better, a moral choice to "express strength"? "We should choose to see our lives as an opportunity to become uniquely full of life, as an opportunity to choose an ideal to strive for. This ideal should be set high, to provide a real challenge for us. This life, with all its pains and sorrows, provides up with worthy challenges, and an opportunity to perfect ourselves according to our own idea.…To embrace eternal return is to embrace all of life." Who would have thought that Bill Murray could have provided us such a magnificent lesson?! [19]

MODERATOR: Prof. Gödel, this would be a good time to ask you to elaborate on your characterization of eternal recurrence.

GÖDEL: As I said before, the discussion up to this point has examined eternal recurrence, whether "as if" or in reality, in terms of the human experience. But a number of people, myself included, have considered the cyclical nature of the physical universe as a whole, and that maybe a recurring life here on Earth is part of a grander scheme that speaks to an eternal recurrence of nature itself. Some—and I believe Prof. Nietzsche

would be in accord—would argue that time is infinite and endless, and given a fixed, finite amount of energy and physical material in the universe, coupled with a "finite number of possible states—situations, modifications, combinations, and developments—all possible occurrences must have already occurred. Each moment has to be a repetition of what once was and will be."[2]

NIETZSCHE: Yes, but how to ever prove this would seem impossible.

GÖDEL: My own idea is a bit different and is difficult to explain to non-physicists. But, in a nutshell, I propose that all the matter in the universe is occurs as a "perfect fluid" throughout space time, and this matter is rotating in an unending cyclical fashion, being eternal "reborn." In this model, time does not actually exist. The British philosopher Barry Dainton called this idea a "bizarre state of affairs"[20] and, granted, my ideas of a cyclical universe have not been met with a large degree of enthusiasm by the physics or cosmology community. Indeed, Albert Einstein, as we discussed this on our daily walks at Princeton, was polite, but clearly thought this was a bit of nonsense. All is I can say is, we shall see. When I first proposed my incompleteness theorem, nobody believed it either. But today my conclusion that there exist mathematical truths which cannot be tested or verified is one of the most powerful of logistical statements.

MODERATOR: I wish to thank all of you who contributed to this virtual conference call. Let's see if I can come up with some summation of what's been discussed. Any reality to eternal recurrence—that we do, in fact, keep living our same lives over and over to eternity—is sufficiently far-fetched as to beg credulity. But the "as if" bears a powerful message, to which we are free to interpret and respond. Human beings possess the capacity to decide a course of living that, despite suffering and challenge, will provide the most fulfilling of existence—one which you would elect "if" you had to experience the same life in a cyclical manner to perpetuity. For Nietzsche this path was a denial of traditional Christian thought which instead presupposed an eternal reward in a glorious afterlife. For Gödel, who in fact ironically died of starvation for fear of having his food poisoned, cyclical recurrence is an established feature of the natural universe. For you, the intrepid reader who has made it this far, the choice of "who's right" is yours.

Notes

1. From Kaufmann W. *The Portable Nietzsche.* Penguin Books, 1954, pp. 101-102.
2. Lomax JH. Löwith's Nietzsche. In: Woodward A. (editor). *Interpreting Nietzsche.* London:Continuum, 2011, pp. 20-34.
3. Reflecting the difficulties in understanding Nietzsche, Wolfgang Müller-Lauter contributed one of the most influential books in the canon of Nietzsche analysis which was entitled *Nietzsche: His Philosophy of Contradictions and the Contradictions of His Philosophy.* Champaign: University of Illinois Press, 1971.
4. Rathbone D. Kaufmann's Nietzsche. In: Woodward A (ed). *Interpreting Nietzsche.* London:Continuum, 2011, pp. 51-65.
5. Klossowski P. *Nietzsche and the Vicious Circle.* London: Continuum, 2005.
6. Nehamas A. The eternal recurrence. Philosoph Rev. 1980;89:331-56.
7. Tomlinson M. Nehamas's Nietzsche. In: Woodward A (ed). *Interpreting Nietzsche.* London: Continuum, 2011, pp. 197-211.
8. Spence JH. What Nietzsche could teach you: eternal return in *Groundhog Day.* In: Blessing KA, Tudico PJ (eds). *Movies and the Meaning of Life.* Chicago: Open Court, 2005, pp. 273-288.
9. Gillespie MA. *Nietzsche's Final Teaching.* Chicago: University of Chicago Press, 2017.
10. Butler-Bowdon T. *50 Philosophy Classics.* London: Nicholas Brealey Publishing. 2013, pp. 220-225.
11. Woody Allen expressed his concern that eternal recurrence would force him to sit though the Ice Capades over and over again as the character Mickey in his 1986 movie *Hannah and her Sisters.*
12. Read about *déjà vu* in a number of key articles: Pašić MB et al. Many faces of déjà vu: a narrative review. Psychiatr Danubina 2018;30:21-25; Sno HN, Linszen DH. The déjà vu experience: remembrance of things past? Am J Psychiatr 1990;147:1587-1595; Sno HN, Schalken HFA, de Jonghe F. Empirical research on déjà vu experiences: a review. Behav Neurol. 1992;5:155-160.
13. Brazdil M, et al. Unveiling the mystery of déjà vu: the structural anatomy of déjà vu. Cortex 2012;48:1240-3.
14. Reports of déjà vu triggered by pharmacological intervention can be found in Taiminen T, Jaaskelainen SK. Intense and recurrent déjà vu experiences related to amantadine and phenylpropanolamine in a healthy male. J Clin Neurosci. 2001;8:460-462; Sigh S. Adolescent salvia substance abuse. Addiction 2007;102:823-824.
15. Pašić MB, et al. Many faces of déjà vu: a narrative review. Psychiatr Danubina 2018;30:21-25.
16. Spatt J. Déjà vu: possible parahippocampal mechanisms. J Neuropsychiatry Clin Neurosci. 2002;14:6-10.

17. Osborn HF. Illusions of memory. The North American Review. 1884;138:476-486.
18. Sno et al. reviewed allusions to déjà vu experiences in over 20 literary sources. These ranged from a description by the French author and politician Alphonse de Lamartine in 1835 to the lyrics of a song written by David Crosby in 1970. See Sno HN, Linszen DH, De Jonghe F. Art imitates life: *Déjà vu* experiences in prose and poetry. Brit J Psychiatry 1992;160:511-518.
19. It should be noted that other interpretations of the spiritual message in *Groundhog Day* have been argued. A Christian analysis, or example, has held that the repetitive days of Phil Connors' existence exemplified Hell, from which he was released in embracing acts of love and selflessness. The director Harold Ramis, who himself was a Buddhist, contended that he was not intent on transmitting a spiritual or philosophical message in this movie but rather simply aimed at providing an entertaining, feel-good story.
20. Dainton B. *Time and Space.* Second Edition. Montreal:McGill-Queens University Press, 2010, p. 371.

7. Aging

It is worth, while dying, to find out what life is.
—T.S. Eliot

The aging process doesn't do it with attitudes. The Clock of Ages does it with biochemicals.
—John J. Medina

Let's say you awake at 3 AM, and, being unable to go back to sleep, you switch on the TV, where an "infomercial" is in progress:

"Just imagine! Our special diet program will add additional years to your life by as much as 40%! It's all that you've ever dreamed and hoped for. Think of all the extra fun you will be able to have with your great grandchildren! No expensive drugs, no messy operations, just follow our special *scientifically-proven* diet plan and you'll tack on those extra years. *But wait—there's more!* We're so sure you'll be pleased with your extended life that we'll throw in, at no extra cost, this amazing serving set of cheeses for all your holiday needs! Don't miss out! Our operators are standing by, eager to take your order, guaranteed to delight you or your money back. *And we'll even pay for the shipping!"*

Are you kidding me? They think I'd fall for something like that? There's no way that can be real.

But it is real.

Truly real?

Yes.

There's got to be a catch. Twenty years added to my life?

Yes, the offer is real. And, yes, there is a catch.

What, dare I ask, is it?

It only works well if you're a rodent.

In 1917, more than 100 years ago, Thomas Osborne and his colleagues in New Haven, Connecticut, noticed that in their nutritional studies in rats that those animals who had been undernourished and experienced an early period of stunted growth lived longer than those with normal diets.[1] Among 91 animals in the latter group, 65 (71%) died before age 24 months (roughly

equivalent to 60 years of human life), and the single longest survivor had a life span of 34 months. In four female rats with early undernutrition and growth retardation, on the other hand, the average age at death was 29.2 months, and two lived to be 32 months old. These researchers concluded that total life span was augmented by the early period of undernutrition (amounting impressively to approximately +50%).

Subsequent studies have revealed similar magnitudes of increase in life span following a low- calorie dietary regimen in a diversity of animals from fleas to monkeys. Such an effect is independent of the constituents of the diet—that is, the relative amounts of fat, carbohydrates, and protein—and appears to be an outcome of reduction in caloric intake *per se.* The mechanism for this anti-aging effect of caloric deprivation is considered to involve a depression in rate of mitochondrial function in response to limitations of energy substrate and/or a reduction in tissue-damaging oxidative molecules that accumulate during metabolic processes (more about this later).

While mechanisms by which caloric restriction extends life expectancy can be logically proposed (and experimentally-supported), just *why* this should occur remains enigmatic. As John Mittledorf and Dorion Sagan have written:

> "There's no intrinsic reason why we should expect that carrying around extra weight should be much of a burden, especially if there's extra resource for creating muscle and bone to support it. Elephants live a lot longer than giraffes. And even if there were some metabolic reason why storing so much fat must be intrinsically unhealthy, then why wouldn't the body just discard the extra food energy with the stool or burn it less efficiently? It's strange that the body would allow itself to be damaged so by food."[2]

The magnitude of the effect of caloric restriction on animal longevity appears to be inversely proportional to life span. That is, the longer the normal lifespan of an animal, the less the increased relative duration. While caloric restriction may enhance lifespan in a laboratory mouse by 50%, a similar reaction in caloric intake will effect an added 20% of life's duration in a dog, but 80% in a fruit fly. In these animal studies, a number of systemic effects have been observed in addition to extended duration of life. These include stunting of growth, diminished basal metabolic rate, impaired immune function, delayed onset of puberty, and an overall depression of hormonal responses to stress.

Would this work in human beings? Would restriction of calories during the early portion of life permit an extension of expected life span? Not surprisingly, the answer is unknown, given the prohibitive difficulties one can imagine in conducting such an investigation. To start with, the study

subjects would have to outlive the investigators, who would face the challenge of assuring long-term compliance of participants to a stark diet. In addition, certain undesirable side effects have surfaced in the few studies which have examined the short-term influence of caloric restriction in humans.

In two early benchmark studies of the effect of caloric deprivation in non-obese, healthy men, a reduction of caloric intake by about 50% resulted in a fall in basal metabolic rate of 15-18%.[3] These investigations lasted 17 and 24 weeks, during which the participants developed a number of troublesome mental disturbances, which included weakness, depression, a fall in libido, irritability, inability to concentrate, diminished physical fitness, and hypersensitivity to cold. While these studies were not designed to examine the question of the effects of caloric derivation on longevity, they did suggest that this was a not a feasible approach in the human species.[4]

More recently, the two-year stay of eight adults in Biosphere 2 from 1991-1993 provided additional insights on outcomes of extended caloric deprivation in humans.[5] Biosphere 2 was a strictly-controlled, closed environmental structure in Oracle, Arizona, devoted to studying ecological changes and constraints (particularly the ability of closed systems to support life in outer space). During the last seven-eighths of this period, the participants were nourished on 1750-2100 calories daily of a diet largely consisting of vegetables, nuts, grains, and legumes. With this caloric intake they lost an average of 17% of body weight and a mean fall in body mass index of 19% in men and 13% in women. Average systolic blood pressure declined by 25%, and significant decreases were observed in white blood cell count (-31%), serum insulin (-42%), and serum cholesterol level (-30%).

Based on such findings, Byung Pal Yu argued that caloric deprivation in humans might be expected to provide dividends, if not in (yet undocumented) longevity, but in health outcomes in the later years of life: "Analysis of CR [caloric restriction] effect based on the life extension may be of interest, but it is a limited approach and not sufficient for assessing CR's efficacy on the functional aspects of human longevity. Thus, more accurate answers would come from assessments of CR's prevention against functional declines and its ability to suppress longevity-compromising disease processes."[6]

So, the effect of reducing "normal" food intake (while maintain proper consumption of vitamins and minerals) on life expectancy in the human species remains unknown. Based on the lifespan-relative findings in animals noted above, it might be expected that, even if it worked, the augmentation in life span for the average human would be in the order of not more than

about 5% (i.e. around 4 years). Research interest examining the effect of caloric restriction on duration of life and physiological function in living beings will nonetheless continue to be high in a) seeking insights regarding the molecular mechanisms for this effect, and b) assessing salutary effects on human beings beyond that of simply extending life's duration.[7]

Types of Aging

Yu's comments remind us that there is an important point to be made here before delving further into the issue of human aging. There exist two separate processes of aging. *Primary aging* refers to the progressive deterioration of cellular integrity and function over time, an intrinsic process which occurs in all physiological processes and one that is independent of the influences of disease and environmental factors. It is expected that the average lifespan dictated by primary aging (based on the recorded longest human life spans) is approximately 120-130 years and assumedly has remained stable over time.

Secondary aging refers to a similar downward trend over time in physiological function which is the result of extrinsic factors such as disease, malnutrition, and environmental insult. The doubling of the average lifespan in the United States—from about 40 years in the mid 1800's to over 80 years today—is accounted for by the changes in secondary aging, a reflection of improvements in medical care, sanitation, and nutrition over this time period.

As would be expected, problems may arise in distinguishing certain physiological processes (such as "hardening" of the arterial walls) as manifestations of primary or secondary aging. This difficulty notwithstanding, the discussion in this chapter will be restricted, as best that can be achieved, to issues surrounding primary aging.

The Human Experience of Aging

We human beings are awash in uncertainty. We have Heisenberg's uncertainty principle, the incompleteness theory of Gödel, the variances of initial conditions of chaos, the randomness of quantum particles. In the total picture of our daily living, certitude is at a high premium. The only certainty we can truly expect is the inexorably finite time period of our existence. Here we have, in fact, the ultimate certainty, that once created we must face the reality that our ultimate death is fixed, inevitable, and unavoidable. One can choose the analogy: On this planet there is, indeed, a maximum stay before check out (the Eagles were wrong about this[8]). Our time on the

human stage will be irrevocably curtailed by the closing curtain. Or, to steal from the basketball vernacular, with your birth the shot clock starts off, and you've about 80 years to get off a shot before the buzzer sounds.

Two correlates surround to this universal dictum. First, the latter portions of one's life span will witness a progressive deterioration in the functional capacity of the human biological machine, which here we will describe as *aging.* And, second, be it a blessing or a curse, with the unique capacity of self-awareness and conscious thought, human beings are the only animals who recognize that they are temporary inhabitants and will, with complete certainty, die.

Just how do human beings respond in their daily existence to this irrefutable fact? It's an interesting question. The Yale University philosophy professor Shelly Kagan writes in his book *Death* that perhaps a majority of people simply do not think of their death at all.[9] Call it a "head in the sand" response, but it has been claimed that, in fact, one is not mentally capable of conceptualizing one's nonexistence. So, yes, as one reaches the elderly years, there is a good deal of looking backwards—with regret, nostalgia, joy, remorse, and all that—but no dwelling on one's ultimate fate. Because maybe human beings are simply incapable of doing so.

Most of us live our lives at a very "sub-philosophical" level. We spend our energies in getting these things done, keeping the "ship upright"—getting our daughter to soccer practice, preparing dinner, paying the bills, finding a parking place at work, and all the multitude of other tasks that permit us to conduct our lives. There's simply no time nor enough energy left over for musing on the (largely unanswerable) "really big" questions. It would be a good guess that today, on this date, not a great number of one's neighbors stopped to think about their limited time on Earth.

Kagan (and a goodly number of philosophers as well) contend this is not the pathway to a fulfilling life. "There's something wrong about lives—something inauthentic about lives—that are lived without facing the fact of our mortality and living accordingly," he has written, "whatever the appropriate responses might be." Those "responses"—how to conduct a life so as to make the "best" of one's time alive—are decisions to be made by each individual. For some it might be hedonistic—go for the pleasure. ("What's worth having? Money is worth having. Sex is worth having. Chocolate is worth having. Ice cream is worth having…")

Such pleasures, however, are superficial and "quickly passing." One is reminded of an episode of the television series *The Twilight Zone* where a man finds to his initial joy that he wins every bet he places, gets every girl he desires, has all the money he desires—but it dawns on him that he can't tell if this hedonistic existence—of which he is quickly tiring—is Heaven

or Hell. (The astute viewer clearly knows which!). "What goals, what purposes, what aims are the most valuable, the most rewarding, the most significant?"[9] More wisely one might choose the development of interpersonal relationships (family, friends), providing security (a meaningful occupation), making a difference (creativity), establishing self-respect, etc.

It's all a personal matter. Your choice. And the universe doesn't really care what you do. No. It's completely indifferent to your behavior. Five minutes before you were born and five minutes after you die—it will be unchanged. The time of your life which lies before you is a blank slate, open to the possibilities that you decide to design.

The Science of Aging

So much for aging, the biological end-game, and the human experience. Indeed, It's no exaggeration to label this as perhaps the ultimate human condition. Much more could be said (and in fact has been for many centuries in a good part of the philosophical literature), but let's move on to the "science," the second half of our connection which we're addressing in this book. Here even the wisest of researchers, after decades of efforts, have let us down. For the abject truth is that no one has yet figured out just how and why humans deteriorate as they age as a prelude to death.[10] (This is not really surprising if one considers that the factors which distinguish the essence of living matter, versus non-living, remain a mystery as well. If we don't know why and how we are "alive," we can expect it will be equally impossible to understand what occurs when we are on a trajectory of being "not alive.") At least we can conclude that this lack of insight is not for want of effort. In fact, it has been estimated that over 300 different theories have been advanced to explain the aging process. We'll discuss a few of these a bit later on. For now, let's focus on just what happens during this aging process.

Functional Decline in the Aging Process

While an explanation as to *why* living beings age remains elusive, the manifestations of this inexorable process—a progressive functional decline in all body systems—are clearly obvious. Here is a brief summary of such events:[11]

The *skin* loses thickness as the rate of cells normally shed begins to exceed that of cell replacement. A similar degenerative process affects *bone formation.* Normally bone structure is maintained by the balanced action of formation by osteoblasts and the parallel destruction by osteoclasts. This

constant re-modelling normally effects a complete replacement of the human skeleton every seven years. In the aging process, the rate of reduction of bone mass exceeds that of bone formation, resulting in weakening and increased brittleness (osteoporosis). Bone mineral density peaks at approximately 30 years of age, and osteal loss becomes evident in both sexes in the following decade. 40 years of age. Subsequently skeletal mass loss is greater in females (8% with each succeeding decade) than males (3% per decade).

A decline in *skeletal muscle strength* typically becomes evident between age 40 and 50 years, with a decline in force capacity which accelerates in the 60's with a reduction by 10-20%. This decline in strength reflects a decrease in muscle mass, which is a manifestation of both intrinsic cell death as well as a reduction in nerve function responsible for triggering muscular contraction (so-called, dis-use atrophy).

As humans age, the ability of the *heart* to generate cardiac output with exercise declines. The firing rate of the sinus node (the cardiac pacemaker) declines such that one's maximal heart rate falls from over 200 beats per minute in early adolescence to about 160 beats per minute by age 70 years. Paralleling similar changes in skeletal muscle, myocardial mass is diminished, which is associated with diastolic (filling) dysfunction and a reduction in maximal stroke volume (amount of blood ejected per beat).

The process of human aging which is perhaps most apparent—and troublesome—to humans is the functional deterioration of the brain over time. This is made most conspicuous by loss of memory, but a variety of cerebral functions display similar deterioration, including difficulties in learning, multi-tasking, orientation (the sense of time and place), performance on verbal skills, and ability to concentrate. Tests of IQ (intelligence quotient) typically reveal a peak between ages 18 and 25 and a decline thereafter. Reaction time in elderly individual is typically 40% slower than that of a young person.

Structurally, brain mass is observed to shrink as one ages. The number of connections between nerve cells (synapses) diminishes, and the amount of myelin, the substance that coats nerve fibers, decreases as well, with consequent slowing of thought processing.

Deterioration in brain function with aging was once considered to reflect progressive death of cerebral neurons. More recently, evidence indicates that, in addition, other degenerative processes contribute to this decline, including (as noted above), a loss of synaptic connections between cells and a decrease in chemical neurotransmitters in the brain such as dopamine, serotonin, and norepinephrine, which are normally critically for information transmission between nerve cells.

The brain is a highly-complex organ governing a wide variety of body functions, and often there exists considerable variability in the rates of functional aging in different functional cerebral centers. Too, the rate of overall cerebral deterioration can be markedly different from one individual to the next, as is well-recognized in our common experience.

In the *lungs* the normal aging process is manifest as a decrease in elastic recoil, vital capacity, diffusion surface area, and chest wall compliance. Alveolar number falls while size increases, resulting in a reduced surface area for diffusion. Strength of the breathing muscles is also diminished as indicated by a reduction in maximal static inspiratory and expiratory pressures. Too, impairment of distribution of air in lung tissue in matching up with circulating blood results in a diminished amount of oxygen being delivered to body tissues. Breathing control is also impaired in the elderly, who demonstrate a reduced ventilatory response to hypoxemia and hypercapnia (low oxygen and high carbon dioxide levels in the blood which normally trigger respirations).

Beginning at about age 30 years, the size of *kidneys* declines, followed by a progressive reduction in ability to filter and remove waste products from the blood. The rate of blood filtered by the kidneys to remove these wastes falls by about 50% between the ages of 30 years and 85 years.

The greatest amount of oxygen that can be delivered to, and used by, skeletal muscle during exercise (maximal oxygen uptake, VO_2max) is a composite indicator of pulmonary, hematologic, cardiac, and muscle function. In a non-athletic male, VO_2max peaks at about 20 years of age at a value of 50 ml kg^{-1} min^{-1} and then slowly declines through the life span, with a 30% reduction by age 60 years.

From these empiric observations, several points can be made:

- Virtually all tissues in the human body participate in the aging process. Still, the *rate* of functional deterioration varies from one organ system to the next.
- The onset of functional decline also varies, but for most tissues this deterioration becomes evident as early as the mid-adult years, with accelerated loss of function once the elderly years are reached.
- An examination of the microscopic changes in cells that are reflected in these system functional breakdowns with advancing age typically surround the process of cell death. (Or, as in some tissues, a failure of adequate cellular replacement or repair in response to natural cell death.)

Cell Death

Given the critical importance of cell death in the course of human aging, it is not surprising that considerable research efforts have been focused on the mechanisms and responsible factors underlying this process. In 2018, Lorenzo Galluzzi et al. published an article intitled "Molecular mechanisms of cell death: recommendations of the Nomenclature Committee on Cell Death 2018," which provided a comprehensive state-of-the art review.[12] For those with an advanced degree in cellular biochemistry this article is a must. For the rest of us, well, let it just be concluded that this a very complicated business.

"Cell death" in such discussions is readily recognized by various indicators of the morphological destruction of cell integrity. Cells die from a large variety of insults (besides the primary aging process), and it needs to remembered that cycles of cell death and replacement are inherent and very normal manifestations of the physiological processes of growth, development, and organ function. In the Galluzzi et al. review, the cascades of biochemical, gene-directed events that effect cell death are not unexpectedly multi-varied, and the morphological expressions of death vary according to molecular mechanisms as well (i.e., cytoplasmic shrinkage, nuclear fragmentation, vacuolization, and chromatin condensation). So, just for the record, the variety of molecular mechanisms and associated morphological cell disruption includes the process of *intrinsic apoptosis* (reflecting DNA damage, endoplasmic reticulum stress, and reactive oxygen species), *extrinsic apoptosis* (caused by adverse extracellular environments, and driven by disturbingly-labelled "death receptors" on plasma membranes), *MPT-driven necrosis* (initiated by oxidative stress and cytosolic calcium overload), *necroptosis* (with failing responses to cell stress), *ferroptosis* (caused by severe lipid peroxidation), *pyroptosis* (with invasion by pathogens), *parthanatos* (associated with DNA damage), *entotic cell death* (when healthy and malignant cells turn cannibalistic), among others.

Just how the process of primary aging operates in this context seems to be obscure. In fact, it is not difficult to suggest that "aging" as a negative process is not a single well-defined destructive force but one which involves different pathways to functional deterioration. For instance, in tissues with a high normal cell turnover rate (i.e. skin, endothelial lining of the gut) insufficient cell replacement might serve as a primary track to functional decline. In the central nervous system and skeletal muscle, on the other hand, which are not typified by significant regenerative functions, an absolute effect of cell death might play a principal role. As mentioned

previously, too, factors other than cell destruction, such a biochemical changes may serve as separate contributory pathways to the aging process.

Why Do We Age? No Easy Explanations

The descriptive features underlying the physiological functional deterioration accompanying the trajectory of the aging process are well-appreciated (indeed, by scientists and lay persons alike). The inevitability of these changes with time that eventuate in death of the human organism is incontrovertible. And by understanding the nature, prevention, and treatment of pathological processes which limit life expectancy, we have advanced secondary aging closer and closer to a limit considered established by primary aging—some inherent process of cell deterioration independent of extrinsic insults.

Most card-carrying biological scientists would be in accord with such a summary. But here all pathways of agreement diverge. The *why* and *how* of the aging processes remain obscure and controversial. If you were to ask someone passing in the street "Why do our body functions deteriorate during aging as we approach the end of our lives," you would probably get a response something like this:

> "Things wear out. Nothing lasts forever. This is the oldest and still the most pervasive idea about what aging is. It is seductive because some aspects of aging fit with this picture; but the idea is also deeply flawed. It is a misapplication of basic physical law, and it also fails to account for some familiar facts about aging."[2]

For biologists, physicists, and biochemists—people who should know—the process of aging can better be examined in the context of divergent views of the role played by changing energy supply, failure of cellular repair, and genetics. In this next section, we review briefly this battle ground of opinion.

Natural selection

Biologists are accustomed to explaining function and structure in living beings via the mechanisms underlying Darwinian natural selection. That is, functions which are adaptive—in the sense of preserving the species—are expected to persevere, while those that are disadvantageous to survival are not. (Those features which are "neutral," being neither advantageous nor disadvantageous, may persist as expression of variation in living beings.) By this dictum, then, one can expect that any process observed in present

human beings has—or, at least, had in the past—some reproductive or survival advantage.

But what, one might reasonably ask, would be the Darwinian advantage of the aging process? What biological benefit would be served by a gradual progression of deterioration of bodily functions from middle age onward which eventuated in one's death? Writing in the early 1900's, the eminent German evolutionary biologist August Weismann proposed that, in fact, this inexorable functional march to death did provide an advantage to living beings. The key to survival, he stated, is contingent upon reproductive fitness—the ability to foster offspring serves as the key element of the process of natural selection. Old people do not reproduce and therefore have no benefit to survival of the species. In fact, the elderly, being frail, susceptible to disease, and requiring care serve to drain the resources of a society. Aging and death by this argument serves as a weeding out of individuals who provide no evolutionary advantage.

Weismann argued that human beings were "programmed" for functional decline and death in order that resources were more available for the younger, reproductive members of a population. In Weismann's day this proposal met with a goodly number of objections, but we shall see later on in this discussion that the concept of aging as a genetically-directed program is consistent with the contemporary ideas of many to explain the aging process.

There exist a number of good arguments which have being voiced to refute Weismann's conjectures. To start with, the aging process is well underway before total failure of reproductive capacity. This is particularly true in males, who not infrequently are observed to father offspring well into their elderly years despite aging-induced reductions in quantity and motility of sperm and semen volume. For females, on the other hand, fertility more or less abruptly ends 5 to 10 years before the age menopause (which usually occurs at about the 50^{th} birthday) and fertility is largely reduced by age 35.

Secondly, the "survival of the fittest" operating directive of natural selection can only operate in populations which are a reproductively active. Thinking teleologically, natural selection is not "aware" that aging individuals exist. That is, natural selection cannot act on the aging process.

Another argument holds that elderly, aging individuals may not possess reproductive capacity, but often play important roles in the fabric of society as to offer advantages for species survival. This occurs not only in the obvious contributions of leadership, inventiveness, and creativity during the aging years at a population level but also in providing stability for family structures. Thus, the contention that "the effort necessary to keep an

organism alive is only worthwhile as long as the creature is reproductively active" is, according to many, erroneous.[13]

In respect to this latter point, in the 1980's Dr. Alexander Leaf from Massachusetts General Hospital studied three populations recognized for their longevity: Hunza, a kingdom in the Hindu Kush mountains on the China-Afghanistan border; Georgia; and Vilcabamba, in the Andes mountains of Ecuador. A number of similarities of lifestyles were recognized in all three populations: a poor agrarian culture involving heavy physical labor; a vigorous daily level of physical activity throughout the lifespan; a vegetarian diet; and, pertinent to the point here, a strong respect for the elderly members of society:

> "No one retired was put on the shelf to feel redundant and useless," he observed. "Chores changed, but the elderly continued to do tasks, although less vigorous, continued a useful role for them in the community and supported their self-esteem. Old age was greeted with respect rather than derision, and the elders were valued for their wisdom."[14]

Energy, Entropy, and Aging

The human body can be viewed as a collection of hierarchical machines, operational units comprised of cells organized into tissues which are assembled as organs and then organ systems, each machine with its own specified function. The cardiovascular machine is responsible for the circulation of blood, the pulmonary machine with gas exchange, the endocrine machine works to produce regulatory hormones, the renal machinery for elimination of metabolic wastes, and so forth and so on. Each of these machines are powered by energy, initially generated 93 million miles distant by fusion of hydrogen atoms to form helium in the sun. Plants on Earth convert arriving solar light energy via photosynthesis into the chemical energy contained in carbohydrates, which we consume directly or indirectly by eating animals that feast on plants.

Within the human cells the energy we derive from ingesting foodstuffs goes into operating the task-specific functions of each of the body's specialized machines. That conversion occurs by the process of *oxidation*—the "burning" of carbohydrate and fat substrate by oxygen—in the mitochondria, small organelles within cells that house the chemical reactions that release energy, making it available for cellular functions. The energy pathway, then, that provides for the operation of living beings begins as solar thermonuclear fusion and culminates in the expression of energy for electrical nerve conduction, kinetic muscular contraction, and chemical manufacturing (e.g., production of hormones by the endocrine system).

The sum of all those energy-providing reactions in the body can be measured as the "metabolic rate"—the amount of energy the body is using to run its various machines. As would be expected, bigger animals, with their larger machines which utilize greater amounts of energy via a greater number of mitochondria, exhibit a higher metabolic rate than smaller animals. The resting metabolic rate of a chicken is more than twice that of a rat but only a tenth of the rate of a pig.

If one determined the resting metabolic rate of a large variety of warm-blooded mammals—large and small—and created an equation relating metabolic rate (Y) to body size (X), $Y = X^b$, it would be expected that the exponent b would be 1.0, meaning that a direct linear relationship existed between animal size and resting metabolic rate. Again, the larger the animal, one expects a proportionate increase in metabolic rate. In fact, however, when such an exercise is carried out, b does not equal 1.0 but rather 0.75. This means that *the metabolic rate of a smaller animal, relative to its body mass, is greater than that of a larger animal.*[15] The "metabolic fires" burn more intensively in smaller animals. For example, the resting metabolic rate relative to its body mass of a 30-gram mouse (168 kilocalories per kg per day) is ten times greater than that of a 300-kg cow (17 kcal/kg/day).

An explanation for this negative relationship between mass-relative metabolic rate and body size was initially felt to be a straight-forward one. Smaller animals have a greater body surface area:mass ratio, and therefore need to have a higher metabolic rate in respect to body mass to compensate for a greater surface heat loss. If so, however, according to dimensionality theory, b in the equation should be 0.67, instead of the empirically observed 0.75. The explanation for this discrepancy, despite decades of scientific wrangling, remains uncertain .[15,16]

The point here to be made regarding the aging process is this: When the metabolic rate among a group of animals is expressed relative to body size (Y/X), one finds the equation to be $Y/X = X^{-0.25.}$. As time (t) can be expressed as the reciprocal of rate, the equation becomes $t = X^{0.25}$. The life span (t) of mammals (in captivity) is $t = 11.8X^{0.20}$. The similarity of the life span of animals and their metabolic rate (per body mass) has raised suggestions that life span is limited by how fast the metabolic machinery turns over. The small animal has a high relative metabolic rate and lives for a correspondingly shorter time.[17] Could this be indicating that the duration of life is constrained by a fixed limit of metabolic function?

The issue is not simply one of proposing a metabolic constraint to life's duration but also in explaining the aging process. During the course of aging the number of mitochondria is observed to diminish, and the metabolic function of individual mitochondria decreases as well, both indicating a

regression of energy utilization. Reflecting this, the resting metabolic rate in human beings falls by approximately 10% between ages 20 and 80 years, even when change in the volume of metabolically-active tissue (i.e., fat free mass) is accounted for.[18]

The conjecture that the *rate* of energy production dictates life expectancy provides a construct by which several explanations for aging could be applied. Most specifically, this would imply that a progressive loss of energy availability was causative in the aging process. Loss of energy supply, of course, would be expected to diminish cellular functions. It would also open the door to the ravages of *entropy*, that process which dictates that in a closed system everything moves from a state of order to disorder, and not the reverse.

Entropy reflects the Second Law of Thermodynamics, which holds that part of the change in energy in a certain reaction will not be available for work.[19] That is, energy cannot be created but only changed from one form to another, and in that conversion a certain amount of energy is unavoidably lost as heat. In the end, the amount of energy available for the subsequent work will always be less than the original. And, as a consequence, this one-way process leads to increasing disorganization, which means that everything "wears down" with time.

Living beings must obey the laws of thermodynamics as much as non-living ones. Yet the key point that permits human beings to grow and develop early in the lifespan in apparent disregard of entropy lies in the observation that entropic deterioration is only true in "closed systems." Living beings are, instead, "open" systems, meaning they possess the capacity of pouring energy into bodily functions that exceeds entropic energy loss (that's the real reason why we eat). It is difficult to avoid the conclusion that this unique ability of living beings to spontaneously and intrinsically avoid entropic decay by augmenting energy availability is somehow intertwined with the true essence of life itself.

So, in the early portions of the life span, humans grow and develop in apparent contradiction to the entropic process. Indeed, "so long as they have a source of free energy and a place to dump wastes, there is no reason living things can't keep this trick going indefinitely."[2] But "keeping the trick going" is something that human beings cannot, in fact, do, as indicated by diminishing energy available in the later stages of life, reflecting the decrease in mitochondrial density and function with age. The total availability of cellular energy may fall during aging to less than that needed to compensate for entropic loss. The result, then, would be reflected in loss of cellular function with progressive deterioration of structure and function.

For some, then, the bottom line here is that mitochondrial "fatigue," with resulting limited energy resources leading to a) cell functional decline and b) the deterioration effects of entropy, is the central issue in the aging process. Others are skeptical. Whether metabolic rate can truly explain the length of life has frequently been questioned. Indeed, Silvertown contended that "the rate of living hypothesis is dead", based on the large number of discrepancies among animal species that appear to violate the rule.[20] Moreover, the central question is not answered: *why* would mitochondrial function decline with age?

As one can become quite dizzy trying to sort out the swirl of conjectures over cause and effect and arguments for the utility of various explanatory models for aging, let's distill this discussion to the three processes that are most commonly argued to explain why we age:

The "Wear and Tear" Hypothesis. Although it has been labelled as "deeply flawed," the idea that the cellular machinery simply (and logically) deteriorates as the result of normal wear and tear after many years of constant operation remains popular. That cells and their contents accumulate non-functional byproducts of metabolism is a natural phenomenon, one normally met by mechanisms of cellular repair and replacement. Abnormal proteins are eliminated, chemical damage of DNA repaired, chromosomal breaks fixed—all of this activity is expected and maintains cellular health and function. What appears to happen with aging, though, is that the errors continue, but repair and replacement becomes inadequate, resulting in accumulation of abnormal protein material, abnormal gene function, and cell death. By this account the number of errors in the cellular machine is not affected during the aging process but the function of repair mechanisms is. By this idea, then, the decline in physiological function with age reflects the cumulative failure of human repair mechanisms.

Leslie Orgel and Leo Szilard—working independently—conceived the concept of "atomic aging." They said that as in the process of cellular reproduction, copying errors are sometimes produced. Over a lifetime, these errors accumulate, causing progressive loss of cell information and normal function. However, it has been argued that such a process cannot occur in this fashion, since the normal replacement involves use of nonspecialized stem cells. "It became clear that new muscle cells don't come from old muscle cells or new skin cells from old skin cells—rather they come from stem cells. Just as there are cells that specialize in functions like skin and muscle and liver, stem cells are cells that specialize in reproduction. They are the queen bees of the body, and their progeny can grow up to be whatever they want to be."[2]

The "wear and tear" hypothesis is a seductive, common sense explanation for aging which conforms to our everyday experience that everything around us wears down with time. Still, there is no good evidence that this mechanism, in fact, defines the process of human aging. Specifically, clear cut evidence of a decrease in the cell's repair mechanisms is yet to be observed.[21]

Accumulative Action of Free Radicals. During the process by which stored foodstuffs are oxidized to provide energy for life's functions, a number of "free radicals" are produced as a toxic byproduct. These free radicals, termed collectively *reactive oxygen species* (ROS), include hydroxy radicals, hydrogen peroxide, and superoxide anions, all which carry unpaired electrons which accounts for their destructive aggressiveness. ROS can wreak havoc on the cellular reproductive mechanisms, causing breaks in the DNA strand and modification of its base components as well as disruption in the chemical structures of intracellular proteins and lipids.[22] This destructive process is a vigorous one, with over 100 different forms of oxidative DNA lesions identified.

Normally the body defends against damage by ROS by the action of agents which are anti-oxidants, including scavenger enzymes and vitamins C and E. The free radical theory of aging, introduced initially by Harman over 60 years ago, holds that "an imbalance exists between cellular antioxidants and pro-oxidants in resulting in a chronic state of oxidative stress and a steady-state accumulation of oxidative damage in a variety of macromolecules".[22] In animal models, reports indicating a relationship between metabolic rate, oxidative damage, and lifespan provide support for this theory. In humans, however, Madlyn Frisard and her colleagues failed to demonstrate any relationship of oxidative damage with increasing age.[18] And the animal data indicate simply an association of oxidative damage with increasing age, without implications of cause-and-effect.

Nonetheless, the oxidative stress theory of aging became a very popular one, for it implied that administration of anti-oxidant agents might serve for human beings as an "anti-aging pill," one which would delay the course of primary aging but also protect against diseases that limit secondary aging. Unfortunately, the veracity of such an effect has not borne fruit. The administration of antioxidants as a pharmacological intervention has failed to promote health or longevity in all species studied, including rats, guinea pigs, nematodes, and man.[20,23]

Aging Directed by a Genetic Program. It is possible that any or all of the above proposed mechanisms for aging could be fixed under the control of gene action.[24] The concept that there might be a genetic program for aging (so-called "suicide genes") has been around for a long time, and there is

now substantial evidence for its existence. In the 1990's, researchers found that a single mutation in the nematode worm *C. elegans* acted to augment the worm's life span, up to six-fold in some. Subsequently life-prolonging mutations have been reported in a number of other species, the highest on the evolutionary tree being the mouse (with increases by 50-60%).

Since then the search has been on for genes that regulate longevity and the aging process in man and higher mammals. Progress has been impeded by a number of difficulties in deciphering genetic effects on primary versus secondary (i.e. development of disease) aging. Moreover, the overall heritability (effect of gene action) on life span has been found to be surprisingly low (no more than 35%). Questions of cause and effect are problematic. The recognition that non-genetic agents are important in regulating timing of gene action (epigenesis) has added to the complexity. And, as well, could we be talking about a *decrease* in gene action responsible for cell health rather than an *augmentation* of function of genes that program senescence?

And, then, again, the issue again arises: *why* should such a program of cell action dictating progressive cellular dysfunction exist? To some, answer lies in the idea presented by August Weismann:

> "In evolutionary terms, it is clear why we die. We are useless to the species after we have reproduced and made our genetic contribution. The only talent honored in nature (which is devoid of the finer sensibilities, among them respect for age or personage) is the ability to reproduce. Nonreproducing organisms are of no use whatever to evolution and natural selection; they are just around, clotting up the landscape and perhaps taking food and space away from some younger, upcoming and more successful genetic experiment." [25]

Living Forever

Confronting the functional ravages of aging which forecast our inescapable demise is difficult and often both emotionally and physically painful. And rare would be the individual who would not gratefully accept a "stay of execution." But would one, given the opportunity, really want to live forever? In Natalie Babbit's book *Tuck Everlasting* young Winnie Foster is offered to drink water from a hidden spring on her family's property which will cause her lasting immortality. But the father of the family that had discovered the spring and consumed water—and whose members were now living forever—provides Winnie a poignant warning:

"It's a wheel, Winnie. Everything's a wheel, turning and turning, never stopping. The frogs is part of it, and the bugs, and the fish, and the wood thrush, too. And people. But never the same ones. Always coming in new, always growing and changing, and always moving on. That's the way it's supposed to be. That's the way it is……Dying's part of the wheel, right there next to being born. You can't pick out the pieces you like and leave the rest. Being part of the whole thing, that's the blessing."[26]

Notes

1. Osborne TB, Mendel LB, Ferry EL. The effect of retardation of growth upon the breeding period and duration of life of rats. Science 1917;45:294-295.
2. Mittledorf J, Sagan D. *Cracking the Aging Code.* New York: Flatiron Books, 2016.
3. Read about the effects of caloric deprivation on non-obese healthy humans in Benedict FG, Miles WR, Roth P, Smith HM. Human vitality and efficiency under prolonged restricted diet. Washington DC: Carnegie Institute Washington, Publication No. 280, 1919; and Keys A, Brozek J, Henschel A, Michelsen O. Taylor HL. *The Biology of Human Starvation.* Minneapolis: University of Minnesota Press, 1950.
4. Equally futile and disappointing, the story that Ponce de Léon, the first governor of Puerto Rico, was searching for a legendary Fountain of Youth when he visited Florida in 1513 appears to have no foundation. Or, in any event, he failed to discover it.
5. The caloric deprivation of subjects in Biosphere 2 was not actually an intended outcome of this project. During the two-year confined stay, it turned out that the participants were unable to raise sufficient food (along with other unintended consequences, such as a fall in ambient oxygen content in the Biosphere facility from 20.9% to 14.5% at the end of 16 months of the project as well as an "explosive overgrowth" of the population of cockroaches).
6. Yu BP. Why caloric restriction would work for human longevity. Biogerontology 2006;7:179-182.
7. Holloszy JO, Fontana L. Caloric restriction in humans. Exp Gerontol. 2007;42:709-712.
8. In their hit recording of "Hotel California" the Eagles cite the nightman who states that "You can check out any time you want, but you can never leave." Not only missing the mark on death, the "meaning" of the lyrics of this song have not always been entirely clear. One does have a strong sense, though, that there is something existentially different about this particular Hilton Garden Inn.
9. Kagan S. *Death.* New Haven: Yale University Press, 2012.
10. Two general, well-written books which address the topic of aging in humans are Medina JJ. *The Clock of Ages.* Cambridge: Cambridge University Press,

1996; and Silvertown J. *The Long and the Short of It. The Science of Life Span and Aging.* Chicago: University of Chicago Press, 2013.

11. Read about the multi-systemic decline in physiological function with aging in Kemper H. Skeletal development during childhood and adolescence. Pediatr Exerc Science 2000;12:198-216; Groeller H. The physiology of ageing in active and sedentary humans. In: Taylor N.A.S., Groeller H. *Physiological Bases of Human Performance during Work and Exercise.* Edinburgh: Churchill Livingstone, 2008, pp. 289-308; Robinson S. Experimental studies of physical fitness in relation to age. Arbeitphysiologie 1938;10:251-323. Medina JJ. *The Clock of Ages.* Cambridge: Cambridge University Press, 1996.; Spirduso WW. Reaction and movement time as a function of age and physical activity level. J Gerontol. 1975;30:435-442.
12. Galluzzi L, et al. Molecular mechanisms of cell death: recommendations of the Nomenclature Committee on Cell Death 2018. Cell Death & Differentiation 2018;25:486-541.
13. Medina JJ. *The Clock of Ages.* Cambridge: Cambridge University Press, 1996.
14. Leaf A. The aging process: Lessons from observations in man. Nutr Rev. 1988;46:40-44.
15. Schmidt-Nielsen K. *Scaling. Why is Animal Size So Important?* Cambridge: Cambridge University Press, 1984.
16. Bonner JT. *Why Size Matters.* Princeton: Princeton University Press, 2006.
17. It is fortunate that we human beings sit as outliers to this equation, since this relationship predicts an expected life span for *Homo sapiens* of 28 years. John Tyler Bonner, in his book *Why Size Matters* (see note 16), comments that "It has been suggested that the reason for this is that our comparatively large brain means that our elders may help the general welfare of the group through their storage of wisdom, which has resulted in selection for a long post-reproductive span of years."
18. Frisard MI, et al. Aging, resting metabolic rate, and oxidative damage: results from the Louisiana Healthy Aging Study. J Gerontol. 2007;62A:752-759.
19. Rifkin J. *Entropy. A New World View.* London: Paladin, 1985.
20. Silvertown J. *The Long and the Short of It. The Science of Life Span and Aging.* Chicago: University of Chicago Press, 2013.
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8. Reflections

The eternal current
Draws all the ages along with it
Through both realms,
Overwhelming them in both.
—Rainer Maria Rilke

Many years ago. I am seated on a blanket alongside the Red Cedar River with a date whose identity has long disappeared in the mists of distant memory. A family comprised of a father, mother, and their two children, probably 8 or 10 years old, glides by, paddling a canoe. It is green, and the number 16 stamped on the port bow reveals it to be a rental from the Michigan State University boat house upstream. Spotting us, the presumed amorous couple on the bank, the father cries out to me, "Be careful!" he shouts, "This could happen to you!"

I should have listened.

The Red Cedar River has its origin somewhere upstream near Cedar Lake to the east, just north of Pinckney (which is just adjacent to Hell[1]), and winds its gentle way, with barely a sound, lazily through the campus of Michigan State University. Finally, 51 miles later, it empties into the Grand River somewhere in the political atmosphere of downtown Lansing. Stately elms, maples, and some oaks line its bank, providing a most agreeable shaded canopy.

Those of you who, like me, eagerly await each month's issue of *Advanced Hydrologic Predictions* from the National Weather Service already know that today, as I sit on its banks, the depth of the river is 3.6 feet. Of course, this must be taken as an estimate, since, as the authors of these *Predictions* make abundantly clear, it presumes, but does not actually take into an account, "the precipitation amounts expected approximately 24 hours into the future from the forecast issuance time." And this amount must be recognized to be only a guess, given that, as a result of the ignorance of pre-existing meteorological conditions, the tenets of chaos theory hold that the exact quantity of water that might be added from any rainfall is actually undeterminable in advance.

There is no better moment for musing on the meaning of my existence than sitting before this gently flowing river. Indeed, this peaceful flow cannot fail to move even the most hardened agnostic—here defined as one who denies that there exists an ultimate purpose, or meaning, for our existence. That is not to say that this requires a belief in God, or indeed any other sagacious Theological Deity, who, seated before a console of levers and buttons, directs which NCAA teams win basketball games, or who has healthy children, or just what will be this Spring's cyclonic conditions in Indonesia.

Oliver Sachs wrote that "It is often felt that Darwin, more than anyone, banished 'meaning' from the world—in the sense of any overall divine meaning or purpose. There is indeed no design, no plan, no blueprint in Darwin's world; natural selection has no direction or aim, nor any goal to which it strives."[2] But the river speaking to me today says "no" to this. What is swelling up inside of me is the incontestable sense that I am in some unexplained fashion a part of this river, that together we share some ultimate system, some overall organization, something that surpasses scientific, and even theological, introspection. That sense of "oneness" with nature, I am again quick to say to myself, does not imply a "design" or a "plan" or even a "scheme." It is something grand, for certain, but something I cannot explain.

And, so, it is impossible to sit on the banks of this Red Cedar River with its hypnotizing, dream-like flow and not to *philosophize.* I have a sense that the University's philosophy department, which is located five floors up in South Kedzie Hall, a mere one block north of the river, has dropped the ball here and not taken full advantage. As I scan the list of the esteemed faculty's areas of expertise, one sees topics like Marxism, social and political philosophy, ethics of health care, epistemology, critical theory, German idealism, and environmental justice. But nothing I could see concerning the philosophical nature of moving water.

One would probably agree that all rivers have a personality, or at least conjure up some kind of an image. Like the Amazon—brooding, dark, dangerous. The Mississippi—wanderlust, free spirit, powerful but unpredictable. The Seine—an impressionist's fleecy clouds. The Thames—stately, business-like, conservative. And so on. For the Red Cedar it's tranquility and calm, a place for introspection. A respite. A quiet place apart (Figure 8.1).

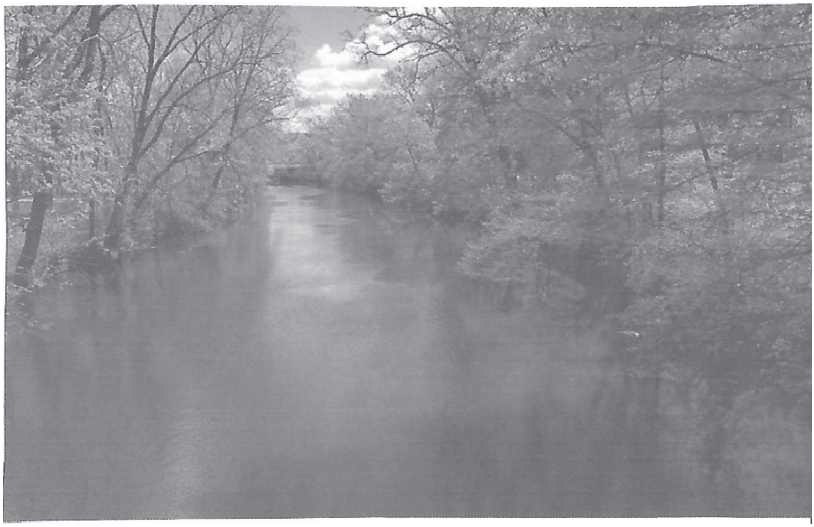

Figure 8.1. The gently-flowing Red Cedar River.

Not that the Red Cedar does not, like the weather, a number of my immediate family members, and the vicissitudes of life itself, have its moods. And it can be mean. For those who cannot remember it clearly, on March 24, 1904, the Red Cedar, in a bit of misanthropic angst, crested at a record depth of 13.40 feet. ("Flood stage," according to my reading of the *Predictions*, is 7 feet.) If this happened today, a goodly amount of Jenison Field House, the Kellogg Center, and the pizza shops in University Village would be underwater. As it is, the University golf course and softball field nowadays often become un-usable due to periodic springtime flooding.

I suspect that when the River does this flooding thing it suffers an aftermath of guilt, much like you and I feel when we lose control of our temper. It felt good at the time, but, you know, when the people out in University Village cannot get their Friday night pizza, a sort of siege mentality takes over, and so now, like, you know, people are beginning to actually *suffer.* And so, as was the case 11 days later back in 1904, the River, shame-faced, then receded to its assigned banks.

Is it possible to sit in front of a river, or a lake, or even an ocean—any body of water, that is, and not find oneself sinking into some "deep thoughts"? Like, what is the meaning of all this? Why am I here? And, critically, what does this jumbled body of molecules consisting of oxygen

joined to two hydrogen atoms by some tough double chemical bonds have to do with such emotions and unanswerable questions?[3]

One idea that a good many have embraced lies in the expectation that this water-me link has something to do with embracing our ancient aquatic origins. We arose from the sea, swimming several biillions of years back in a primal soup, before we'd had enough of all that and climbed out onto a nice beach somewhere. The sea had provided us, like did our mothers, with warmth, nutrition, and security.[4] In gazing at the river am I feeling some sort of an indestructible maternal-infant bond? And, too, the obvious cannot be ignored: the same aquatic environment cushioned us during the nine-month preliminary to our birth on this planet. A good many have waxed poetically on all this, like the historian Simon Shama:

> "To see a river was to be swept up in a great current of myths and memories that was strong enough to carry us back to the first watery element of our existence in the womb. And along that stream were borne some of the most intense of our social and animal passions: the mysterious transmutations of blood and water; the vitality and mortality of heroes, empires, nations, and gods."[5]

They say that except at times of heavy rains the river is safe for swimming, which amounts to about three-quarters of the year. Fortunately, the officials at Michigan State monitor this and kindly post Contaminations Reports to inform those who I assume must have been waiting lined up overnight before the bulletin board at the International Center. The people in East Lansing who live along its banks have at times made some rather negative comments regarding the wisdom of eating fish taken from the river, being worried about the content of the water when it recedes from their front lawns after a flooding. (Think septic tanks, large dogs, lawn fertilizers.) But these are people who one suspects are generally troublemakers, mainly fifth year doctoral students on shaky grant funding, and who are best ignored.

But I don't think it's all just an historical sentiment, this emotion I'm feeling. Why is it, I ask myself, that this flow of water strikes me with such a sense of raw beauty and order that I'm engulfed with a feeling of being at "oneness" with the world, a reassurance that there does exist some mystical essence to my being? I take a deep breath. In truth, I'm grateful, for these are powerful emotions. I'm not entirely sure I desire an explanation. But I can't escape the feeling that it has something to do with the immutable progression of time and the inevitability of change that we humans share with the flow of this river.

Watching the leaves float lazily by on its brown-red surface, this flow of water had a past, an origin upstream, and that it is headed with absolute certainty toward a future destination, five miles away. It does not stop. It is never *here.* No, it only has a past and a future. From one's vantage point on the bank it's always coming or going. Never still. The things this river can teach us! The river is *change.* Our existence is *change.* Neither can step outside the flow of time. We and the river have only future and past. The inexorable flow of time, mirrored in the flowing water in front of me, defines our lives. The duration of our place on the Stage is delimited by a birth and death that are separated by the passage of time. We are but brief actors.

Despite centuries of hard thinking, alongside rivers or not, no one has really come up with a satisfactory answer to "what is time?" But this is the conventional way we've come to think of it in our daily existence. An objective reality, independent of human endeavors. Like a movie reel that unwinds, always forward, linear, absolute, and objective. In this progression of time, a constantly moving "now" creates a defined past from an uncertain future. One can understand it. It fits well with our everyday observations of nature around us—the motions of the heavenly bodies, the tides, the seasons, and the flow of rivers.

But, as the Italian theoretical physicist Carlo Rovelli has asked, when we think about time, "What exactly is this *flowing"?*[6] We can define time only in respect to the duration of something we use to measure it—the periodic swing of the pendulum of a clock, the emission of electromagnetic waves from a cesium atom, the rhythm of the motion of heavenly bodies. The nature of time itself is clouded in mystery, as are the lives of human beings. We could be thinking of our own existence, instead of the nature of time when Rovelli concluded "What distinguishes the past, its having been, from the future, its not having been yet, in the folds of the mechanism of the world…..We cannot change the past; we can have regrets, remorse, memoires. The future instead is uncertainty, desire, anxiety, open space, destiny perhaps. We can live toward it. Shape it, because it does not yet exist. Everything is still possible……"[6]

For some it may be jarring to learn that physicists tell us that this concept of time as an absolute, flowing of future to past is erroneous, or at least incomplete. Instead we must consider time as actually relative, dependent, according to Einstein, on the velocities of its observers, or comprised of a block universe whereby future, present, and past all occur simultaneously, or that time must be considered as part of a space-time continuum. And those who claim to understand quantum theory tell us that at the sub-microscopic level time really has no meaning at all. Some thinkers have

proposed, in fact, that the everyday experience of humans of an absolute flow of time may be only a fallacious construct of our brain's limited view on the "real world," much like our senses telling us that the Earth is flat, and that the Sun, in its progression across the skies, is revolving around the Earth. (Saint Augustine's take on this issue was perhaps the best. When asked "what is time?" he concluded "I do not know.")

Should we really care about these other ideas, these various concepts of time in different domains in the real world? Perhaps, not really. Sitting here, the river's lessons of the inevitability of change and unrelenting passage of time are quite clear. For we normal humans, who are not moving near the speed of light, time evidently just flows by, no matter what we do. And if we were to gather all these thinkers down here for a picnic on the river's banks—sort of a contemporary *Le Déjeuner sur l'Herbe*[7]—perhaps they would have to agree. We humans will stick to a pragmatic view of time, one that fits the narrow realities of human existence. We will leave it to the astronomers and physicists to tackle the "bigger" issues. Where and when did this relentless forward flow of time that we experience in our daily lives first begin? And where will it end? And what how can we describe what happens to time before and after these two particular events?[8]

The very title of Oliver Sacks's book *The River of Consciousness* offers another perspective on how the flow of this river triggers such emotions of connectiveness of my being with the realities of nature.[2] Put this book you're reading here down for a moment and just sit. What are you thinking? (It's a rhetorical question, not demanding an answer). You're carrying on a conversation with yourself within your brain (presumably in your native language). Now, try to stop thinking. You can't do it. Sacks cites the philosopher William James, in his 1890 book *Principles of Psychology,* who contended that "the stream of thought [is always continuous], without breach, crack, or division." The only means of stopping thinking about something is to shift to thinking about something else.[9] The conscious mind is an omnipresent companion that will not clam up.

My own personal identity—*me*—is tied up with my ability to autonomously converse with myself in a stream of consciousness. The river, time, and my conscious self—they all flow on and on, *sans cesse*.

So here I sit, enthralled by the peaceful grace of this river, its beauty. Ah, but now even more difficult questions arise. Maybe ones that are truly unanswerable. What do I mean by "beauty?" And, by what means does my brain appreciate or "feel" the beauty of this flowing water? And, even more critically, is the beauty of nature an objective quality of reality? Or does it require the interpretation of a human brain to make it real? That is, would

the Red Cedar River still possess this quality of beauty if I wasn't setting here, witnessing its slow progression downstream. I find the depths of such questions unsettling. But I can find solace in the fact that I'm not alone on this. Such issues have troubled thinkers since forever, with no answers yet in sight.

Only after a great deal of hesitation do I reluctantly evoke the time-worn quandary that might, in fact, shed some light on these questions of the nature of beauty:

If a tree falls in a forest and crashes to earth with no person there to hear it, does it make a "sound"? With some attention to semantics, perhaps this question can be satisfactorily resolved. And maybe we will be able to say the same thing about the objective and subjective nature of beauty.

The tree falling to earth creates a physical disturbance in the molecules and atoms in the air that surround it, resulting in alternate waves of compression and expansion at a certain frequency. So, in this physical act, the tree crashing to earth has provided a necessary substrate for "noise"—an objective reality. But then a "sound" can only be created in the human brain as the different portions of the auditory apparatus transmit electrical signals to brain centers that are interpreted in our consciousness as a "sound" of the tree crashing.

One can only conclude that *both* an objective, physical reality (the falling tree initiating waves of air) and an interpretive receiver (the ear and brain turning the rarefaction and compression of air into a conscious event) are necessary for "sound" to be appreciated. Without either of the two inputs, there would be no sound.

One might approach the question of the nature and interpretation of "beauty" in the same fashion. Is there evidence for an objective physical reality, independent of human interpretation, of beauty? By what mechanisms might the brain turn sensory input (particularly visual and auditory) into a sense of "beauty" appreciated by one's consciousness?

The argument for an intrinsic, independent beauty in the natural world has been grounded on three premises: a) there exists "truth" as an ultimate absolute reality in the universe, b) this truth is characterized by beauty, and c) the essential goal of science is the uncovering of this beauty-in-truth. So science, truth, and beauty get all mixed together. Science seeks truth, truth is expressed as beauty, and a valid scientific construct or theory should be characterized as one that possesses beauty. "The metaphor since at least the seventeenth century, has been of the world as a beautiful machine."[10]

Such assumptions have been the source of a long-standing dictum that proposes that beauty is evidence of truth in scientific investigations. The cosmologist Janna Levin has summarized nicely this sentiment that "In

science we really hold onto beauty and elegance as the goal, because, for reasons I think nobody fully understands, it's a good criterion for distinguishing what's right from what's wrong. And if something is beautiful, it's probably right."[11] She is echoing here the quotations of a good many others (including the likes of the poet John Keats, Galileo Galilei, the French mathematician Henri Poincaré, and Bertrand Russell): "the evident power of aesthetics as a guide to scientific sensibility."[10]

But what exactly is this "beauty" whose essence is so critical to the reality of the world? Many authors have tried to pin this nature of natural beauty down in words, none entirely successfully. The biologists Arturo Casadevall and Ferric Fang considered natural "beauty" in the guise of "elegance," in which a phenomenon or scientific theory exhibits "precision, neatness, and simplicity." They proposed scientific elegance as meeting criteria of "being clear, clever, correct, explanatory, and parsimonious," using Darwin's theory of evolution and the double helix model of DNA as examples.[12]

In his book *A Beautiful Question. Finding Nature's Deep Design,* the physicist Frank Wilczek provides an historical take on this question. Such a discussion far exceeds the purview of this chapter, but to summarize very briefly: Pythagoras and his followers in the Fourth Century B.C. felt that beauty and harmony were linked to ratios of numbers, evident in stringed instruments, a "truth" which extended to the motions of heavenly bodies. The geometrical principles set forth by Euclid (and still challenging today's high school students) were long considered reflective of an ultimate beauty and truth in the universe. Newton's laws were dynamical in nature, expressing beauty of motion and change, unlike the "static beauties" of Euclid and Pythagoras. In another domain, Einstein's laws of relativity and his formulation of a space-time continuum are considered elegant and beautiful. Even in the subatomic level of quantum mechanics, the equations for energy, light, and the elements of the Standard Model are considered to "embody beautiful ideas."[13]

Wilczek considered two features as central to "Nature's artistic style": First, *symmetry*—exhibiting harmony, balance, and proportion, and, second, *economy*—producing effects with a minimum of means. Importantly, he proposed that all this natural elegance and harmony served as the basis for our personal interpretation of beauty: "When we find that *our* sense of beauty is realized in the physical world, we are discovering something about the world, but also something about ourselves." So here we are already gaining insight in the shared relationship of an objective natural beauty and that perceived and interpreted by the central nervous system of human beings.

It should be recognized that there is a growing suspicion on the part of many that the assumption of obligatory connections between beauty, truth, and "good" science may be false. The theoretical physicist Lisa Randall, for one, remains skeptical. She has contended that the assumption that truth and beauty are linked is "a little slippery." And that simplicity and symmetry, which define beauty, may vary with different descriptions of the reality as revealed by science.[14]

Such skepticism is being fueled by growing evidence indicating that the natural universe is not, as previously supposed, a harmoniously-regulated set of phenomena but in reality is rather "the result of imperfections, imbalances, and asymmetries." Wrote David Orrell, "The [natural] phenomena we are dealing with are best seen not as part of an elaborate machine but as part of a complex organic whole. A defining property of complex systems is that they exhibit what is known as emergent behavior: properties which emerge from the system but cannot be predicted using knowledge of the system's components alone. This …calls for a new aesthetic, that we will no longer look for neat Theories of Everything which unify phenomena over all scales. Instead models are more like patches which reveal a portion of the complex whole." We need, he concluded, "a shift in aesthetics, from order and symmetry to something more complex, organic, and messy…Whether a theory or experiment is in some sense ugly or attractive should not enter the calculation. All that matters is whether it works. Beauty is the province of (non-modern) art museums."[10]

So much for an objective beauty of the natural world. What about the receiving end of this equation, the perception and interpretation of something, like a river, as beautiful by the human mind. How does this work? There would be little argument, one supposes, that beauty exists "in the eye of the beholder." That is, a sense of beauty is defined by the brain but lacks an objective sense—what is beautiful to you may not at all be for me.

To start with, this perception of beauty would seem to be, for some reason, a critical feature of human consciousness. As George Santayana wrote, "There must therefore be in our nature a very radical and wide-spread tendency to observe beauty and to value it. No account of the principles of the mind can be at all adequate that passes over so conspicuous a faculty."[15]

In addressing this issue one is immediately confronted with another classic philosophical dilemma—the problem of mind-body duality. On one side of this argument the *physicalists* contend that all mental functions can be explained by biophysical-chemical processes, that our brains are essentially extraordinary neurochemical machines. One's sense of what

constitutes beauty, then, would lie somewhere in the billions of connecting networks of neurons that fill the cerebral cortex.

Others (the *dualists)* would say "no," that human beings are blessed with a spiritual essence that transcends simple physical-chemical mechanisms, that in this sense our minds are separate from our physical bodies. "Beauty" then is an interpretation that speaks to a more spiritual explanation, something more profound than the myriad electrical connections in our brains.

In recent years the pendulum of opinion has generally swung toward a physicalist view of brain function and interpretation of beauty, among together activities, due largely to the advent of neuroimaging techniques (such as functional magnetic resonance imaging) that can identify specific areas of cerebral activity related to specific emotions or functions. There has developed, in fact, an entire area of scientific investigation termed *neuroaesthetics,* defined as the field of inquiry that seeks to understand the biological bases of human aesthetic experiences.[16] Most investigations in this area have involved neural responses to perceptions of art, music, and sculpture, and in this way become entangled with questions of "what is art?" as well as neural substrates to human aesthetic appreciation. Too, these studies seem to differentiate "emotional responses" from aesthetic ones, a distinction which is difficult to make when considering the psychological impact of gazing upon the hypnotizing flow of a lovely river.

The difficulty of definitions, in fact, has been viewed as a "conceptual stumbling block" for the field of neuroaesthetics. As Marcus Pearce and his colleagues have written, "one of the major sources of criticism of neuroaesthetics has been characterization of aesthetic experience—its very object of study. This might seem alarming and unprecedented, but is not uncommon in the history of science. At one stage, biology had to grapple with the question of what life is, and physics with the questions of what matter is" (which, of course, they still do).

Such issues notwithstanding, information regarding neural responses to and interpretation of beauty may have relevance to the Red Cedar in front of me. Subjects who have been shown beautiful pieces of art have been demonstrated to activate particular brain regions. For instance, facial portraits increase activity of the fusiform gyrus, while a landscape painting stimulates reactions in the parahippocampal gyrus. Beautiful visual images and music cause responses in other regions as well, such as the oribito- and medial-frontal cortex, ventral striatum, and cingulate cortex. Importantly, neuroimaging studies like these reveal diffuse network connectivity with multiple other brain areas that are related to memory, attention, emotion, and social cognition. This provides neural evidence, then, for the

expectation from common experience that human interpretation of beauty is subjective and highly personal, conceived in the brain as a synthesis of experiential and cultural influences. As Pearce et al. put it, the aesthetic perception of beauty is "the quintessential essence of those experiences: their unique, privileged, and individual quality."[16]

Through breaks in the shadows covering the river one sees sparkles of sunlight reflecting off the water, reminding me that the personality of this river has its light side, too. It says that the meaning of human existence may be an important topic, but certainly no more than the nature of human pleasure. And the pleasure it speaks of is—ice cream. Ice cream? Yes, and here one can struggle with a new philosophical nut, the acceptability, the existential ethos, of hedonistic pleasure. Let me explain.

As the river enters the central campus, just upstream from where I am sitting, it passes by Anthony Hall, which houses the University Dairy Store, a true gastronomic mecca that serves arguably the most superb ice cream in the Free World. The Store is operated by Department of Food Science and Human Nutrition, with the ice cream plant itself just behind, manned (and womanned) by students pursuing careers in the dairy and food processing industries. In my next life, this is what I want to be when I grow up.

The flavors are many yet, sadly, one's gastric capacity is limited.[17] Thus, one must choose. There's Banana Choc-Eye Chunk. But, maybe, Pralines-N-Cream. No, it's got to be Golden Apple (that's cinnamon ice cream with candied apples and cinnamon shortbread pieces). There's even a flavor for each of the Big Ten schools. Like Badger Berry Cheesecake (cheesecake ice cream with a strawberry swirl), and Buckeye Blitz (peanut butter ice cream with thick fudge swirl and buckeye candies), and Gopher Smore (marshmallow ice cream with a chocolate swirl and graham cracker pieces), and Hoosier Strawberry (self-explanatory), and Husker's Sweet Corn (with real sweet corn pieces), and Illini Orange Crush (orange ice cream with pineapple chunks), and Maize-N-Berry (vanilla with blueberry pie-filling swirl and pie pieces), and Nittany White Out (vanilla with salted caramel swirl and white chocolate covered pretzel pieces), and Purdue Tracks (vanilla with a caramel swirl and caramel-filled footballs), and Wildcat Crunch (vanilla with blackberry swirl and cinnamon shortbread pieces). For local Spartan fans one has to give a try to Dantonio's (he's the head football coach) Double Fudge Fake (chocolate fudge ice cream with a caramel swirl, milk chocolate caramel-filled footballs and chewy brownies).

But just what is it that makes this ice cream so superb? I would guess that it has something to do with generous amounts of butterfat, limited additions of air, and, most particularly, fresh, high quality dairy products.

The latter are provided, of course, (this being at heart an agricultural school) by the University's own dairy herd.[18]

So, now we come to the principal (and for some, disturbing) question that arises as one departs the Dairy Store, mountain of hedonistic delight perched on a waffle cone in hand. Should one have some kind of lingering guilt about indulging in this kind of gastronomic pleasure? After all, we recognize that

Medio de fonte leporum,
Surgit amari aliquid quod in ipsis floribus angat.

That is to say, "From out the very fountain of delight, rises some gall, our merriment to blight." What about that? A reason to hesitate, to worry? Well, it would seem to depend on whom you listen to. To take just a few examples of great thinkers who have weighed in on this issue:

Epicurus (b. 341 B.C.). Epicurus contended that happiness in life hinged on indulgence in sensual pleasures. This, he claimed, was particularly expressed in enjoyment in good food. Based on rumors circulating during his life, one can guess that Epicurus would have self-induced vomiting at last twice a day so that he could head back to the Dairy Store for a re-fill.

Pythagoras (b. 575 B.C.). Pythagoras (he of the Theorum) founded a secretive and highly devoted cult which espoused a meditative, ascetic lifestyle. This demanded a simple, plant-based diet, without meat. One story goes that among his followers, temperance in all things dictated a suppression of sensual appetites. Consumption of beans was particularly forbidden, since it was considered that this would cause flatulence and interfere with intellectual contemplations.

Kierkegaard (b. 1813). This Danish philosopher said that repetitive sensual gratifications would ultimately become boring, which could be transiently escaped by only more indulgence. He would have said that ice cream cannot drown out the anguish and melancholy that is intrinsic to our existence. We need, he said, to replace [ice cream] with something that possesses a more spiritual and intellectual basis.

Freud (b. 1856). By his "pleasure principle," Freud contended that our mental processes strive to obtain pleasure and avoid unpleasantness. But this gets all confounded by issues of sex, death, pain, emotional trauma, dreams, and the like, and so it is not exactly clear how he would have stood regarding a lust for ice cream.

Schopenhauer (b. 1788). This German thinker felt that "the world is an absolutely utterly vile and ghastly place" and that "existence itself was a terrible mistake." From these comments it is clear that he never visited the MSU Dairy Store.

Whom to believe? The reader is free to choose.

I would suspect that for most readers, raising the question of "guilt" here triggered images of expanding waistlines instead of such philosophical issues. To my mind, this can be dispensed with quickly. What would life be worth without ice cream? The question barely deigns a response. So, end of discussion on this point.[19]

There is one more emotional stirring evoked from this river that I'd like to address. This one is more personal, a bit of nostalgia, a Proustian remembrance of times past, and for this I will seek the reader's forbearance in recounting it here.

The Red Cedar meanders east-to-west through the campus beneath its shady canopy, past the library, and then the botanical gardens, and on towards the athletic fields. On the left stands Spartan Stadium, where the river has each autumn bore witness to the Spartans' ascendancy as a national football power. The team first "arrived" in the early 1950's, when in 1952, under coach "Biggie" Munn, they went undefeated and took the national football title. The next year MSU joined the Big Ten conference, and credibility was immediately gained by winning the conference championship and going on to a victory over UCLA in the Rose Bowl. Those were certainly intoxicating times for MSU fans. I was there, didn't miss a home game in six seasons. Knew by heart all players by their numbers (#63 Roland Dotsch, #32 Ellis Duckett, etc.).

We worshipped the "Pony Backfield"—Tom Yewcic (#41) quarterback, Leroy Bolden (#39) halfback, Evan Slonac (#33) fullback, and Billy Wells (#14). "Pony" because these guys *averaged* 172 pounds. Bolden stood 5' 8". Some publicist created a picture of the four of them, in full uniform, sitting astride four small horses. On the gridiron they were champions. Since then there have been many great players at MSU, but nothing has surpassed the Pony Backfield.

It is a sobering thought to recognize that the "Pony Backfield" is now gone. Wells died in California at the age of 70 years in 2001. Bolden, called a "loner," passed away in 2008 with "no survivors" noted by the funeral home. These were the heroes of my youth, a fantasy world of super-human feats and touchdowns and winning field goals. Their deaths leave me with a *gnawing emptiness.*

I wonder if the River feels the same way.

So, I'm about to bring this discourse to an end. One can only sit and contemplate so long beside a quiet river before succumbing to gluteal numbness. As I stand up, I see the campus buildings on the far side of the river, through the trees. There are tens of thousands of young people over there, scurrying to get to their 2:00 lecture. They're over there learning how to be engineers, botanists, journalists, farmers, hotel managers, teachers, lawyers. Looking for lives of achievement, competition, comparison. But are they learning to *live*? Are they ever asking themselves questions? What is important? What is lasting? Are there options to consider? Are there better ways to conduct a life? What am I *doing* here?

Listen to the river, young people. If they were to ask me, that's what I'd say to them. Listen to what it tells you. There is much there to learn. Important things that you don't learn in textbooks. Things about how human existence reflects the flow of time, about the union of the human spirit with the natural world, about the meaning of beauty, about sensory pleasures, about bittersweet recollections of *le temps perdu*. Sometimes I wish that someone had said this to me. Maybe there were, in fact, options. In particular, maybe I should have embraced the advice provided by strangers paddling canoes in quiet rivers.

Notes

1. Hell is a small community in the lower part of the state of Michigan, boasting a few handfuls of inhabitants. I have visited Hell (the one in Michigan) a couple of times and have, quite frankly, found it a bit disappointing. The major commercial focus there is that of selling postcards that say nifty things like "This is the card from Hell" and things like that.
2. Sacks O. *The River of Consciousness.* New York: Alfred A. Knopf, 2017, pp. 21-22.
3. To read on everything you ever wanted to know about water—spiritual or otherwise—consult Philip Ball's book *Life's Matrix. A Biography of Water.* New York: Farrar, Straus, and Giroux, 1999.
4. It should be recognized that we have not, in fact, truly escaped our primitive aquatic environment. And a good thing, too, for without each cell of the human body being constantly surrounded by water, with its supply of nutrition, mineral content, and oxygen (not to mention the removal of wastes), we would not survive. All of this is provided thanks to the cardiovascular system, which developed in an evolutionary way as animals escaped their watery confines and moved onto land. The flow of blood (dare one say, like a river?) in arteries, capillaries, and veins, pumped by the heart,

provides the same life-sustaining aquatic environment as our primitive ancestors enjoyed in the primitive seas.

5. S. Schama. *Landscape and Memory.* London: HarperCollins, 1995, p. 247.
6. The book sellers are filled with works seeking answers to the nature of time. One of the most recent, *The Order of Time,* by Carlo Rovelli (New York: Riverhead Books, 2018) has provided a most stimulating discussion on the issue.
7. Famous *tableau* by the French impressionist Edouard Manet, which attracted attention not for reasons of defining the nature of time but rather the unexplained nudity of the young lady eating lunch in the left foreground. This took the unwary Paris public by surprise, since at the time (1863) it had not been recognized that enjoying a picnic lunch on the banks of the Seine in the altogether was an option.
8. E-mail me if you have any answers to these questions.
9. This observation bears particular significance in situations in which it is inadvisable to "think." Such as when you step to the foul line to shoot a free throw with the score tied and 0:02 to play. Or when serving at match point. The experts say you *must* focus your thinking on something other than the importance of the moment—the front rim of the basket, for example, or the fuzz on the ball. Otherwise you will self-destruct.
10. Orrell D. *Truth or Beauty. Science and the Quest for Order.* New Haven: Yale University Press, 2012, p. 7.
11. Levin J, Lethem J. The truth of fiction. In: Bly A (ed). *Science is Culture.* New York: Harper Perennial, 2010, pp. 131-136.
12. See Casadevall A, Fang FC. Elegant science. Mbio 2018;9:e00043-18.
13. Wilczek F. *A Beautiful Question. Finding Nature's Deep Design.* New York: Penguin Press, 2015.
14. Randall L. *Knocking on Heaven's Door.* New York: Harper Collins, 2011.
15. Santayana G. *The Sense of Beauty: Being the Outline of Aesthetic Theory.* New York: Scribner, 1896.
16. Read about the exciting new field of neuroaesthetics in Chatterjee A, Vartarian O. Neuroaesthetics. Trend Cogn Sciences 2014;18:370-375; Pearce MT, et al. Neuroaesthetics: the cognitive neuroscience of aesthetic experience. Perspect Psychol Sci. 2016;11:265-279.; Meskin A et al. Philosophical aesthetics and cognitive science. WIREs Cogn Sci. 2018;9:e1445.
17. The experts say that, when stretched to its maximum, the adult human stomach can expand to a volume of about 2,000-3,000 ml. (although you'd pretty uncomfortable at this point). Now, if a single-dip ice cream cone, melted, is, say, about 330 ml., that means that one could consume in the neighborhood of 6 to 9 different flavors in one sitting. Good luck with this.
18. One doesn't actually see cows when visiting the Dairy Store, but you have the strong feeling (or is it "sense," or perhaps more accurately, "scents"?) that they're very nearby. Indeed, in the bull barns to the south of the main campus there exist some monsters that you would not want to see loose. (It is well-recognized that there is nothing more soul-satisfying to do in East Lansing on a Sunday morning with the family after church than pick up a

bag of donuts and head on out to the bull barns. Really. They're open from 7 AM to 3 PM., and you're free to get up close to these guys, some who weigh as much as half a ton. Students there, who do research and learn how to manage these beasts, take courses such as ANS 222 (Introductory Beef Cattle Management) and ANS 300A (Advanced Lifestock Judging). This is really eye-opening for us big-city people.

19. There is, however, one health risk here that bears more serious consideration, and that's the "ice cream headache." I think you know what I mean. With zeal you dig into your pile of coconut chocolate almond delight when—*shazam!*—you suddenly are struck with a sharp bilateral pain across the forehead which can be most unpleasant. Now we're talking about a real public health issue. And I have been relieved to discover that this malady has not escaped scientific investigation.

To start with, it's common. In one study of over 8,000 Taiwanese adolescents, 41% reported experiencing an ice cream headache at one time or another. The pain is triggered by cold applied to the back of the palate, so avoiding contact of your strawberry swirl with this region can help. It will almost predictably disappear in 10-20 seconds. An interesting finding in one study was that headache caused by applying crushed ice to the palate could only be induced in hot weather. It didn't happen in the winter months. The most gratifying aspect of all this research has been that there is a general consensus that abstinence from ice cream is not necessary.

ENTR'ACTE II

FOUCAULT FOR THE TELEVISION FOOTBALL WATCHER

A SHORT POEM

[The philosopher and social theorist Michel Foucault (1926-1984) was a critical and outspoken observer of the human condition. Born in Poitiers, France, and educated at the Lycée Henri-IV, he rapidly rose in influence in French intellectual circles. The range of his ideas was wide but focused mainly on a disdain for the oppression of individual freedoms by authoritarian tyranny, most particularly the suffering of disfranchised and marginalized persons (i.e., prisoners, the insane, homosexuals). Although highly influenced by the ideas of Fredrich Nietzsche, Foucault was not always in accord with those of contemporary philosophers such as Jean Paul Sartre. He died of AIDS in Paris in 1984 at the age of 57 years.[1] Despite the impact of Foucault's ideas upon the intellectual climate of the time, his "impenetrable" writings were often difficult to understand. Consequently, Foucault's works have been generally inaccessible to the average man in the street, who would prefer instead a beer in an easy chair in front of the television. As a service to these individuals, the following was composed to bring the ideas of Foucault down to the level of parlance of the common man.]

Winning the coin toss
And electing to defer
This and humanism
Denials of Nietzsche's will to power

So is going for one after a score.
One reaches heaven through hell. Take risks!
Like up in Minnesota when
They often gopher two.

An errant toss, since they weren't on the same page.
Foucault and Sartre couldn't hook up.
Some rancor over humanism.
Getting "chippy" out there.

Iranian revolution
He didn't like what he saw, called
Time out!
And reversed field. Too many lopped heads.

Late hit out of bounds after a scramble
Is a "limit expression"
Like drugs, and S-M sex
Pushing beyond the limits of propriety.

Penalized, that is.
But, no.
To walk off 15 denies
The realm of human possibilities.

Those in striped shirts
Embodiments of the moral and
Physical dictates of the game.
See it otherwise.

Such punishment means societal control
Of behavior
So, save your soul and refuse the penalty
And take the down.

Would one gamble on fourth and one
Like free sex in San Fran baths?
A hard count to draw an offside flag
Could move the chains.

He's open in the flat
Clearly marginalization of the individual.
Better to be integrated
Into the crowd? No, a certain pick six.

Single wing→ T formation→the "I"→the "pistol"
Forget the arrows.
The game is independent in its own right
Like language.

Flowing words, not just to tell a story
Have intrinsic value in themselves
Like the nickel back and the zone read
(What exactly do these mean?)

Knowledge is power.
Power makes knowledge.
Sensing the blitz
Throwing a quick slant.

From the blind side
Tacklers have their ears pinned back
Escape the rush! Resist
Institutions that smother free spirit.

Escape the grip of powers
The grasp of society
Yards after the catch
Count the most.

The intellectual *engagé*
With earphones up in the booth
Signals traps and fly sweeps
Things like that

Bo, Woody, and the Bear
Preached **team**
Individual freedom for Foucault
Reconcile-able?

The hermetic quest for self
What value one's existence?
After further review

Just a black hole off tackle?

Embrace the costs of pursuing an ideal
Give up your body
Lay it out
For six points.

Evil, madness, torture, death
Trash talk, sideline interference
Chop blocks, rub routes
Are all positive experiences.

Sudden death
In overtime victories
Is sweet
And authenticates life.

But taking a sack
Running out the clock
Icing the kicker
Denies the glory of enlightenment.

Putting yourself "out there"
The true author, life, and the football player
All require
Leather balls.

Note

1. To learn more about the life and works of Michel Foucault, read Gutting G. *Foucault. A Very Short Introduction.* (Oxford: Oxford University Press, 2005); and Miller J. *The Passion of Michel Foucault.* New York: Simon & Schuster, 1993.)

9. MUSIC

Music is the language of the spirit.
—Kahlil Gibran

Ultimately, music is meant to move our souls, to stir our emotions, to arouse us to swing by its rhythms, and this cannot be achieved by mathematical principles alone.
—Eli Maor

And there was music, when I
Marched into my high school graduation ceremony
Worked on a manuscript over a *pain au raisin* in my favorite coffee shop
Caressed the face of a beautiful woman
Waited on the line for the next available agent
Stood and proudly faced the flag at Fenway Park
Watched a father walk his nervous daughter bride down the aisle
Sat beneath a constellation canopy over the lawn at Tanglewood
Watched Eric Liddell run the beach in *Chariots of Fire*
Drank beer with Bill Bullard at the Schwaben Bar
Rocked my newborn son to sleep
Witnessed Bob Timberlake celebrate the winning touchdown against Ohio State
Exulted at Fourth of July fireworks on the Esplanade
Sat downfaced at my brother's funeral

Music, defined from a scientific perspective: A series of alternate rarefactions and compressions of traveling waves of air molecules produced by the vibrations of a string, or vocal cords, or a column of air, with a base frequency and its multiples comprising a *tone.* Reaching the human ear, the vibrations in the air are transferred by the eardrum to physical vibrations of the boney structures of the middle ear, then sent as fluid vibrations in the cochlea of the inner ear. Here the mechanical vibrations are converted to electrical signals. Ionic shifts across cell membranes in the cells of the nervous system cause this electrical signal to be transmitted to auditory centers, where the electrical signals are appreciated by the human

consciousness as rhythmic sounds. (So all music is, in the final analysis, electronic.) Here a series of tones are interpreted by the brain as music. The auditory cortex, the part of the brain that recognizes sounds, is located in the temporal lobes. From here, neural connections radiate out to other areas which are known to become active in recognizing rhythm and pitch. Importantly, neuroimaging techniques indicate that neural connections exist that link incoming sounds of music to more primitive regions of the brain, such as the limbic system and amygdala, which are considered important in generating emotions.[1]

The neurotransmitter *dopamine,* which facilitates electrical communication between nerve cells, appears to play a key role in this function of these "musical networks." When animals listen to music, the dopamine activity of their brains increases.[2] A study in humans indicated that genes responsible for secretion and transport of dopamine were more active when subjects listed to classical music.[3] This finding may be significant in that dopamine is recognized to play a critical role in mental processes that provide us with pleasure (your morning coffee, falling in love, etc.). Here then is a potential chemical basis for the deep satisfaction one feels in listening to a favorite piece of music.

By this account–which is the best that science can provide us at present—"music" can be described as patterns of activity of a purely mechanical/electronic/biochemical phenomenon. Just a matter of physical forces, and neurochemical changes, and cerebral electrical wiring.

But, no!, would react a goodly number of readers who would find this definition of music altogether sterile, deprived of any intrinsic spiritual value or deeper meaning. The philosopher Peter Kivy, who was an expert in aesthetics of music (d. 2017), would be among them. In his critical book *Music Alone. Philosophical Reflections on the Purely Musical Experience* he wrote:

> "[This model] takes pure music to be a physical stimulus that, by interacting with our sense organs and, through them, the rest of our auditory apparatus, puts us in a pleasurable state. It is directly analogous to the way wine intoxicates us and sugar pleases the taste but wormwood doesn't. It is an utterly hopeless view, but more than merely antiquarian interest impels me to take it up. For it is my experience that a surprising number of well-educated and musically sophisticated people still hold such a view, believing, somehow, that when it is stated, not of course in seventeenth century terms but in those of modern neurophysiology, it is the 'scientifically correct' account of the matter."[4]

In the late Seventeenth Century, Gottfried Leibniz provided a very similar description of the process of appreciating music, except that instead

of the transmission of electrical signals carrying "music" to the various parts of the brain (which, of course, he knew nothing about), he substituted "Music charms us, although its beauty consists only in the agreement of numbers and the counting, which we do not perceive but which *the soul* (italics mine) nevertheless continues to carry out…" Ah, so here we encounter the idea of music as an expression of the human spirit. Indeed, authors, musicians, psychologists and a whole lot of others have been waxing poetically on this for centuries. In the Fall, 2017, issue of *Lapham's Quarterly,* entirely devoted to music, the following quotations were culled (listed here with apologies to their original authors). Music is:

A universal language
The sound of nature
An expression of the highest states of human consciousness
The quintessential of life
The mosaic of the air
The capacity for saying the unsayable
A beautiful opiate
Our myth of the inner life
Immunity from death
The Deity's chief instrument
Wild sounds civilized into time and tune
Born free
Invented to deceive and delude mankind

One is challenged to think of another earthly phenomenon that commands such descriptions. And all this surrounding a sense—the auditory one—which is not a principal means by which human beings engage and navigate through the "real world." Music, to many, serves as an expression of the human soul, not being simply a matter of pleasing sounds, which possesses spiritual qualities. From this view point the harmonies of music are by some means capable of mining the depths of the human psyche. And so on, with progressively more eloquent metaphysical analogies.

In assuming this position one necessarily becomes a *dualist*, holding to the idea that there exists a separate spiritual mind apart from the physical body. This idea of a mind-body duality has taken a hit in recent years with neurophysiological information indicating a neurochemical-anatomic substrate for a good many cerebral functions that might have once fit into the "mind" category (subconscious influences on day-to-day choices, for example). On the other side of the argument, the *physicalists*—those contending that mental processes are generated by basic physical-chemical

processes—are happy with the hard-wired definition of music interpretation outlined at the beginning of this section.

One wonders how proponents of a mystical meaning for music would respond if they were asked to pinpoint exactly what they mean by such a transcendental viewpoint. Just what is the "human spirit"? And how does a melody, a series of musical notes, activate this elusive entity? (Contemporary thinkers, in line with current psychological concepts, would substitute "the subconscious" for the soul and retire with impunity.) In truth, Professor Kivy was not taken with this spirituality explanation, either: "Music makes straight for the inner life: it is one of those all-too-familiar claims about the mysterious powers of music, claims we have had since Orpheus tamed the wild beasts…Surely we want more than an enthusiast's assurances that music, or anything else, can entirely reverse the usual pattern of our emotional lives before we accept such an audacious claim. We want some believable account of how the thing is done."[4]

Kivy proposed an alternative viewpoint—that listening and enjoying music was an active, *cognitive* process. "According to the cognitivist, music possesses emotive qualities that the listener recognizes there. In other words, we hear emotions in the music, we do not feel them in ourselves." This would be true particularly for what has been called representative music—that which tells a story. Hector Berlioz' *Symphonie Fantastique* (a flight of imagination of a cocaine-drugged victim of unrequited love, along with a ball, a witch's sabbath, and a march to the scaffold, the latter which, not surprisingly, ends badly) and *The Four Seasons* by Antoine Vivaldi (the musical representation of the annual parade of nature) could be cited as obvious examples. But Kivy took this explanation one step farther, suggesting that pure music—that which is not "programmatic"—like, say, a Beethoven string quartet—also transmits auditory meaning though active listening.

From this idea some interesting questions arise: Does a certain piece of music make us sad? Or is the music itself somehow sad, and we simply recognize this? Put another way, does music express emotion (i.e., sadness), or is it that music moves us to respond with sadness? There exist major difficulties on both sides of this argument. First, how can a piece of music, by itself, a series of rhythmic notes, possess the quality of "sadness"? We know precious little about the origin and nature of emotions, but one thing that would appear certain, they are a product of the human brain. Emotions are "conscious states." How could a piece of music possess such a character? But, on the other hand, we normally sense emotions in response to some event or trigger. You get angry when a driver cuts you off on the highway, you are saddened by the death of a friend. If a piece of music

makes me sad, what is the object of that emotion? "We have no explanation…in place for how such emotions could possibly be aroused by 'organized sound'," wrote Kivy. "We are at a complete loss."[4]

In the final analysis, one is free to adopt—or reject—any of these particular interpretations of the undeniable—and often-times powerful—human emotional response to music. They're all just conjectures, flights of one or another person's dogmatic imagination. Despite advances in our knowledge of neurophysiological events, just what constitutes music and how it nudges the human brain into this or that emotional response remains *terra incognito*. When the scientists can lay out a plausible explanation of what it means to be sad, or happy, or angry, or proud—then we can begin to find some answers. But for now, you're on your own. As Philip Heseltine concluded,

> "The fact is that when we come to the fundamental question of what music really is, we are all—composers, critics, and public alike—very much in the dark….Music's a rum go."[1]

May 29, 1913. Le Théâtre des Champs-Elysées, Paris

The members of the audience that filed into the Théâtre des Champs-Élysées on 15 avenue Montaigne that Spring day must have had some inkling that they were about to witness a musical performance out of the ordinary, something innovative. What they didn't realize, though, was that they were about to participate in one of the most striking historical examples ever of the power of music and dance over the human emotions—and a negative one at that. They would become eyewitnesses that afternoon to what was to become a legendary near-riot of angry displeasure in response to the jarring rhythms of the premiere performance of Igor Stravinsky's *Le Sacre du printemps.* Riots. Now, usually such events in the French cultural landscape occur in the backdrop of barricades, flag-waving and slogans touting brotherhood and liberty, and an inconvenient shutdown of the rail system. Such public disturbances are not to be expected of the social *haut de gamme* who subscribe to classical music series. But riot, they did. Such is the power of music, or—as they interpreted it—very bad music and bizarre choreography. Scandalous!—from all points of view.

Picture yourself among them. You've found your way to Row N seat 18, on the aisle, from where you can see the vaulted ceiling of the new théâtre (which you had fortunately realized beforehand was not actually located *on* the Champs-Élysées but rather near-by). You had been surprised at the strikingly bland rectangular appearance of its exterior, with just a few unimpressive bas-reliefs—a purposeful Art Deco design of the architects

who sought to construct a venue more suitable to contemporary, innovative works in contrast to the traditional performances such as those at the Paris Opera, with its Art Nouveau style.

The building has only been open for a month. You unfortunately had missed its blockbuster gala opening on April 2, a spectacular concert which included works directed by their own composers such as Claude Debussy (*Prélude à l'après-midi d'un faune),* Paul Dukas *(L'apprenti sorcier)* and Gabriel Fauré *(La naissance de Vénus).*

The growing audience around you today (it's obviously going to be a full-house) is a musically-sophisticated one, accustomed to being exposed to inventive and challenging new works. Stravinsky's *The Firebird* had been presented with Sergei Diaghilev's Ballet Russes on May 15. And just last week you attended *Jeux,* a new orchestral work by Debussy accompanying a ballet and conducted by Pierre Monteux. Applause had been polite but muted; it was difficult to get excited about a work that had around 60 different tempo markings. The strange scenario which consisted of three children trying to find a lost tennis ball didn't help matters.

According to today's program notes, Stravinsky, who is a relative newcomer on the Paris musical scene, has been recruited by Diaghilev specifically to provide music to accompany the performances of the Ballets Russes company. In *Le Sacre du printemps* the scenario involves the sacrifice of a young virgin as part of a pagan Russian celebration of spring, in the process of which the girl dances herself to death. Heady stuff, this!

But enough. The lights are dimming. The expectant crowd hushes. A long pause. Then, from the first note of the orchestra, provided by a wandering, haunting bassoon solo, one senses that something electric is about to occur.[5] As the classical music critic Anthony Tommasini of *The New York Times* has written so colorfully in his book "The Indispensable Composers" (Penguin Press, 2018),

> "A solo bassoon, playing in an unusually high register (was it some kind of oboe? Or saxophone?), spun out a bare melody in which an insinuating sustained pitch kept breaking into eerie squiggles. As the melody continued, atop a two-note intrusion from lower horns, some clarinets slinked down in stark parallel fourths. Other instruments joined the fray, squirreling around, needling the music with sputtering repeated tones and rude trills, finally cutting loose into jumpy riffs that sounded crazed. And where were the strings? They mostly seemed sidelined, except for flecks of pizzicato, a strange soft trill. During one sudden episode, the weird sounds of sustained string harmonics somehow broke through a mass of madhouse brass and woodwinds."

Derisive laughter is heard coming from the upper balcony. As if in response, then comes drumming, driving primitive rhythms, one after another, jumping all over the place. And then dissonances! Faster, still faster! A cacophony! This is not music, this is a nightmare! Angry voices call out! All this hammering, these jarring harmonies!

But then the curtain rises and the dancing begins. Further horror! Instead of the beauty of graceful body motion, the audience is treated to stick-like creatures dressed in strange costumes, moving in jerky, disjointed motions. It is a pagan ritual of virgin sacrifice, after all! But a terrifying one, at that. The audience unrest intensifies, their vocal displeasure at this performance creating so much noise that the dancers can no longer hear the orchestra. Now a fight breaks out between groups of supporters and horrified detractors. Vegetables and other objects are hurled onto the stage. It is not clear if it is Stravinsky's primitive rhythms or the bizarre appearance of the dancing that is causing this scandalous disorder, but one might guess both.

This is too much! Shaken, you rush to leave by a side exit. It is not clear if the police actually came to the theatre to quell this ruckus or not. In the newspaper the next day you read that a number of concert-goers were expelled from the theatre.

(Think about this a minute. When was the last time you rioted—or, for that matter, even considered rioting—when taking in a classical music concert? Yes, you probably have fidgeted uncomfortably in your seat during a performance of some atonal or minimalist opening piece, but, in civilized fashion, this was endured with the knowledge that Dvorak's more "accessible" *Symphony from the New World* would anchor the second half of the program.)

And so, as wrote Leonard Bernstein, the "rhythms of such jaggedness and irregularity [of Stravinsky] all but annihilated the comfortable symmetries of yesteryear."[6] The epilogue to this oft-told historical account, of course, is that Stravinsky's *Le Sacre du printemps* eventually not only gained public acceptance but achieved a position as one of the major works in Western orchestral music.

> "The music was indeed outrageous: thumping, static, and for many listeners, nerve-wracking. It had practically no conventional melodies; instead, the audience was treated to fortissimo, abrupt, frequently repeated chords like so many explosions. His was anti-romanticism at its most ruthless. Interestingly enough, later presentations of the *Sacre,* whether in repeat performances or in a concert version, were consistently and warmly applauded. So rapid and uncontested a shift from pariah to classic was given to few modernists."[7]

All of this raises some intriguing questions regarding the link of music and its human emotional response. Specifically, is this a biological reality? Or rather one created by habituation and cultural influences? As far back as Pythagoras in the Sixth Century B.C. it has been recognized that the frequency of vibrations making a musical note are only "pleasurable" to the human brain if produced in certain combinations. Otherwise, music is unpleasant, grating, and *dissonant*. It has been assumed, then, (but not at all verified), that this physical reality that causes music to create a pleasurable human emotional response is tuned somehow into a functional "psychosomatic resonance" within the neurologic function of the human brain.[8] So does this shift from horror to broad public acceptance of Stravinsky's work provide us a lesson that human sensibilities, at least those defining "enjoyable" music, may be largely cultural? Maybe. But still, as is written in the liner notes of my vinyl version, even today *Le Sacre du printemps* "remains inexhaustibly radical, maintaining its unquestionable power to shock and stun."

July 25, 1965. Newport, Rhode Island, Folk Festival

Bob Dylan. What is left to write or say that hasn't been a good many times before? Complex, iconic folk-rock musician, poet, composer, and singer. The iconoclastic voice of a generation. Rebellious folk poet. Winner of the Nobel Prize for Literature in 2016 (rather a surprise for those who haven't got past "the pump won't work 'cause the vandals took the handle"). And all this sung "in a curiously arresting, mumbling country-steeped manner" with a voice that was "frankly nasal, as if sandpaper could sing."

Robert Zimmerman—for that was his given name—was born and raised in northern Minnesota, thus providing credibility for his rural musical roots. His original forays into musical performance in high school and college (one year at the University of Minnesota), though, were in rock and roll, as pianist (à la Little Richard) and guitar (inspired by Chuck Berry and Buddy Holly). Moving to New York City, within the intoxicating air of Greenwich Village he developed his singing talents as a folk guitarist, and later as song composer.

Early in his career songs he composed often gained fame and riches for popular singers well

before he gained wide recognition as a performer in his own right. It would only be later that listeners would say, "Oh! That song was actually written by Bob Dylan!" To make the point, the reader is invited to take this quiz. Which of the following highly successful songs recorded in the early 1960's was NOT written by a then-obscure Bob Dylan?

“Blowin’ in the Wind”	(Peter, Paul, & Mary)
“It Ain’t Me, Babe”	(The Turtles)
“Turn! Turn! Turn!”	(The Byrds)
“Mr. Tambourine Man”	(The Byrds)
“Mighty Quinn”	(Manfred Man)
“All Along the Watchtower”	(Jimi Hendrix)

Answer: “Turn! Turn! Turn!” was written by Pete Seeger. Only later, with his rising stardom did Dylan achieve success with his own recordings of self-authored songs such as “Lay, Lady, Lay,” “Like a Rolling Stone,” and “Knocking on Heaven’s Door.”

By the mid-1960’s Dylan had become the darling of the “genuine” folk music scene, and he was a major draw at the third Newport Folk Music Festival in 1965. Dylan could not have expected, though, the reception he received as he took the stage on this the final of the Festival’s three nights. Attired in a black leather jacket and black jeans, and carrying an electric guitar (a Fender Stratocaster) instead of his traditional acoustic, he launched into “Maggie’s Farm” with a rock backing band. Many of the audience applauded, but there were catcalls and then the booing began. Peopled were in shock—booing Dylan! After three numbers Dylan and the band left the stage, to even more audience hostility.

Why were these people so upset? There is a good deal of uncertainty of just what happened that night and why. By the most dramatic and enduring account, as interpreted by the popular press (and some first-hand witnesses), a great number of folk music “purists” in the audience were angered by what they saw as a betrayal by their idol of their altruistic ideals of genuine folk music. That electric guitar symbolized, for them, a “selling out” to the commercial music industry—an in-your-face performance that betrayed their ideals of what folk music should be. To them, “Dylan was shutting himself off behind a wall of electric noise, locking himself in a citadel of wealth and power, abandoning idealism and hope and selling out to the star machine.”[9] Among the stories surrounding the events that transpired that evening, many of them probably apocryphal, the most stunning was the story that Pete Seeger, the long-standing patriarch of folk music, had become so scandalized by Dylan’s raucous departure from the true music that he threatened to cut the guitar and amplifier cables with an axe.

As will be explained below, this story of the motivating factors accounting for the audience’s shocking display of anger and rejection of Dylan’s departure into electronic-based music may only, at best, be partly true. Still, it made some sense, for that Festival witnessed a collision between two trajectories—one personal, the other cultural—that might have

been expected to surface as emotional fireworks. On the one hand stood a musician/poet/songwriter whose works had exemplified an entire culture of disenfranchised youth seeking to shake what they saw as an oppressive commercialized musical establishment. Dylan, however, then as now, if nothing else is a fiercely independent individual who disdains trends, and certainly ones he might be interpreted as personifying. Indeed, it is just his constant shifting during his career of musical genres—rock, gospel, folk, rhythm and blues, bluegrass—which have proven so troublesome to a sometimes-bewildered fan base. And here at Newport, he was again being his own man. Maybe in-your-face it was. As Elijah Wald has so astutely written, "If the booing at Newport has often been exaggerated, that is because it was essential to the legend, proof that no matter how high Dylan's records climbed on the pop charts, he was neither selling our or buying in, but bravely going his own way."[9]

At the same time, the world of folk music was in major flux. Those who were determined to sustain themselves on genuine folk music of native roots had witnessed the erosion of their songs by highly commercialized groups such as the Kingston Trio, Peter Paul, and Mary, the Limeliters, and the Brothers Four. To folk music purists these groups reflected the power of a commercialized, phony world which corrupted the meaning of traditional folk music. Such trends toward mass popularization of slick, watered-down versions of folk music (albeit highly successful) meant that the crowds entering the Newport Folk Festival that weekend were already highly sensitized to what were viewed as menacing changes in the world of authentic folk music. Now to have one of their own—indeed, their cherished champion—jump ranks as well might have been just too much to take.

For the purpose of this chapter, which attempts to examine how music is enveloped in the "human condition," this version of the events at Newport in 1965 provides some lessons. Whether we like it or not, we all conduct our lives in the midst of a political-social cultural milieu. Our individual responses to these influences are manifest in the music we embrace. Music in this sense reflects "truth"—as each of us would individually define it—and the music we chose serves as an expression of this truth. In this version of the Dylan-Newport story, on one hand we witness the altruism of authentic folk music, expressing traditional humanistic values, clash with the commercialized, profit-driven music establishment. No doubt, the musical expressions interpreted as reflecting this conflict were not short of being highly-charged. Viewed from another perspective, though, one perhaps more accepting and realistic, we see music as an accompanying—even deterministic—factor in the process of social change. The "human condition" is one in a state of constant evolution, and the musical themes—

like that of a good movie—which accompany and often provide it meaning are powerful ones.

All this being said, it is important to recognize that much of the popular lore surrounding this event may been have been the result of gross misinterpretation and/or exaggeration. As Elijah Wald describes in his excellent account *Dylan Goes Electric,* there existed a number of alternative explanations for the hostile reactions of the crowd that evening[9]. First, the music had been clearly under-rehearsed, and the backup band struggled. Beforehand, the sound check had been a disorganized shambles. Consequently, to the audience the music was being played not only poorly but unevenly and overly loud. Dylan played three numbers—"Maggie's Farm," "Like a Rolling Stone," and "Phantom Engineer"—then, after 17 minutes on stage, left as the unrest swelled. Much of this might have reflected the strong disappointment of having Dylan on stage for such a short time (although he did subsequently return for acoustic versions of "Mr. Tambourine Man" and "It's All Over Now, Baby Blue"). Some have suggested that the anger in the crowd may have actually partially originated from Dylan fans who were disturbed by the disruptive behavior of the others. A combination, then, of a loud, raucous, short-lived, poorly-played performance by the idol they had driven many miles to hear might well have triggered the audience ire. Whatever the explanation, Bob Dylan did not return to Newport for 37 years.

There do exist recordings of this performance, but the microphones were, of course, aimed at the musicians, and it is difficult to truly ascertain audience reaction. What is particularly striking are the eyewitness accounts quoted by Wald from people who would be expected to be reliable, which often directly contradict each other. Some called it a disaster; others were effusive in their praise of the performance. Some claimed massive booing. Others said there was none.

> "There were upward of seventeen thousand people in the audience…What anyone experienced depended no only on what they thought about Dylan, folk music, rock 'n roll, celebrity, selling out, tradition, or purity, but on where they happened to be sitting and who happened to be near them… Dylan's set left some listeners thrilled, some baffled, some fascinated, some angry at him, some angry at other listeners. Whatever one's opinion, the naysayers have some facts on their side: The band was under-rehearsed, and even if one thinks the first two songs sound great, "Phantom Engineer" was a high-energy train wreck… Aside from the music, Dylan's performance was halting and disorganized, and he made no attempt to engage with the audience….To many listeners it seemed like a deliberate affront or betrayal."[9]

As for Pete Seeger and his axe, a more likely story is this. When Dylan left the stage after his original three numbers he asked that someone search out his acoustic guitar. Music aficionados know that "axe" is a slang term used by musicians for their guitar (like a tennis player stepping onto the court with his "stick"). That someone cried out for an "axe" was not likely Seeger expressing hostile intent but rather a call for Dylan's acoustic instrument. Seeger never acknowledged a desire to chop into Dylan's performance that evening but contended—at least in public—that instead it was the terrible quality—particularly the loudness—of the sound system that angered him. In fact, Seeger always expressed support of rock and roll and claimed to appreciate the electric guitar performances of Chuck Berry and Muddy Waters. Later, Seeger went on to collaborate with electric-based musical groups. Wald cites Seeger as writing that "Maybe Bob Dylan will be like Picasso, surprising us every few years with a new period…I don't think there's another songwriter around who can touch him for a certain independent originality, even though he is part of a tradition."

August 29, 1952. Woodstock, New York

Mentioning "Woodstock" and "music" in the same sentence evokes images for most people of the "three days of peace & music" that drew over 400,000 to Max Yagur's dairy farm in southern New York State in 1969. (In fact, this historical rock concert did not actually occur in Woodstock but rather just a cross the town line in Bethel.) To call this a "Music Festival" would be like saying that the Los Angles freeway traffic becomes "heavy" at 5:00 pm. It was, in fact, a massive musical and spiritual sharing, fueled by the driving rock rhythms and folk songs of the likes of Jimi Hendrix, Arlo Guthrie, Janis Joplin, and the Grateful Dead. Even today, almost a half century later, "Woodstock" continues to be considered as a "game-changing" counterculture spectacle by those who attended—somehow forgetting the rain, the mud, monumental traffic jams, and lack of adequate sanitary facilities—that served as a communal celebration of peace, love, and joy.

This discussion, however, is not about *that* Woodstock but a very different one. The two Woodstock concerts were separated in time by about 14 years and by location just a mile or two down the road, but these two musical events could not have been more dissimilar. Here's the story:

By the 1950's the American composer John Cage was widely recognized for his inventive, experimental works. Better said, Cage was a musical anarchist who eschewed music in any organized form. Paralleling in a sense the artistic works of Marcel Duchamp and Robert Rauschenberg, a Cage

concert would commonly include the intrusion of "ready-made" articles, such as transistor radios, bells and screws inserted between the strings of a piano, variable-speed turntables, or a gong played under water.[10] Most famously, many of his compositions were characterized by "chance," meaning there was no designated succession of notes, which instead were inserted by elements of chance, such as star charts, or providing each individual musician in an ensemble a 45-second time slot in which to play a single note.

On this date in 1952, the audience sought their seats in the Maverick Concert Hall, a rustic auditorium in the woods a couple of miles from Woodstock, awaiting a concert billed as "new music." John Cage, who was in attendance, composed two works to be premiered on the program. The first involved pianist David Tudor playing a piano, duck call, and a transistor radio. And for the second, Tudor again took the stage, started a stopwatch, opened the lid of the piano and just sat there. Not a note of music. And he remained in such a position for four minutes and a half, reflecting the title of *4'33".* And then he stood up and left the stage. To the stunned (and the many already bored), it was "Say what?!!"

This event has often been labelled as the premiere performance of Cage's landmark work of nothing but "silence." But, of course, this wasn't true. There was no silence during that four minutes and a half (In fact, there couldn't be, for there does not exist such a thing as absolute silence.)[11] No, instead what could be heard during the duration of this "piece" was the rustling of people shifting in their seats, a cough from the audience, the sound of raindrops striking the roof of the theatre (does it always rain in Woodstock?), birds chirping, the distant rumble of a passing car. And this was Cage's intention. He wanted to the persons in the audience to feel—to appreciate—the "music" created by the sounds that without cease surround us in our daily existence, ones of which we are scarcely aware. The lesson was "what we as humans needed to do was to listen harder to the sounds of our lives, because they were music as well".[12]

Many in the audience, of course, did not see it that way. And ever since, opinions have similarly been divided—surprise, disdain, amazement, anger, laughter. Even with humor, as in a limerick, cited by Richards:[13]

A modern composer called Cage
For silence became all the rage
No performer, he found,
Ever played the wrong sound
Or misread the notes on the page.

Sitting in a warm, humid concert hall in rural New York State taking in random ambient sounds for four and a half minutes might heighten one's perceptions of physical reality. But is it "music"? And, to take the question even further, is it "art"? It might be expected that for the great majority, the answer to both questions is "no." But for a remaining 1%, Cage's approach to aural "meaning" (or, if one prefers, "spirituality") continues to be considered as revered, if not misunderstood. For these few, Cage explored in new ways the relationship between music and the human experience, challenging us to consider the wisdom surrounding the traditional concepts of the meaning of music.

Most of the bewildered members of the audience filing out of that Woodstock auditorium in 1952, however, were instead asking themselves this question: How did classical music get to this?! And, indeed, like them or loathe them, Cage's compositions music must be considered precisely in response to that query. This, of course, opens up a subject far too vast to be condensed here, but perhaps one central point might be made. Classical music, like all the "arts" (visual, dance, literature, etc.) has progressed through history in eras, whereby one form—the "traditional one at the time"—is replaced by a new, innovative (and typically less "organized") form which is considered to be more closely aligned with truth, the human spirit, or whatever (and which is quickly determined to be *dépassé* when the next new wave of innovation came along).

So, in classical music we see a progressive parade of "eras": Medieval (500-1400 AD) → Baroque (1600-1750) →Classical (Mozart, Beethoven) (1750-1820) → Romantic (Wagner, Ravel, Brahms) (1780-1910) → various forms of modernism (1930 on). Until the early 1900's, for the most part these works were highly accessible and acceptable to the general listening public, which can be interpreted as indicating that these forms of music, even though constantly evolving, satisfied a certain "meaning" for the human psyche. But then things began to change. Innovative works by composers such as Prokofiev, Poulenc, Debussy, and Shostakovich, were still enjoyed by a general audience, but less so (these being termed "transitional" between classical and modernistic composers). And then came the musical chaos and dissonance of Schoenberg, Weber, Berg, and Scriabin, which general audiences found "unlistenable." From that point in the years that followed, modernism in music has taken off in many different directions, particularly in the late 1900's towards minimalism, which is characterized by (seemingly) endless repetition of one or two notes or chords, unusual combinations of instruments, and absence of any melody.[14] What all these post-modern strands have in common, though, is that in their musical experimentations, except for a select few, they have failed to find

acceptance by the general listening public. It might be said, then, these avant-garde pieces of music were/are incapable of mining any sympathy—no resonance nor meaning—within the contemporary human psyche.

The "indeterminancy" of John Cage's compositions fits into this modern or post-modern picture. (Indeed, *4'33"* could be viewed as the ultimate minimalist composition; i.e., no notes at all.) To Cage, though, it made no difference. As Peter Gay has written, "[Cage] made this avant-garde duty a central feature of his mission in life…He shared this frontier perspective on providing novelty at all costs."[7] The cost, then, is public acceptance. The extent that failure to satisfy a listening public alters any existential meaning of Cage's compositions, including *4'33"*, remains the elusive unanswered question.

February 3, 1959. Clear Lake, Iowa

It was just after midnight, and the pilot and his three musician passengers left the remodeled farmhouse which served as the airport's terminal and headed across the tarmac to their waiting chartered single-engine Beechcraft 35 Bonanza. The snow was falling lightly but swirling, and drifts were piling up by the 25-mph wind. Groups of enthusiastic fans had followed them to the Mason City Municipal Airport following their performance that evening at the Surf Ballroom in nearby Clear Lake. Now, from behind the airport fence, they yelled out for autographs. The musicians smiled and waved and climbed into the plane's cabin.

The pilot who had been assigned by the Dwyer Flying Service to fly them to Fargo, North Dakota, that evening was a 21-year old local pilot named Roger Peterson. Peterson, who had been flying for four years and had accumulated 711 hours in the air, possessed a rating which restricted his flying to VFR (visual flight rules) conditions, meaning that he could pilot only when he could observe directly where he was flying. He was training for—but had not yet achieved—an IFR (instrument flying rules) rating which would have allowed him to fly by instruments alone.

The musicians were exhausted. The stop in Clear Lake was part of a 24-city Midwest tour in as many days, during which they had traveled entirely by cold uncomfortable buses (at one point requiring a hospitalization for frost bite). The chartered flight had been arranged as a means of allowing them some rest before the next performance in Moorehead Lake, Minnesota, 365 miles from Clear Lake.

The plane taxied and took off on runway 17 to the south. Besides the snow and wind, the sky at the time was totally obscured at 3,000 feet altitude, but forward visibility was good at 6 miles. Poor weather had been

forecast, including blizzard conditions, but Peterson had never received this information.

The Bonanza never reached Fargo, which had the nearest airport to Moorehead Lake. The tangled wreckage of the plane was spotted the next day in a corn field about 6 miles northwest of the Mason City airport. Buddy Holly (age 22 years), J.P. Richardson (age 27), and Ritchie Valens (age 17) had instantaneously perished, along with the pilot, when the plane struck the ground in a nose-down attitude at an estimated speed of 170 mph.

The principal opinion of the Civil Aeronautics Board which investigated the fatal accident held that the pilot had flown into IFR conditions for which he was not prepared.[15] The low bank of clouds, the snow, and the lack of visual landmarks in the Iowa corn fields (particularly on a dark, snowy night) were presumed to have failed to provide enough markers to permit VFR flight and consequently maintenance of the proper attitude of the plane. Lacking skills to utilize flight instruments in such conditions, Peterson was assumed to have suffered from "spatial disorientation" and lost control of the aircraft.[16]

In the movie *American Graffiti,* which was set in a California town in the year 1962, John Milner laments that "Rock and roll's been going downhill ever since Buddy Holly died." That sentiment was echoed in Don McLean's hit record "American Pie," which alluded to Holly's death as "the day the music died." Was this true? Given the challenge of defining exactly what is meant by "rock and roll," the answer is a bit difficult. Holly, originally along with his backup band, the Crickets, was among the group of rock musicians who held sway in the late 1950's, including Elvis Presley, Carl Perkins, Chuck Berry, Bill Haley, the Everly Brothers, Buddy Knox, Eddie Cochran, Jack Scott, Jerry Lee Lewis, and Ricky Nelson. Only in one year, 1957, did Holly crack into *Billboard's* list of top 40 single hits, with *That'll Be the Day* (#20) and *Peggy Sue* (#32). After his death in 1959, most of that original group of popular rock artists were still going strong. Whether there existed a decline in rock music in the aftermath of Holly's death was rendered moot by the arrival of the Beatles and the "British invasion" of rock artists. Interestingly, sales of Holly's records rose dramatically in the years following his tragic death. And a good many giants of rock and roll and popular music have attributed their inspiration to Holly's music, including the Beatles, Eric Clapton, and the Rolling Stones. A reasonable conclusion, then, is that Holly meant more to the early development of rock music than was apparent in his short life. As is not infrequently the case, only in the time of his absence has his fame grown to near-iconic proportions.

Human drama is literally played out with a musical accompaniment. But what is music, really? And why and how does it so deeply influence our being? How did this relationship between humanness and music every develop? These remain among the most unsolved mysteries of the human condition.

Notes

1. Heseltine P. The idea of a song. In: Barzun J (ed). *Pleasures of Music.* Chicago: University of Chicago Press, 1977, p.40.
2. Mavridis IN. Music and the nucleus accumbens. Surg Radio Anat. 2005;37:121-125.; Sutoo D, Akiyama K. Music improves dopaminergic neurotransmission: demonstration based on the effect of music on blood pressure regulation. Brain Res. 2004;1016:255-62.
3. Kanduri C, Raijas P, Ahvenainen ME, et al. The effect of listening to music on human transcriptone. Peer J. 1997;3:830.
4. Kivy P. *Music Alone. Philosophical Reflections on the Purely Musical Experience.* Ithaca NY: Cornell University Press, 1990.
5. The opening solo in *Le Sacre du Printemps,* which has been called "outrageously stratospheric," is a *bête noir* to all bassoonists. It's all to be played at the very top of the bassoon's register—someplace bassoonists rarely go—and requires a certain finesse and degree of courage, with special attention to both concentrated calmness and a loose embouchure. The outcome, still, is often highly unpredictable.
6. Bernstein L. *The Infinite Variety of Music.* New York: Simon and Schuster, 1962.
7. Gay P. *Modernism.* New York: W.W. Norton & Company, 2008.
8. One can learn about the science of music in any of a large number of works on music theory. One of the most enjoyable is by Daniel Levitin, entitled *This is Your Brain on Music. The Science of a Human Obsession* (New York: Dutton, 2006).
9. Wald E. *Dylan Goes Electric.* New York: Dey Street Books, 2015.
10. In one famous 1950 concert, Cage's composition *Imaginary Landscape No.4* called for a chance-derived score for 24 players to be accompanied by the simultaneous output of 10 transistor radios, each tuned to a different station. The effort was barely successful, however, since the piece was performed so late in the evening that many of the stations had already gone off the air.
11. Whether there exists a state of complete, absolute silence has long been a contested issue. For human beings the answer is "no." Even when all ambient environmental noise is blocked out, as occurs in soundproof (anechoic) chambers, the sound of the human bodily functions persists (the sound of blood coursing through the eardrum, the gurgling of gastrointestinal gas). As George Michelesen Foy writes in his book *Zero Decibels. The Quest for Absolute Silence* (Scribner, 2010), "To be perfectly silent is to be perfectly dead." Even the psychological effects of sitting in an anechoic

chamber are sufficiently terrifying as to make it impossible to tolerate for more than short periods of time. John Cage was very interested in this question of absolute time, and in 1951 he visited the anechoic chamber at Harvard University (which had been built for secret military research during World War II).

12. Foy GM. *Zero Decibels. The Quest for Absolute Silence.* New York: Scribner, 2010.
13. In his book *John Cage As…* (Amber Lane Press, 1996) the musician Sam Richards noted that Cage (whom he called "a High Priest of Avant-Garde Modernism") embodied a philosophy of music that surprisingly paralleled concurrent developments in the world of physics now accepted as expressions of physical reality. Not only did Cage's works manifest a relativism mirroring that of Einstein, "his practice of creating a musical score as a flexible, commonly-shared pool of information and possibilities" reflected the microscopic world of quantum mechanics.
14. The reader who wishes a taste of minimalist musical compositions might listen to John Adams' *Short Ride in a Fast Machine, Steve Reich's Music for 18 Musicians,* or Philip Glass' five-hour opera *Einstein on the Beach.* This is just a taste. For more, read this: writing in the August 27, 2018, issue of *The New Yorker*, Alex Ross reviews Tim Rutherford-Johnson's book "Music After the Fall: Modern Composition and Culture Since 1989" (University of California). Their combined impression is that tonality and other traditional aspects of classical music have made somewhat of a comeback in compositions produced since the turn of the Century. Still, their mutual conclusion is that the world of "modern music" remains fragmented and that its output is largely unpalatable and consequently inaccessible to the tastes of the modern listener of the classical music repertoire.
15. Flying "on instruments" generally means that the pilot employs a number of indicators of an aircraft's orientation in space and flight direction, including the attitude indicator (provides information regarding the airplanes' pitch (nose up or down) and bank (the plane's tilt in respect to the horizon), altimeter (altitude), and heading indicator (compass). Even VFR-training students are provided some instruction as to the means of "scanning" successively and responding with the aircraft's controls to these three instruments, but it takes considerable practice to perform this with sufficient skill so as to prevent loss of control of the aircraft. The problem for the inexperienced pilot is that these controls do no necessarily correspond to what his brain is (erroneously) telling him or her about the positional status of the plane. It is generally considered that a situation in which a VFR-rated pilot flies into IFR conditions (i.e. not able to see the ground or having no visual reference to a horizon) will lead to a fatal outcome. (This scenario was used to explain the crash and death of John F. Kennedy, Jr. in 1999, while he was flying at night over a hazy Nantucket Island Sound.)

16. In 2015, 56 years following this tragedy, a retired pilot named L.J. Coon petitioned the National Transportation Safety Board (NTSB) to reopen the investigation of its cause. The claim was that inappropriate blame had been placed on the pilot, and that other factors, such as improper weight distribution or structural failure of the aircraft were responsible for the crash. The NTSB declined to re-investigate.

10. ADULTERY

Sin is the only colour element left in modern life.
—Oscar Wilde

If it were possible, all people would do exactly as they please.
—Plato

Sometime around the 16th Century BC, so the story goes, Moses descended from Mount Sinai clutching a tablet upon which were engraved the 10 Commandments. The operant word here is "commandments"—these were not, as some cartoonist once supposed, meant to be simply the "10 suggestions." No, instead, these reflected powerful directives and interdictions that defined moral behavior as it would glorify God. Indeed, the word on the street is that these originated from Himself himself, thereby loading these dictums with a high degree of credibility.

Figure 10.1. Rembrandt's version of Moses.

At first glance, some of these commandments are rather banal. "Honor thy father and mother" (a no-brainer, this. A small effort to be made in exchange for 18 years of free room and board). But then the one that really grabs your attention is number 7, Hester: thou shall not commit adultery.[1] One must not exercise sexual union if you or the consenting partner are married (to someone else). Call it immoral, unethical, or sinful—the differentiation between these terms being sometimes rather fuzzy—this is something you just must not do. The act defies God's will, and moreover, in some cultures, even in developed countries, is punishable as a criminal offense.

So far this makes some sense. But inquiring minds are troubled by some unresolved questions. Okay, no adultery. But exactly *why*? There are no supplementary notes accompanying the Commandments to explain this. Why did the prohibition against adultery (as well as the other particular nine commandments) make the top-10 list? Did somebody, or some Divine Committee, approve this list? Did it undergo proper peer review? Were there public hearings? One is left in the dark on these important questions, which leaves one with a bit of disquiet on accepting such directives simply at face value.

Apparently, such skepticism is shared by others, because, given this strict interdiction against adultery, the number of otherwise sane persons who actually engage in this practice is really quite astounding. The several survey studies which have been performed generally indicate that between 25-50% of American men and 15-25% of women have engaged in adulterous acts at some time in their lives.[2] Overall, maybe one out of four. That's a large number—in the tens of millions—who have stepped outside normally-accepted moral grounds. That doesn't even count those who have "sinned" by simply entertaining adulterous thoughts and fantasies; the percentage, one might confidently suppose, would be even more stunning if such persons were included. And these are not—for the most part—persons you would think are "evil" or even unethical. In fact, without stopping here to name names, the reader can quickly summon up glaring examples of well-respected men and women who have met their downfall through the disclosure of adulterous affairs, carelessly conducted, and seemingly without thought to the consequences.

We are surrounded by adulterous behavior, not only in the daily news but in our most famous and popular novels, plays, operas, song lyrics, and movie themes. Indeed, the success of French cinema, it might be proposed, rests on the altar of adultery. So, behind the statistics of overt adulterers and fantasizers, there is a closet full of individuals who are titillated by the

forbidden pleasures of extra-marital sex. Vicarious moral transgressors, call them.

How can any behavior which is so popular, and from which one must be presumed to derive a great deal of pleasure, be considered immoral and, in the eyes of religion, "sinful"? And how can this many otherwise "good" people engage in such behavior that so obviously bears a long list of disadvantages and serious risks? Herewithin we examine these questions. The first section that follows below will address the question of just *why* adultery carries the label of immoral and sinful behavior. Section Two then moves on to speculating on the mental processes that drive individuals to commit adultery. In Section Three things get a bit more interesting as a useful list is provided for prospective adulterers of some convincing reasons to abstain, quite independent of any moral implications.

The Origins of Morality

The grounds by which any particular behavior is considered counter to human virtue (or the will of God)—be it "sinful," "immoral," or "unethical"—has served as fodder for philosophical thought since antiquity. Certain debated themes are recurring: are the rules of moral behavior innate, or do they reflect the society in which they operate (so-called moral relativism)? How do such interdictions arise? How can the basic rules of "what is right" be justified? Do they reflect practical concerns or consequences? What role do such rules of behavior serve in cultural evolution (i.e., how have they acted in the development of human civilization)?

The concepts of what constitutes moral behavior are most distantly rooted in the religious teachings of the ancient prophets. Their preaching that certain acts "violated the will and glory of God" was—and, for many, continues to be—a game-ender. Failure to follow the Commandments means unpleasant punishments, including Eternal Damnation. For those ascribing to this concept of evil acts, the decision of what makes "good" versus "bad" behavior poses no difficulty. It is just the way it is, decreed and written, quite literally, in stone.

In more recent times, philosophers have offered up a number of other, rather divergent concepts of moral behavior, more enlightened in leaving room for human interpretation and personal decision-making. Here's a (remarkably) brief survey:[3] Aristotle thought that socially proper behavior was linked to human happiness, that "happiness requires perfect excellence and virtue" and in striving for happiness, behavior approaches noble goals. "A man is not good at all," he wrote, "unless he takes pleasure in noble deeds."[4] It is clearly a bit late to respond in person to this idea, but, if it were

possible, one could raise his or her hand and point out that moral behavior, the "right thing to do," often comes, in fact, at the expense of one's personal interests or pleasures.

Immanuel Kant would have nodded his head in his agreement with this objection. In the late Eighteenth Century, this German philosopher proposed that moral behavior necessitated "good will," which meant that one should feel a duty to doing what's "right" beyond personal gain or pleasure. "Power, riches, honor, even health, and the general well-being and contentment with one's condition which is called happiness, inspire pride and often presumption," he claimed, "if there is not a good will to correct the influence of these on the mind…"[3] Kant's view of moral decision-making by humans was one of cognitive thought, that one should chose a proper action through reasoning and thoughtful consideration.

In their philosophy of "utilitarianism," John Stuart Mill and Jeremy Bentham moved the focus of moral behavior from the individual to the society at large. According to this movement, moral and ethical behavior should do "the greatest good for the greatest number." Proper individual behaviors are still an "indispensable condition," since "whether a noble character is always the happier for its nobleness, there can be no doubt that it makes other people happier, and the world in general is immensely a gainer by it."[5]

In a similar vein, Thomas Nagel proposed that "there is no substitute for a direct concern for other people as the basis of morality…[which is] a belief that good and harm to particular people (or animals) is good or bad not just from their point of view, but from a more general point of view, which every thinking person can understand. That means that each person has a reason to consider not only his own interest but the interest of others in deciding what to do."[6]

Others have challenged this "nobility" of moral behavior. A.J. Ayer contended that acting in an ethical manner is nothing more than a simple expression of human emotion. That is, we behave in a certain way because, as a result, we feel "better" and gain feelings of approval from those around us as well. Moreover, "The exhortations to moral virtue are not propositions at all but ejaculations or commands which are designed to provoke the reader to action of a certain sort."[3] Consequently, these exhortations of ethical/moral behavior lack value since they cannot be backed by any empirical fact. This focus on emotion as an explanation for moral actions echoed that of the earlier writings of the philosopher David Hume, who contended that morally good actions make us feel good, while bad actions made us feel bad.

This link between emotions and moral behavior has been supported by brain imaging studies indicating that cerebral centers associated with emotional state are activated when a person is making an ethical decision.[7] The problem here is one of the direction of the arrow of causality. Do moral decisions trigger emotions? Or, conversely, do emotions stimulate moral behavior? Nobody knows. As Jesse Prinz concluded, "The fact that emotions are active when we make moral judgments does not show that they actively contribute to those judgements."[8]

Friedrich Nietzsche was a naysayer on the whole matter, describing rules of moral behavior dictated by religious beliefs as a "sham." Using words like "pretentious" and "ceremonious," he condemned such moral dictates as "meant to justify their author in the eyes of other people," concluding that "Every system of morals is a sort of tyranny against 'nature' and also against 'reason'."[3]

Is Morality Absolute or Relative?

The popular concept of "moral relativism" holds that there exists no absolute, universal set of moral behaviors, which are instead contingent on the society, temporal circumstance, and geography involved. Such a viewpoint has been necessitated by a) objective evidence of the variability of moral codes among human populations (e.g., cannibalism, infanticide, polygamy, homosexuality, slavery, incest, etc.),[9] and b) the proliferation of multiple viewpoints in defining moral behavior. This "pluralism" of opinion has generated uncertainty regarding the nature of what is "good" and "bad" behavior and, as Robert Kane contends in his book *Through the Moral Maze,* is responsible for the loss of a "spiritual center" by which one can confidently decide how to conduct one's life. One is faced with the realization that "there may be more than one right or wrong way of doing things, and that our way may not be the only "right way"…[and therefore] it weakens commitment to our own beliefs."[10] How to respond to this dilemma? Kane proposes that "judgements about good and evil, right and wrong…are personal matters and should be made for ourselves only and not imposed on others without their consent."

The above arguments address the *nature* of human moral behavior but have little to tell us about the *origins* of such standards. For this we must turn to an examination of vigorously polarized positions on two separate fronts—secularism versus religion (are moral values provided by God?), and nature versus nurture (are moral values innate or do they stem from cultural influences?).

Moral relativism requires that the behavioral constraints placed on human behavior (rape, murder, incest, etc.) are dictated entirely (or at least predominantly) by cultural influences, the fact that human beings must act appropriately within a civilized society.[11] According to this concept, moral behavior is *learned,* beginning at about age two years when the toddler finds he is scolded by his parents for biting the hand of the playmate who has just taken his toy. "You just cannot do that!" is the message, and it's just the beginning of a long list of similar life-long admonitions that say you can't beat your wife, or murder your boss, or cheat on your income tax.

Every person lives with certain goals—respect of others, raising a loving family, being financially secure, working at a fulfilling job, making a creative contribution—and he or she quickly learns that if such aims are to be reached, one must behave in certain manner that conforms to societal expectations. The behaviors that satisfy these "rules" are learned from parents, peers, teachers, movies, books, plays, coaches, and so on. Each morning when you arise and take on a role of parent, spouse, employee, colleague, or whatever, you are imitating the behavior from these sources and so, too, what constitutes "good" and "bad" behavior. Of course, some are reinforced by legal constraints as well. One is not permitted by law to rob liquor stores or even to fail to stop at a red light. In short, then, attempts to break free of cultural dictates on moral behavior are usually self-destructive.

It is the adoption of these behavioral constraints by individuals that permits societies in which they live to flourish as well. This conclusion leads directly to the concept of "social Darwinism," which holds that survival of societies, like animal species, is dictated by survival of the fittest.[12] The "fittest" in the social context here is achieved by cooperation and community-supportive behaviors by its individual members. Human civilization could not exist, would perish, if everyone were free to behave only in self-promoting fashion without moral constraints. As Roger Scruton has emphasized, "A population genetically averse to cooperation, to parental affection, to self-sacrifice on behalf of children, and to sexual restraint and the control of violence is a population endowed with traits that are dysfunctional to reproduction. Hence, it will disappear."[13] Rules of behavior must be followed to permit a society to function, even if they mean some sacrifice of human freedom of choice. In sum, then, one must recognize that to maintain normal moral standards in his or her life leads to the benefit of both the individual and society as a whole.

Some have objected to the idea of moral relativism, arguing that moral standards are absolute and universal, the same for all cultures throughout the world now and in all times past and future. Moreover, rules of moral

behavior, they would contend, serve as a fundamental structure of the universe. These believers in "ethical absolutism" recognize that moral behavior differs between cultures, but contend that this only reflects the ignorance of these societies concerning the true standards of "right" and "wrong". Such an outlook reflects long-traditional religious beliefs. That is, the source of this fixed set of moral dictates rests with the will of God. As the philosopher J.T. Stace wrote, "For the true believers the author of the moral law is God. What pleases God, what God demands—that is the definition of right…..Ethical absolutism [by this argument] is taken for granted without any argument."[14] In its strongest statement, "Some people have even believed that if there is no God to back up moral requirements with the threat of punishment and the promise of reward, morality is an illusion: 'If God does not exist, everything is permitted."[6]

This interpretation bears a number of distinct advantages. In considering moral choices, one is relieved of uncertainty, doubt, definitional pluralism, and whatever. Simply, one behaves in a certain manner because this follows the dictates of God, without further discussion or explanation necessary. Of course, anti-theists will have nothing to do with this line of thinking. To them, facing the challenges of uncertainty is the hallmark of the authentic life and the essence of the pursuit of scientific investigation. Wrote Bryan Magee, "Religious discourse…is a form of unjustified evasion, a failure to face up to the reality of ignorance as our natural and inevitable starting point. Anyone who sets off in honest and serious pursuit of truth needs to know that in doing that he is leaving religion behind."[15] Touché.

Setting aside the cultural influences on moral behavior, is there any evidence that the inherited information set in one's genes could dictate proper ethical conduct? Thinkers have long been struggling to answer this question. The answer seems to be "almost certainly," but the extent to which genetic information controls moral actions remains unclear. Clearly, animals can be bred for particular behavioral characteristics (e.g., aggressiveness). In humans, studies by behavioral geneticists have demonstrated a genetic influence of social attitudes in parents to those of their children.[16]

By one line of thinking, related again to emotions, the role of genetic control of moral activity seems evident. As noted previously, human behavior may originate largely in response to human emotions. And the latter—anger, joy, hatred, jealousy, sadness, and so forth—are considered basic neural functions in arising in the primitive areas of the brain and controlled by genetic action.[17] So, gene action → emotion → behavior is a plausible construct. The counter-argument would be, though, that not all human behavior is driven by emotions, and morality might just fit into this category.

John Mikhail has contended that an innate "universal moral grammar" might serve as the basis for moral standards of behavior.[18] He notes the ability of humans to make moral judgements in situations they have not previously encountered, and the evidence indicating that small children make early moral judgements in matters that are not quickly explained by parental influences. In these cases, he points out, moral judgements appear to be intuitive. Others have dismissed moral relativism, since lacking objective standards of behavior there can be no basis for moral judgements.[16]

Supporting an innate origin of moralistic behavior, such standards are generally stable over time in a given population, resisting perturbation. Despite repeated attempts, one witnesses the general failure to discard traditional moral standards. "Utopians meet defeat after defeat in attempts to persuade people to slip their chains, and attempts at revolution fall victim to a combination of impossible drams and cabals of the selfish, vicious, and power hungry."[11] Anarchistic movements dissolve. People who go off the moral rails are termed psychopaths and usually end up institutionalized.[19]

On the other hand, such arguments are weakened by the diversity of moral principles clearly documented between populations. You, it would be supposed, would never consider feasting upon your next door neighbor. But, still, in some cultures he or she might be considered a delicacy. How could moral standards be innate in the face of such behavioral contradictions?[8] In fact, Jesse Prinz failed when he tried to identify *any* universal moralistic norms that would hold true for all cultures (such as forbidding harming others, or sharing resources). "It is very hard to find universal moral norms," he wrote. "In fact, I would venture that there is no specific moral rule that in universal. For every society that prohibits some act, there has been another that either tolerates it or encourages it."[8]

An innate nature of moral laws would seemingly necessitate a biological (i.e. genetic) basis. And that, in turn, would be expected to be manifest in primates and other mammals as well. In fact, although one can find striking examples of cooperation and altruism in animals, no evidence has been found that they experience moral emotions such as guilt and shame (although it is not entirely clear how these would be detected).

Dr. Robert Burton took a more balanced position on the issue. "If we conclude that morality is driven solely by our innate biology, we are faced with a fairly dim view of the human condition. If, on the other hand, we deny the major role that biology plays in the determination of our morality and character, we are swimming upstream against compelling contrary data. Of course, in practice," he concludes, "most of us believe in neither extreme—morality and character are the complex interaction of nature and nurture."[20]

From this brief survey it must be inescapably concluded that the origin of moral behavior—be it cultural, genetic, environmental, or the dictates of a Divine Wisdom (or a little bit of each)—is not even remotely clear. To each his own interpretation and decision on this. We all participate in these constraints imposed by molar standards, and most of us are quite insistent—even passionate—regarding the differences between "good" and "bad behavior." But just *why* remains obscure.

Many have considered, in fact, that despite centuries of philosophical wrangling, it is quite impossible for we humans to tease out definitive origins and underpinnings of moral behavior. Bryan Magee wrote that "If it is indeed the case that morality is rooted in some sort of sharedness of inner being, that would explain why we are so immediately aware of moral imperatives in our relationship with others, and also why we are unable to support these imperatives with rational argument: they're not rooted in reason."[15] He continues "That I am flooded with the feeling 'Yes, surely this must be right' is not a validation, not even a credential. Total reality might be like that, but it might be nothing like that at all. How am I to know? The permanent unknowability of it gnaws at me."

A.J. Ayer contended that propositions concerning moral behavior often settle on "a mysterious intellectual intuition…[yet] it is notorious that what seems intuitively certain to one person may seem doubtful, or even false, to another. So unless it is possible to provide some criterion by which one may decide between conflicting intuitions, a mere appeal to intuition is worthless as a test of a proposition's validity."[21]

Magee used the example that we all would have a conviction that torturing children for pleasure is wrong; but as individuals we give different reasons why it is wrong. Some of us think it is wrong because it offends God's law. Others do not believe there is a god, and think it wrong because they have compassion for the child. Yet others think it wrong because of the requirements of human beings living together successfully. "However, common to everybody is a strong feeling of certainty that the deed is wrong. It is something about which we are unwavering: we do not budge, we don't have the slightest doubt. Yet the disconcerting truth is that we not knot *know* what the reasons for the wrongness are."[15] It is easy to drop back 10 yards and punt an explanation that a moral standard like this one originates in a combined effect of genetic, environmental, cultural, and Divine influences, but that doesn't reveal much. The mystery remains. How can the genesis of moral behavior be explained when a definitive sensation of wrong behavior can be conceived by such disparate pathways? And, then, as Magee concluded, "in the demands of morality…the most important truths cannot be reached by any amount of common sense of scientific observation, nor

by logical thought, but only by insights and intuitions that are driven forward by intense concentrations of feeling. Of these the question can always legitimately be asked, 'But how can we be sure this is valid and not misleading'?"[15]

But does this uncertainty, this lack of understanding of why something is immoral, indicate that there exists, ultimately, no bedrock basis for ethically proper human behavior? One would suggest the answer to this question is "no"—many things in life we encounter in human existence are unknown or uncertain or intuitive but are still very real (the passage of time, romantic love, the essence of life, the weird complexities of quantum mechanics—the list is a long one). And, in our ignorance, we still act upon and experience such unknowns as a part of human existence. The same can be said for moral behavior. The "truth" of explanations for moral behavior may not be understandable. But the necessity, ubiquity, and strength of moral reasoning is clear to all, regardless of the explanatory direction one comes from. *Which one* can be up to the individual to decide.[22]

But Why Adultery?

With all these ideas regarding the nature and origin of moral values in mind, we can now move on to the next question: On Moses' Top Ten list of moral guidelines, why "adultery"? Rather than simply accepting "Just Don't Do It," one cannot help but ask what is it that makes this behavior morally unacceptable? For the true skeptic, in fact, this inclusion of item #7 might seem altogether arbitrary. So, what are the arguments here? Why should the private sharing of a supreme physical pleasure between two consenting adults outside of marriage violate moral standards?

The answers must start on a religious basis with the idea that adultery threatens the sanctity of marriage. On this basis adultery is forbidden as evil and sinful by all the major religious traditions.[23] Adultery is a terrible mistake, foolish and dangerous, with disastrous consequences—that's the message. In the pages of the Bible one can find several "thou shalt nots" interdicting adultery, as well as examples of adulterous relationships, which, perhaps predictably, do not turn out well.

As specifically directed in the marriage ceremony, joining in holy matrimony demands a commitment to fidelity, and adultery is a breach of this trust. Betrayal of same causes irreparable emotional wounds and collapse of the family structure, felt to be in direct contradiction to God's will. Marriage is an expression of God's love, and in committing adultery one is unfaithful to not only a spouse but to God as well.

One might expect that the roots of such spirituality surrounding marriage would be found in the evolution of monogamy in human history. That is, what biological advantages would marriage with one other person bring in a Darwinian sense? Here, however, the trail is not at all clear. To start with, monogamy in mammals other than human beings is rare.[24] In fact, only a few of such species (about 3%) exhibit single-partner relationships in a family structure that would mimic that seen in humans (that would include beavers, otters, wolves, and some foxes). (Meanwhile, over 90% of birds are monogamous.) It has been suggested that monogamy bears survival value when offspring take an extended period of dependency in order to mature, as is the case in human beings. However, a convincing Darwinian explanation for the strength of monogamy as dictated by religious and culture influences remains obscure.

At the other end of the scale of opinion are those who debunk entirely the idea that adultery constitutes a breach of moral behavior and would contend that such constraints reflect the tyranny of "moral authority" on individual freedom of action. These people would dismiss as meaningless any ethical concerns of engaging in sex with a married partner. To wit:

- Roger Scruton: "The suggestions that certain partners are forbidden (because they are of the wrong sex or in the wrong organic relations or wrongly situated in the social world), that sex within marriage is morally of a different kind than sex outside marriage, or that there are real temptations that should be resisted, even when the temptation is mutual—all such suggestions seem groundless, mere superstitions hanging over from an unenlightened age."[13]
- British socialist Dr. Catherine Hakim: "Sex is no more a moral issue than eating a good meal. The fact that we eat most meals at home with spouses and partners does not preclude eating out in restaurants to sample different cuisines and ambiences, with friends or colleagues."[25]
- Bertrand Russell: "The psychology of adultery has been falsified by conventional morals, which assume, in monogamous countries, that attraction to one person cannot coexist with affection for another. Everybody knows that this is untrue."[26]

It has been contended, however, that even individuals who would adopt such a libertarian view of adultery feel that this practice is somehow "wrong," even while they personally commit such acts within their own framework of belief in individual freedom. Others would examine this overview of conflicting opinions on adultery and conclude that morality in

any definitive sense must be reduced to individual decision-making and not to the dictates of religion or societies at large. Still others would point out the strength of religious and moral constraints on adulterous sexual behavior in the face of libertarian opinion which would make such individual decision-making moot.

"What Was He/She Thinking?"

If one's moral code is defined by dictates of God's will, punishment is sure to follow acts of moral transgression, including adultery. If nothing worse, such sinful behavior will bring overwhelming and unrelenting guilt and shame, suffered for a few fleeting moments of exquisite physical pleasure. And if you are not a true believer, the potentially adverse outcomes of adultery which are independent of any moral failure (see section that follows) are sufficiently onerous that, for an objective observer, the wisdom of participation in an adulterous affair must be admitted to beg credulity. Even if you, as an individual, find no moral or ethical problem with adultery, it is certain that the majority of those around you *do*, and without impunity, you will suffer the adverse consequences of your actions.

Still, it can be suspected that the one out of four adult men and women who have had sexual relations with a married person *already know all this.* The *why* of such behavior, then, must be assumed to lie somewhere beyond any notion of common sense. Just what were these people thinking, then? Here are a few ideas that have been proposed, recognizing that as there is virtually no scientific research which has focused on this intriguing issue, one is free to speculate with impunity:

1. Perhaps the most automatic explanation to explain adulterous behavior is that "forbidden" sexual congress with a married person represents the victory of the animal nature of human beings over their reasoning, civilized self. Aggressiveness, territoriality, hunger—and sexual drive—are all inherent animal instincts which human beings share, covered over by a rather thin veneer of civilized behavior. Does adultery reflect the former overwhelming the latter? An inappropriate released expression of sexual hunger? On one hand, that would account for the observation that adultery seems to be engaged in with little conscious decision-making ("What was he thinking?" "Well, actually he wasn't thinking."). However, it might be fair to say that a good percentage of adulterers are, in fact, receiving adequate sexual activity on the home front. If not, if sexual

pleasure has left a marital relationship, then this explanation might hold true.

2. That adultery reflects an attempt to escape an unhappy martial life is another traditionally-supposed caused for sexual straying of both men and women. "Falling out of love" with a spouse, lack of emotional support, and any of a number of marital unpleasantness would serve as a motivational source for adulterous behavior. In fact, adultery by some might be purposeful in aiming to end an unhappy marriage.
3. Adultery has been explained as a search for novelty. Being restricted to a single partner in sexual activity for tens of years may trigger a need, appropriate or not, for conjugal and emotional relationships with other individuals.
4. Psychological explanations for adulterous behavior include a sense of personal inadequacy in which the "conquest" of members of the opposite sex outside of marriage might be elected to serve to shore up one's self-image.
5. Under the "forbidden fruit is the sweetest" hypothesis, the thrill of sexual activity may be exaggerated when such activity is considered "wrong." Adam and Eve knew all about this one. And so did Friedrich Nietzsche, who claimed that "the secret of reaping the greatest fruitfulness and the greatest enjoyment from life is to live dangerously." Others have been quoted as experiencing the greatest sublime sex outside of their marriage. Such exalted sensations may well be biochemical in nature, as dopamine pathways have been incriminated, particularly in animals, as responsible for sexual drive and pleasure. And that would explain the addictive nature of extramarital sex, which poses a difficulty when one or both parties are conflicted about the need to end the relationship.
6. Electing to engage in sexual activity outside with a married person may reflect an expression of individualism and need for individual freedom by those who feel they have been overly constrained by societal behavioral demands.

Nobody has a clear answer as to what drives an individual to engage in adulterous behavior. If you checked "all of the above" from this list you are perhaps correct.

Why Committing Adultery Does Not Make Good Sense

The central admonition against adultery, from all sources, is that this is a destructive practice. Sex with a married individual is harmful to the adulterer (guilt and loss of self-respect), the betrayed spouse (destruction of marriages and families), and to relations and acquaintances (who will view your actions as a betrayal of their concepts of good and bad behavior in the people that surround them). An important lesson here is that one's own personal opinion on the sinful or benign nature of adultery does not alter these truths. In the harsh light of reality, such behavior causes social damage and creates risks because of how *others* will view one's adulterous act.

But all such questions of moral failure and detrimental behavior aside for a moment, there exist a number of solid practical reasons why engaging in an adulterous affair is clearly disadvantageous. As a service to those in need, then, here is a quick survey of some practical pitfalls of adultery which can be laminated and placed in a handy spot at the occasion of one's next office party, church social, or business trip to Buffalo. (The author disavows any paternalistic intent here. Indeed, the extent that the following downsides of adultery might be balanced by positive, soul-fulfilling outcomes, satisfying to both parties, is left to the opinion of the reader.)

Committing adultery is a good way of getting yourself shot. The husband/wife of your sexual partner will not take lightly the discovery of your illicit union. Not at all. And this reaction will have nothing to do with their past behavior. Even men who mercilessly beat their wives on a nightly basis can be expected to be quite overwhelmed with insane jealousy, anger, and out-for-revenge rage when they find out about all this illicit sexual activity that's going on behind their backs. And they can strike anywhere and at any time, often with the implicit expectation of legal leniency. In the annals of human history, and today in many states, juries and judges have looked favorably on deceived husbands and wives who have murdered—even in cold blood—one or both transgressing parties. You, the adulterer, will have to be on high alert 24 hours a day, everywhere you go—coffee shops, movie theatres, even public parks. Behind every bush, in every waiting line, might be a deceived wife or husband brandishing a Smith & Wesson pistol. There will be no escape.

One risks acquiring a nasty venereal disease. The unfortunate truth cannot be avoided. When intermingling sexual parts with a married person one is, from a medical standpoint, having sexual union with every partner, particularly his or her spouse, with which any of the aforementioned has ever engaged in sexual congress. The list of potential diseases which one might thereby acquire is daunting: gonorrhea, chlamydia, chancroid,

granuloma inguinale, syphilis, AIDS, genital herpes, genital warts, trichomoniasis, public lice ("crabs"), jock itch (Tenia cruris), and so forth. Explanations to one's spouse might prove problematic. Consider, too, the many highly-intelligent famous persons, just in the arts, who have unknowingly tread this deadly microbial path: Franz Schubert, Scott Joplin, Oscar Wilde, Guy de Maupassant, Robert Schumann, Henri Toulouse-Lautrec, Charles Baudelaire—they all went mad from syphilis and succumbed to illicit sexual intermingling.

Getting pregnant. Enough said.

Becoming highly vulnerable. Thinking here of legal issues. Your partner in an adulterous evening of unbridled sex suddenly in the aftermath becomes shaken with his or her impropriety, and now, denying consensual activity, cries "sexual aggression!" to the legal authorities. (How were you to know she was the principal of a Roman Catholic elementary school?) Even if acquitted, you will suffer.

Become victim of the partner's obsession. Short of a full psychiatric assessment prior to initiating the affair, one can never be sure that the adulterous partner might not become mental unbalanced and pathologically attached to you, particularly when you decide that such a relationship should be terminated. Serious risks to marriage, reputation, and health can ensue. Movies such as *Fatal Attraction* (with Michael Douglas and Glenn Close) and Woody Allen's *Crimes and Misdemeanors* (Martin Landau) have described this risk so graphically that little further discussion would seem needed here. (It might be suggested, in fact, that the rate of adulterous behavior at least transiently plummeted when these movies were released.) Too, it should be pointed out that the difficulties for the male adulterer in these two films were only resolved by the murder of the offending obsessed female. This may be more drama than you would desire.

Having to schedule. Consider the energy and time required to craftily arrange to deceive one's spouse to meet up with the neighbor's wife for a clandestine assignation. Getting the kids to soccer practice in time to reach the vet's office before closing time for the dog's shots is difficult enough.

Suffering devastating "heartbreak." As with any amorous affair, a decision by your adulterous partner to break off the relationship may cause you to suffer serious anger, depression, and even suicidal behavior. Your emotional stability is left wide open and can easily be blind-sided by the actions of your illicit lover.

Destroying personal reputation. Society, your peers, and anyone who reads the newspaper or attends to local gossip will view you as a person labelled as lacking in moral responsibility. And that's regardless of the many valuable and laudable contributions you have made to the good of

society. Government leaders, religious personages, prominent scientists, television personalities—they've all learned this. You will be turned, irretrievably, from a "good" person to a "bad" person.

Some Final Thoughts

So, adultery. Sinful in the eyes of religious commandments. Behavior viewed as a moral failure by contemporary societies. Placing its practitioners at high risks. Yet, engaged in by tens of millions of men and women, since antiquity. A practice which by some means is satisfied—or at least is triggered by—a strong human need. A need that is difficult to explain by any thoughtful risk-benefit analysis.

In closing, one might consider the thoughts of the philosopher Jesse Prinz:

> "Like everyone, we learn morality through cultural inculcation, long before we engage in careful rational reflection, and there is a risk that our most treasured arguments are rationalizations, not justifications….Our moral values are emotional values. We have internalized them by learning to feel outraged when they are violated, and ashamed when we question their authority. But the history of culture is a history of moral transformations and should remind us that we are not stuck with the values we learned on Mother's knee. Together with our communities, we can explore the possibility of moral reform. The flexibility of morality does not condemn us to an anything-goes moral nihilism. It frees us from intolerance and moral stagnation and allows us to improve on what we have."[8]

Notes

1. Despite all efforts, the author cannot resist at least one literary allusion here (which is promised to be the last). Hester Prynne, it will be recalled, is the adulterous protagonist in *The Scarlet Letter,* Nathaniel Hawthorne's mid-Nineteenth Century novel which depicts the conflict of sexuality with the demands imposed by society. Her husband assumed (erroneously) to be dead, Hester becomes pregnant by the local pastor and consequently is condemned by the community to wear a scarlet letter "A" for the rest of her life. In more contemporary popular culture, the seductive attraction of such behavior is reflected in the musical *The Music Man,* in which the shyster Harold Hill, desiring a girl "with a touch of sin," sings that "I hope, and I pray, for a Hester to win just one more 'A'".
2. See Choi KH et al. Extramarital sex and HIV risk behavior among US adults: results from the National SAIDS Behavioral Survey. Am J Public Health 1994;84:2003-2007; Wiederman MW. Extramarital sex: Prevalence and correlates in a national survey. J Sex Research 1997;34:167-174; Atkins DC

et al. Understanding infidelity: correlates in a national random sample. J Fam Psychol. 2001;15:735-749.

3. Information on this quick review can be found in the book *Twenty Questions. An Introduction to Philosophy* by G. Lee Bowie, Meredith W. Michaels, and Robert C. Solomon, Sixth Edition. Belmont CA: Thomson Wadsworth, 2007.
4. Aristotle recognized, which may come to the relief of some readers, that material goods were also legitimately important for happiness besides just behaving in noble ways: "Happiness plainly requires external goods, too, as we said; for it is impossible, or at least not easy, to act nobly without some furniture of fortune…For a man is not very likely to be happy if he is very ugly in person, or low birth, or alone in the world, or childless, and perhaps less if he has worthless children or friends, or has lost good ones he had….Happiness seems to stand in need of this kind of prosperity; and so some identify it with good fortune, just as other identify it with excellence." This he wrote in "Happiness and the Good Life" (see note 3 for reference).
5. Mill JS. *Utilitarianism.* London: Longman, 1907.
6. Nagel T. *What Does It All Mean? A Very Short Introduction to Philosophy.* Oxford: Oxford University Press, 1987.
7. Greene JD, et al. An fMRI investigation of emotional engagement in moral judgement. Science 2001;293:105-108.
8. Prinz JJ. *Beyond Human Nature. How Culture and Experience Shape the Human Mind.* New York: W.W. Norton, 2012.
9. The American anthropologist Ruth Benedict argued convincingly for the concept of relative mortality, which she considered simply an expression of a socially approved custom in a given culture, with no implications as to an intrinsic universal moral law. In her article "Anthropology and the Abnormal" (J. Gen Psychol. 1934;10:59-82) she wrote that "We do not any longer make the mistake of deriving the morality of our locality and decade directly from the inevitable constitution of human nature. We do not elevate it to the dignity of a first principle. We recognize that morality differs in every society, and is a convenient term for socially approved habits…The concept of the normal is properly a variant of the concept of the good. It is that which society has approved. A normal action is one which falls well within the limits of expected behavior for a particular society."
10. Kane R. *Through the Moral Maze.* Bath, UK: Paragon Books, 1994.
11. See Richerson PJ, Boyd R. *Not by Genes Alone. How Culture Transformed Human Evolution.* Chicago: University of Chicago Press, 2005.
12. The concept of social Darwinism was not addressed by Charles Darwin himself but rather initially by the theorist Herbert Spencer in 1860. He argued that a society (that is, a grouping of individuals) can evolve in the same manner as living beings described by Darwin in the selective nature of survival of the fittest. Since then, social Darwinism has been interpreted in numerous ways, many which describe a negative influence on human civilization. In the discussion above, "fitness" was interpreted in a positive light as attributes of cooperation and adherence to moral principles of the

members of a society. However, others have considered "fitness" in the context of social Darwinism as societies which are more competitive and aggressive, as exemplified by enslavement and colonization of underdeveloped countries.

13. See Scruton R. *On Human Nature.* Princeton; Princeton University Press, 2017. He goes on to point out, though, that this line of thinking of preservation of societies by moral behavior of individuals sheds no light on the question of the *origin* of this behavior. "From this trivial truth, however, we can deduce nothing about the causes of moral conduct or moral thought and nothing about their grounds…Nothing that follows would serve either to bypass or to undermine the work of philosophy in exploring the foundations of moral judgement and its place in the life of a rational being."
14. See Stace WT. *The Concept of Morals.* New York: The Macmillan Company, 1965.
15. Magee B. *Ultimate Questions.* Princeton: Princeton University Press, 2016.
16. Richards JR. *Human Nature after Darwin: A Philosophical Introduction.* New York: Routledge, 2000.
17. Bevilacqua L, Goldman D. Genetics of emotion. Trends Cogn Sci. 2011;25:401-408.
18. Mikhail J. Universal moral grammar. In: Edmonds D, Warburton N. *Philosophy Bites Again.* Oxford: Oxford University Press, 2014, pp. 37-49.
19. The consequences of exceeding normal moral boundaries make for exciting cinema fare. For instance, at the end of Claude Chabrol's 1995 French film *La Cérémonie* the female characters played by Sandine Bonnaire and Isabelle Huppert, apparently fed up with bourgeois mentality, dispassionately blow away an innocent family of four with multiple shotgun blasts as the victims are watching a Mozart opera on the television.
20. Burton RA. *A Skeptic's Guide to the Mind.* New York: St. Martin's Griffin, 2013.
21. Ayer AJ. Emotivism. In: Bowie GL, Michaels MW, Solomon RC. (eds). *Twenty Questions: An Introduction to Philosophy.* Sixth Edition. Belmont CA: Thomson Wadsworth, 2007, pp. 542-545.
22. This statement is, in fact, a provocative tease, offered as a token recognition of an aspect of moral behavior in humans which will not be entertained in this chapter. Does one truly have the free will to decide which moral behaviors he or she is willing to exhibit, what individual benefits one is willing to sacrifice for the rewards of gaining personal goals and enhancing the greater good of the society in which he or she lives? Or are moral behaviors no decisions at all, being pre-determined by religious dictates and cultural pressures so that, in fact, one has no real choice in the matter? More critical unanswerable questions…..
23. Religious interdictions against adultery have been so forceful throughout history that a frightening list of various punishments have been enacted, including stoning, strangulation, burning, flogging, drowning, and impalement. Having sex with the King's wife in England was particularly to be avoided, given the automatic sentence of capital punishment. One cannot

fail to be astonished that participation in adulterous sexual behavior has persisted despite such harrowing consequences.

24. Wittenberger JF, Tilson RL. The evolution of monogamy: hypothesis and evidence. Ann Rev Ecol Systematics 1980;11:197-232.
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11. REALITY

When all these factors have been taken into account, it is surely clear that reality will never be intellectually mastered by humans.
—Bryan Magee

Reality is merely an illusion, albeit a very persistent one.
—Albert Einstein

By the mid-Nineteenth Century, physicists and astronomers were convinced. Copernicus was right—a "heliocentric" model of the solar system accurately described a rotating Earth and other planets revolving in orbits about the Sun. Not entirely persuaded, however, were the conservative ecclesiastical authorities as well as, in fact, a doubting general public. For the former, such ideas still ran counter to the existence of a providential God who moved heavenly bodies in a geocentric model around the Earth. Such resistance persisted as a hold-over from the strong influence of the Church two hundred years before, when advocacy of the Copernican heliocentric model caused the monk Giordano Bruno to be roasted at the stake in Rome (in a strikingly prescient manner, Bruno also contended that the distant stars were surrounded by planets as well). And the story is well-known of Galileo's narrow escape of the similar fate at the hands of the Inquisition in the same era.

For a good number in the population a similar skepticism reigned. That the Earth rotates and orbits the Sun on a yearly basis was simply too inconsistent with one's daily experience. Afterall, the sun was observed clearly to rise each morning and move across the heavens. One's senses made it obvious that the inhabitants of planet Earth stand on a motionless ground—not whizzing by at 1,000 mph as required by the rotating planet. And if this was true, why wouldn't people be caught up in a violent wind of similar velocity? If you threw a ball straight up, it comes straight down, right where it started. That wouldn't happen if the Earth was rotating. No, human experience, based on all that one learned from one's sensory input, indicated the impossibility that our planet turned on its axis.

"The very concept of a spinning Earth was preposterous to the geocentrists, who appealed to common experience. Stand outside at night, they suggested, and watch the stars drift slowly across the sky; there is

absolutely no feeling of motion underfoot. Why deny the credibility of one's own senses?"[1]

To instruct these still-doubters, Louis-Napoléon Bonaparte in Paris in the year 1851 ordered Leon Foucault to demonstrate evidence for the rotation of the Earth by means of the swinging of a pendulum. Foucault, a physicist at the Paris Observatory, connected one end of a 67-meter cable to the ceiling of the dome of the Panthéon and to the other affixed a 28 kg lead ball, or bob, encased in brass. This pendulum swung over a wooden circle on the floor, marked with degrees. With each swing of the pendulum, which lasted 16.4 seconds, the direction of the plane of the swing around the circle advanced by 2.5 mm, and over the course of 24 hours the direction of the pendulum's sweep would progressively alter its direction to complete a full 360 degrees (Figure 11.1).

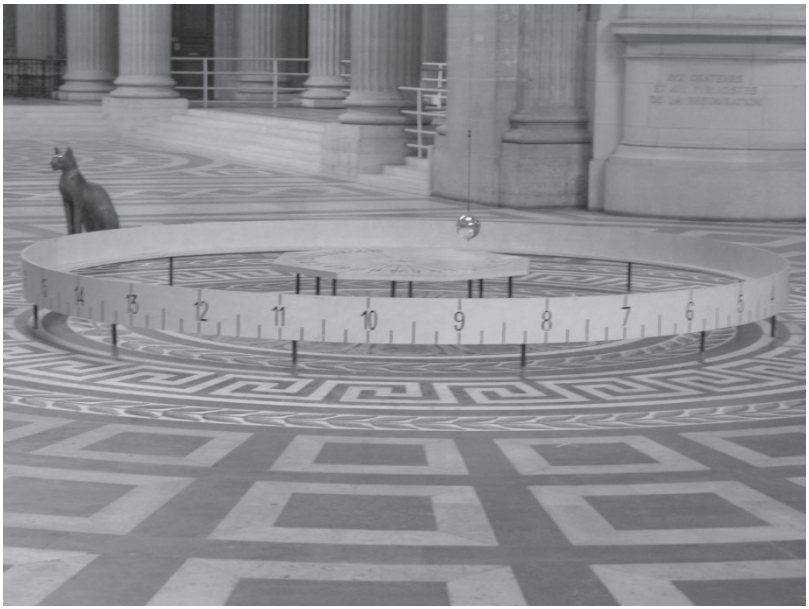

Figure 11.1. One can today view the Foucault pendulum swinging from the ceiling of the Pantheon in Paris.

The perception that the pendulum's sweep direction was changing was, of course, an illusion. In fact, the pendulum's swing orientation was constant; what *was* moving was the Earth, rotating on its axis. Indeed, it was just this that Foucault was attempting to demonstrate. The lesson here was

that the frame of reference of the observer is important to recognize in considering explanations for any natural phenomenon—even when such observations may deny common experience that we derive from our senses.[2]

Foucault's pendulum became an immediate tourist attraction, and the Pantheon was flooded with curious observers. But did they really believe the explanation? The whole phenomenon was still inconsistent with their perception of a stable, fixed Patheon upon which they stood and the progressive of change in direction of this constantly swinging silent bob. "What is certain is that for some this installation was not self-evident. It even irritated," states the current visitor's guide to the pendulum in the Panthéon. "Do we need go recall that the century was stamped by a strong anticlerical movement in keeping with the desire to ensure that science and its prodigious developments benefited from independent thinking and research? The shadow of Bruno and Galileo still walked."[3]

And what did the Church feel about this scientific documentation of the heliocentric model? In December of 1851, Louis-Napoléon took over the French government in a *coup d'état* and presented the Panthéon to the Church as a means of gaining favor. Not unexpectedly, the pendulum was removed.

So, what is "reality?" And how can we recognize it ("really") when we see it? Perhaps it is fair to state that for the average person in the street, this is not a particularly vexing issue. Reality is what we are, where we live, where we work, our personal relationships, our favorite baseball team, the best pizza restaurant in town, and so on and so forth, all of this being fixed and predictable from one day to the next. This is our quotidian reality, and this is what we are dealt and deal with.

Philosophers, as would be anticipated, are not content with such mundane, concrete answers, and seek instead to discover more profound explanations for what makes human experience "real." And while human beings for the most part can be quite content with defining reality by one's daily experiences, philosophers go to bed each night restless, with no defined answers. As described earlier in the Preface to this book, scientists—meaning here physicists, biologists, astronomers, mathematicians, and the like—have their own take on this issue, preferring to describe reality in respect to established the physical laws which govern it. In doing so, reality has become to be seen as relative to the domain proscribed by these laws, and that different forms of reality—all still "true"—encompass the physical world.

In this chapter we will examine these perspectives as the impact human experience. It is intriguing to see how these different versions relate—or fail

to relate—to each other. The reader who finds this all oppressively obscure may escape back into the seemingly factual world of human reality. But be forewarned. As revealed in the discussions that follow (and presciently presented in the above vignette of Foucault's pendulum), there are some rather disturbing clues that our brain, upon which we bank for providing our individual definition of reality, is capable of being fooled.

The Philosopher's View of Reality

Just what constitutes "truth" or "reality" for human beings living in their surrounding universe has been the focus of philosophical discourse since the dim origins of recorded thought. And over the centuries a plethora of schools of thought, or perspectives, on this question have evolved, including materialism, phenomenology, skepticism, empiricism, rationalism, solipsism, idealism—the list goes on. Advocates of these differing—and often contrary points of view—have included such illustrious thinkers as Kant, Hume, Russell, Berkeley, Plato, Galileo, Locke—even Homer Simpson and Woody Allen. All felt that their opinion held some essential key to what constitutes reality, but, in the end, and true to their profession, the essential answer continuous to lie not only undiscovered but perhaps undiscoverable.[4]

All these schools of thought surround the field of *metaphysics,* which seeks to examine the nature of reality. One venturing into this domain, however, quickly realizes that such discussions often transgress into broader areas of philosophical thought, such as the resolution of the mind-body problem (does there exist a *soul* beyond the material composition of the human brain?) and questions surrounding the extent that human behaviors reflect one's free will or are directed by determinism.

The primary metaphysical issue surrounding this grand debate for the most part centers on the relationship—or even the existence—of an objective fixed natural world outside of human consciousness and b) the reality created by the human brain based on its sensory input of this extrinsic reality. That is, is reality for human beings just what they see, hear, feel, and smell? Or is there a much grander reality of which we are only dimly ware or blissful ignorant? Or, probably most likely, both?

One model for thinking about these questions calls for two versions of reality as viewed from the human perspective.[5] The first, termed *primary qualities*, identifies objects whose existence is independent of interpretation by the human mind. Such objects can be identified by factors such as position, number, shape, and size. These qualities reflect an objective realty of the world about us. They just "are"—regardless of our mind's interpretation.

For some reason, an orange has traditionally been used by thinkers to illustrate this distinction. One appreciates, by way of one's vision and past learning, that an orange sitting in a bowl on a table is an objective part of an external reality. That orange is part of a "truth" of the physical nature of the universe. For us, it requires no interpretation, no further cerebral analysis. Ditto for tables, chairs, your automobile, one's spouse, the snow covering the driveway, etc.—essentially every other noun in one's existence. Indeed, one can easily describe his or her own personal reality in such terms in a long conversation to anyone who would care to listen. What's more, as evidence of this external objective reality, a) your friends and family can equally share the perception (that is, they all can see the same orange), and b) that orange, left undisturbed, will be found in the same location tomorrow.

But peel that orange and take a bite. Now you savor a delicious *sweetness,* which describes a different character of the orange. In fact, there is nothing in the orange that incorporates sweetness. This *secondary quality* is all within the interpretation of neural constructs within the brain. It is a constructed, subjective reality that cannot be accurately quantified or measured. The brain creates this secondary form of reality, based on a certain chemical composition of the orange, but the nature of this reality is highly dependent on who's doing the tasting. What's "incredibly sweet" to one individual may be "barely tasteful" to another. This was a distinction between primary and secondary qualities of reality was made as far back as the early Seventeenth Century by Galileo, who recognized that qualities such as color, taste, smell, and beauty are all a function of the mind on the observer. Today, the neurophysiological mechanisms underlying such subjective creations of sensory input remain largely mysterious. We still await such insights to resolve classic philosophical conundrums—such as, am I seeing the same "color" red when I regard an apple that you are?

This construct seems like a useful and accurate way to consider the nature of reality, but philosophers have not been content to leave well enough alone. In the Eighteenth Century the theorist George Berkeley claimed that it was inappropriate to distinguish primary from secondary characteristics of reality. If we view a chair, he said, the image of that chair in our conscious mind is not a "real" chair but rather an image of the chair constructed in our brain. In Berekely's opinion, then, primary qualities of reality are as much dependent on creation and interpretation as secondary qualities. "According to Berkeley, physical objects do no lie beyond our ideas. Rather physical objects *are* ideas."[4] Reality from this viewpoint is entirely mind-dependent. "All we can ever know is derived from our perceptions."[6]

The obvious corollaries to Berkeley's ideas raise some unsettling questions. Does reality therefore rest entirely in the human mind? If there is no human to witness the world, is that world real? In sum, apart from the perceptions of the human mind, does a broader, objective reality even exist? One might legitimately ask here, how would we know that this was the case? Our only means of measuring reality is our brain itself. There exists no outside independent "observer" to make this call, no means of determining if there is something "out there" or if it's all in our heads.

As Jim Baggott wrote in his book *A Beginner's Guide to Reality,* "All we can ever know is derived from our perceptions. We have by definition no access to any evidence of an independent physical reality causing us to have these perceptions."[6] And, similarly, in his review of Immanuel Kant's take on metaphysics, A.W. Moore contended that "The fact that we carry these native spectacles [referring here to our bodily senses] around with us means that there must be such a distinction. We can never take these spectacles off. We only have access to how things appear to us. How things are in themselves is something that we can't know…"[7]

A consequence of Berkeley's ideas is that—difficult as one might have in imaging it—physical objects do not exist when they are not being observed. This contentious concept has fueled the fires of philosophical discourse ever since. Berkeley himself said that things continue to exist in the world unobserved by humans because God was doing the watching. The phenomenologists and other schools insisted that physical phenomena existed when not observed (by God or anyone else). And so one can pick an opinion here among none which provide any proof or experimental support, and simply "retire in confidence."

Amidst all this debate concerning the location and existence of a "real world" (inside our minds? Outside? Both?), one conclusion seems evident: *the human brain can only perceive a reality from the informational input provided by the body's senses.* The brain, encased as it is in the pitch-black darkness of the cranium, has no direct access to the external world. Its entire function in assembling, or reflecting, or representing an external reality must be derived from the information received that defines what see, hear, smell, touch, and taste.

Needless to say, perhaps, that the accuracy of any concept of reality so obtained is contingent on the precision of such sensory input and the means by which it is interpreted by the billions of neural connections that make up the human brain. Normally we assume such accuracy of the brain in reflecting the physical "truths" about the outside world as we conduct our daily lives. We trust our sensory input to navigate I-94 during the morning rush hour, to slice a drop shot at match point, to assess our daughter's new

boyfriend. We do not question these or any of the others among the multitude of facets of daily life, all which conform to what our brain is telling us is "common sense." Still, there is growing awareness that our senses a) provide only a small window onto the "real world" out there, and b) are capable of being deceived, thrown off by the erroneous assumptions of "common sense."

The Very Small Window

One does not need to delve very far in the literature examining the nature of reality before encountering the proposition that there may exist "parallel worlds" that lie beyond human recognition. And, in fact, such "worlds" do exist. Indeed, among the multitude of theories, proposals, arguments, and debates regarding the nature of reality, this serves as one indisputably *true fact* (this is so unexpected that the words need to italicized here). Broad expanses of reality do go undetected by our senses. In the evolutionary development of hearing and vision and so on, such capacities have been limited to providing only a very narrow window on the true nature of reality.

Work in the mid-Nineteenth Century by Michael Faraday, James Clerk Maxwell, and Heinrich Hertz revealed that we live in world encompassed by fields of electromagnetic radiation. Moreover, such radiation exists in an extraordinarily wide range of characteristics based on its wave length (and frequency, the reciprocal of wave length) and its effect on physical matter. There thus exists an *electromagnetic spectrum*, consisting of wave lengths varying from the dimensions less than that of a single atom to those which can cover thousands of miles. When you listen your favorite talk show, your radio is picking up electromagnetic transmissions from a transmitter with wave lengths in the range of one to 10 meters. Cooking up a bag of popcorn in your microwave oven is achieved by utilizing the heat-producing nature electromagnetic radiation of one meter in wavelength. Your sunburn on the beach last summer was the effect of the damaging effects of ultraviolet waves on the cells of the skin. The X-ray taken to assess your painful ankle is generating a picture using radiation with a tiny wavelength of 1 nanometer. Even shorter wave lengths are typical of gamma rays, which are forms of highly-penetrating radioactive emissions from elements such as radium.

When we say we "see" an object, say a chair, we are indicating that a narrow band of this radiation in the form of light—made up of tiny packets of energy called photons—enters our eyes and excites receptor cells in the retina after having bounced off the chair. These receptors in the human eye are, however, uniquely restricted to appreciate light radiation in a very

narrow range of wavelengths, from 380 nanometers, which we see as the color violet, to 780 nanometers, which appears as deep red. To the rest of the electromagnetic spectrum we are blind. Our optical apparatus provides us with only an extremely tiny window on this real physical world. To quote David Eagleman:

> "Visible light constitutes only a tiny fraction of the electromagnetic spectrum—less than one ten-trillionth of it. All the rest of the spectrum—including radio waves, microwaves, X-rays, gamma rays, cell phone conversations, Wi-Fi, and so on—all of this is flowing through us right now, and we're completely unaware of it. This is because we don't have any specialized biological receptors to pick up on these signals from other parts of the spectrum. The slice of reality that we can see is limited by our biology."[8]

We are now confronted with the difficult question as to why, biologically speaking, human beings are so limited in their view of external reality, at least in the fields of electromagnetic radiation. And why is our "vision" into this real world defined (clearly on a genetic basis) by the specific wavelengths of 380-780 nanometers? Biologists will readily account for our selective blindness on a Darwinian basis. That is, in the course of human evolution the development of acuity in these particular wavelengths must have provided a selective reproductive advantage over other alternatives. But just why remains a mystery. Some remain disquieted. As Jim Baggott has written,

> "The pragmatist in you might still not be satisfied. The human mind, you say, is the result of evolution by natural selection, operating through millions of years, leading to us, *Homo sapiens.* Does it make any sense to suggest that the human mind as evolved based on a brain with a sensory apparatus—sight, taste, smell, touch, and hearing—that is not completely attuned to the physical reality around it? Put another way, would an organism that perceived the world around it very differently from the world as it really is be fit to survive?"[6]

As intimated by Baggott above, similar limits of perception of a total reality are recognized in our other senses as well. Take hearing for example. Because of limitations in the hearing apparatus of the middle and inner ear, human beings are capable of discerning sound waves (alternate rarefaction and compaction of air molecules) in the range in frequencies from 20 hertz (cycles per second), the deepest sound, to 20,000 hertz, the highest pitch. Ability to hear high-pitched sounds deteriorates during the life span, and the elderly are particularly prone to experience a decreasing upper limit of audible frequencies.

But, similar to the story of electromagnetic waves, the range of sound waves in nature is actually far more extensive, both above and below those frequencies which are audible to humans. Many of these frequencies outside the human audible range are, in fact, detectable by animals. A dog, for example, can detect frequencies as high as 45,000 hertz, while a cat's upper limit of hearing can reach 64,000 hertz. A number of animals use high sound frequencies (ultrasound) to detect prey and for navigational purposes, such as bats, nocturnal insects (moths, beetles, etc.), and whales. Porpoises are said to hold the record for highest audible sound frequencies, around 160,000 hertz.

Ultrasound has become familiar as a non-invasive, safe means of visualizing internal structures and function of the human body and has become a standard diagnostic method in many medical fields, particularly obstetrics and cardiology. In this method, ultrasound waves are transmitted into the body, and these are reflected back to a receiver to provide a visual picture of the anatomic structures in question. (In a similar fashion, sound waves provide a means of underwater range finding, useful in localizing enemy submarines, ancient wrecks, etc.) Newer ultrasound techniques have given clinicians and researchers the ability to measure rates of flow (e.g., cerebral blood flow, cardiac output) and physiological function (myocardial contractility). But, to emphasize the point, in none of these means of employing sound waves is that sound detectable by the human ear.

Again, the human sensory apparatus fails to provide a comprehensive view of the nature of the real world. In the preceding discussion we were almost blind, now we're deaf as well. The other senses do not stack up well either. As K.C. Cole has pointed out, "Our chemical senses (taste and smell) are extremely limited compared to those of a plant, or a cell, or a dog. We can barely perceive the difference between hot and cold: a blindfolded person can't tell whether she has been burned by a hot iron or dry ice…To say that we are narrow-minded (or at least "narrow-sensed) is the least of it."[9]

It is disappointing to recognize that our view of reality, being totally reliant on sensory input to a brain hidden away from the physical world, is characterized by such dramatic limitations. (At the same time, the ingeniousness of humans to utilize these "extra-sensory" realities for human benefit is most impressive—witness those emotional images of your first baby *in utero* by ultrasound, the entertainment provided by radio and television, the diagnostic capabilities of X-rays, re-heating last night's pizza in the microwave, and so on.)

But still to come, more unsettling news: our senses do not simply report a perspective of realty to a passive brain; instead, that extraordinary

complex cerebral electrochemical apparatus acts not only to interpret all this incoming information but also to *create,* within its sheltered confines, its view of the real world that it cannot witness. Since vision constitutes the major portion of such sensory input, it is worthwhile describing in some detail our current understanding of how signals from the eye become constituted into an internal reality by the human mind.

The Eyes Have It

You are to be forgiven if you consider the eye as working like a television camera, recording images of the objects and events in the outside world and transmitting these to be viewed by the "mind's eye" in the brain. That's because it certainly seems to operate that way. But, no, that's not how it works. Instead, "seeing" by the brain involves construction and deconstruction of images, transmission of visual signals by electrical impulses, and, on top of this, a good deal of interpretation and active creativity by the brain to define visual images.[10]

While different schools of thought have proposed how the cerebral process of vision is achieved, Richard Gregory's conclusion seems most insightful: "There is nothing closer to our intimate experiences, yet the brain is less understood and more mysterious than a distant star." Most researchers would now agree, though, that "[visual] perceptions are *hypotheses.* This is suggested by the fact that retinal images are open to an infinity of interpretations... [That is,] sensory signals are not adequate for direct or certain perceptions; so intelligent guessing is needed for seeing objects. The view taken here is that perceptions are predictive, never certain."[10] What the brain is doing in the visual process is taking sensory input, combining it with expectations, knowledge of past experiences, and emotions and then producing a "best guess" of what's out there. The bottom line is, as expressed by David Eagleman, "Our experience of reality is the brain's ultimate construction."[8]

But let's back up and start at the beginning. Light from an outside object world enters the eye through the pupil in the form of photons, tiny bundles of energy that can act like particles or waves. These photons arrive with a particular frequency (or frequencies) corresponding to particular colors that have bounced off the object, which absorbed all photons in other color frequencies in the visual range. If the object appears to be red, this means that all wave lengths in the rainbow spectrum have been absorbed by the object *except* for red, which was reflected off the object and into the eye. That is, the object is inherently not "red" but actually "anti-red."

The photons entering the eye are focused, or bent, by the cornea and the lens onto the retina at the back of the eye. Conforming to the laws of optics, this image is upside down and inverted left-to-right. Receptor cells at the back of the retina convert the arriving photons into electrical impulses. In this manner the optical image on the retina becomes *deconstructed* into a pattern of nerve impulses, an electrical phenomenon which consists of extremely rapid alternate transmissions of sodium and potassium ions across the cell membrane. Just how photon stimulation of the retinal cells is converted into traveling spikes of electricity remains uncertain.[11]

This neural information then travels back into the brain via the optic nerves. The optic nerves from the two eyes then cross each other in the optic chiasma, the right coursing to the left brain and the left to the right cerebral hemisphere. The first stop for each is the lateral geniculate bodies, which actually receive more nervous input from higher brain centers than from the eyes themselves. It has been pointed out that "this is an anatomical basis for higher centres modulating or adding to visual signals, giving meaning to retinal images from knowledge."[10]

The neural pathways then converge on the visual cortex in the occipital lobe at the rear of the brain. From here neural patterns are dispersed throughout the cerebral cortex. Animal studies, particularly in cats, as well as more recently by magnetic resonance imaging in humans, have indicated that these different anatomic areas of the brain specialize in interpreting separate aspects of visual characteristics, with different neural pathways and centers for detecting form, movement, stereo depth, color, even angles and orientation of edges of objects.

Somewhere and by some means all this information is gathered and *reconstructed* by the brain and combined with the influences of memory, experience, emotion, and prior knowledge to form a representation, or perception of the outside world, the image that we see in the "mind's eye." By this means, human vision is not simply an optical experience but a psychological one as well.[12] It needs to be emphasized that what the brain constructs for us as an internal image is just that—a symbolic representation or perception, based on a hypothesis of reality.[13] "Vision is not simply a window onto the world, but truly a creation of the brain."[14] Which leaves us rather unsettled, one might guess, by David Eagleman's question: "Everything you experience—every sight, sound, smell—rather than being a direct experience, is an electrochemical rendition in a dark theater….How much of this reality is a construction of your brain, taking place only inside your head?"[8]

Still, as Eric Kandel has written,

> "Luckily for us, although the raw data taken in by the eyes are not sufficient to form the content-rich hypothesis called vision, the brain generates a hypothesis that is remarkably accurate. Each of us is able to create a rich, meaningful image of the external world that is remarkably similar to the image seen by others."[14]

On Fooling the Brain, Really

As we have seen, some of the greatest philosophical thinkers throughout history have contended that reality can only be defined as residing within the function of the human mind, and, as a corollary, that appreciation of reality is dependent on sensory input from the environment. If so, *de facto* this sensory input must portray an accurate picture of an objective world, and the mind must depend on an accurate reception and interpretation of sensory input. Discussions in this chapter up to now have revealed that such an assumption may be—quite unexpectedly, perhaps—on shaky grounds. What's more, clearly the brain is capable of being misled by certain ambiguous sensory input, as indicated by particular traditional optical illusions. But beyond this, we are surrounded by evidence that as spectacularly as our brain functions, it may not always serve as reliable indicator of any "truth" in the objective external world. The following discussions illuminate a few such situations. In each case "the most important truths cannot be reached by any amount of common sense or scientific observations nor by logical thought, but only by insights and intuitions that are driven by intense concentrations of feeling. Of these the questions can always be legitimately be asked: But how can we be sure this is valid and not misleading?"[15]

1. Proof from the Pendulum

During the entirety of human existence on this planet up until about 400 years ago it was believed, with little disagreement, that the Earth was the center of the universe, stable, unmoving. A design of an All-Knowing Creator. This Ptolemaic vision of the universe was entirely consistent with human sensory experience, and, thus, common sense. The evidence provided by one's sensory experience, previously alluded to before in this chapter, was irrefutable. The Sun and stars revolved about the observer on Earth in a predictable fashion every 24 hours. One did not feel the earth moving, like a merry-go-round, beneath one's feet (and, particularly, one that would have to be moving at extremely high speeds—1000 mph at the equator—that would have demanded by an Earth that rotated

But…wrong! Following the contentions of Copernicus, we now recognize that it is the Earth that rotates on its axis every 24 hours, responsible for the apparent motion of the heavenly bodies in the sky, and that the Sun, rather than the Earth, serves as the focus on the Solar System, and that all of this is hurtling through space as a tiny locus in a giant galaxy composed of billions of other Suns. In fact, rather than standing on a motionless Earth, its inhabitants are experiencing, beyond their recognition, the wildest of rides though the interstellar space.

To start with, yes, at the equator an individual and all his or her surroundings are moving at a velocity of about 1,000 miles per hour as the Earth rotates in the course of a day. (One standing directly on the North Pole, however, would turn in a circle during the same period but without otherwise moving at all.) The reason there's no viscous windstorm, and that vertically-tossed rocks fall in the same place, is the same reason one sits comfortably in a 747 jetliner flying at 550 mph at 37,000 feet over the Atlantic from JFK to de Gaulle—everything inside the plane is moving at the same speed, so relative to each other there is no motion perceived at all (for this one can be grateful, since, otherwise, trips to the plane's restroom would pose a problem).

"In addition, the entire spinning earth is whizzing around the sun with a speed of almost 20 miles per second. The solar system itself is moving with respect to the center of our galaxy at 120 miles per second, and our galaxy, the Milky Way, is rushing toward the neighboring Andromeda Galaxy (from its point of view) at 50 miles per second."[9] That this vertiginous maelstrom of motion is beyond our experience and comprehension is gratifying but, again, indicates the limits by which the human brain is capable of conceptualizing external reality. "Our perceptions of time and space are largely limited to things in our own experience, of our own relative size. We find it almost impossibly difficult to comprehend numbers much larger than those we can count on our own fingers and toes, or spans of time much longer than our lifetimes."[9]

2. Flat Earth Society

One would have thought that after Christopher Columbus' ships did not tragically fall off the edge of the earth that the long-held opinion that the Earth is flat would have been dispelled. Given the overwhelming evidence from our senses, however, the notion still persists. (Try looking out the window at the central Illinois countryside as your Airbus 320 is about to land at Willard Airport in Champaign-Urbana, and attempt to convince me that the Earth is not flat.)

Since the mid-Nineteenth Century there have existed, in fact, various forms of organization of Flat Earth Societies, devoted to the idea that the Earth is flat rather than globular. These groups contend that NASA, the government, astronomers, astronauts, and the like are perpetrators of the hoax of a spherical Earth, which, they claim, is flat, with the North Pole at the center and surrounded by Antarctica as a 150-foot high wall of ice. One of the central themes of such organizations in that both the Bible and our human senses support the idea of a flat Earth.

3. Biological Control of Physical Activity

Evidence exists that there resides in the brain an inherent control center, operating outside of our awareness, that regulates the amount of our physical activity. This, of course flies in the face of common sense and normal human experience. Do we not cognitively *decide* what physical activities we're going to engage in? We're out of milk, so I will walk to the store. I will take the elevator instead of the stairs. I will enjoy a 3-mile jog around the park this morning. It's *my* decision.

Maybe. One must face some rather compelling evidence that a biological, involuntary center in the brain may participate or control such "decisions."[16] Interesting, too, is the *diversity* of this evidence. To wit:

- The amount of energy we expend in physical activity, adjusted for body size, steadily declines as we age. That this decrease is biological in nature is supported by the observation that in every animal ever studied the same fall in activity with age is witnessed.
- In experimental animal models, lesions created in the brain can alter levels of daily physical activity.
- Neurochemicals in the brain (e.g., neurotransmitters such as dopamine) have been identified that are responsible for motivating physical activity.
- Pharmacological agents administered to animals and humans can alter levels of motor activity.
- Genes have been identified that are linked to controlling physical activity, and it has been estimated that approximately 50% of physical activity levels in human beings can be accounted for by hereditary influences.
- Physical activity levels display organized variability characteristic of biological phenomena.

A credible argument can be raised, as well, for an evolutionary *reason* such a biological activity controller should exist as an important means of establishing body energy balance. Maintaining a constant body weight is critical for human survival, and yet we are equipped with only limited means of doing so: regulating and balancing the "in" of energy by diet (i.e. appetite) with the "out" in the form of the rate of metabolism of the body's tissues (the basal metabolic rate) and—pertinent to this discussion—level of physical activity.

So, it is very likely that involuntary control by the brain of one's amount of physical activity is real, and there is a convincing argument as to why, from a biological standpoint, this should exist. But beyond this a great number of critical questions remain unresolved: How much does one's apparent cognitive decision to exercise relate to such biological control? Can the biological controller be "over-ridden"? Can it be modified by environmental factors? The bottom line: how important is this biological control in the big picture of factors that control how much we engage in physical activities? The answers to these questions bear very practical import from the standpoint of public health initiatives to promote levels of physical activity in the population as a means of improving health and well-being.

4. Central Governor Hypothesis

Consider for a moment the difficult task facing the distance runner as he or she toes the starting line of a 10-km road race. What running pace should be adopted in the opening portions of the race? If one goes out too fast, energy resources will be exhausted well before the finish line, posing the possibility of an embarrassing deterioration well before the race is over. On the other hand, to start slowly with the goal of preserving energy availability might, to the contrary, result in crossing the finish line with "gas still in the tank," resulting in an equally-disappointingly slow race time. The usual wisdom is to maintain a relatively even pace throughout the race, although minor variations (fast start→slower finish, or the reverse) are also acceptable strategies. But how fast should that steady pace be?

The conventional approach adopted by distance runners is to monitor markers of physiological fatigue that serve as guides as to the appropriate pace for the race distance. Rate of breathing is a particularly accurate indicator, but also leg fatigue, sweating rate, and other sensations are useful as well. The runner who passes the 2-km mark experiencing what he considers excessive indicators of fatigue elects to slow down. On the contrary, if levels of stress are low at this point in the race, he speeds up.

The central point here is that this is a cognitive decision by the runner. He or she controls her pace by consciously altering race pace upon receiving physiological feedback. Ask any runner and they will tell you this is how it's done. The experienced runner, they will say, makes intelligent decisions about pace based on physiological feedback coupled with knowledge of prior experience, weather, terrain, presence of other competitors, personal health status, and so forth. The common wisdom is that the runner is in control.

Or is she? Is it possible that her thinking mind is being deceived? By an alternate model, called the *central governor hypothesis,* the pace during a distance running event is determined not by the conscious decision-making of the runner but rather by a subconscious controller within the brain.[17] This governor sets one's pace to a "best velocity" for distance based on past experience and current race conditions, but, more importantly, it regulates muscular effort within particular limits to keep the body safe. It is recognized that extremely vigorous prolonged exercise poses serious risks for the athlete: spasmodic contractions (tetany) of skeletal muscle, bone fractures, heat stroke and death from hyperthermia, excessive demands on coronary artery blood flow and heart muscle function leading to fatal arrhythmias, etc.

The observation is, however, that in fact such tragic occurrences of sports competitions are extraordinarily rare. And, according to this concept, this is thanks to the subconscious governor in the brain that prevents such exaggerated extremes of physical effort. It accomplishes this by *creating* those horrible feeling of fatigue—hyperpnea, nausea, dizziness, muscle weakness, collapse—that force us to stop exercise. That is, it is the *feelings* of fatigue created by a watchful brain regulator that limits exercise effort (instead of physiological factors *per se*) that keep the athlete safe. (It has been noted that this protective function of the brain makes sense from the standpoint of biological evolution. Why would the process of natural selection permit a brain to be developed that would allow ourselves to exercise so hard as to put the body at high risk?)

The validity of the central governor hypothesis, in which a) the runner no longer has control over extent of physical effort and b) all "peak" physical performance is, in fact, submaximal, has not been convincing established. A number of indirect pieces of evidence support its reality (see reference in note 17 for discussion). Still, for the great majority of runners, this theory is not consistent with their common experience that they themselves are cognitively in charge of pace and physical effort during a competition. Too, it contradicts the traditional concept that physiological

factors (rise in production of lactic acid, glycogen depletion, etc.) are responsible for limiting performance. But, perhaps they are being fooled.

5. On Making Decisions

Our daily lives consist of a constant stream of decisions—what to have for dinner, what car to buy, what to do next. Consider for a moment how you probably believe you go about making all those choices. Take settling on which house to buy, for example. You probably feel that you weigh all the pros and cons of each domicile (needs new plumbing? Good schools nearby?), then select, through the process of cognitive thought, the most intelligent choice. But, again, on this seemingly apparent interpretation you could be wrong, a deception that your thinking mind is in charge of such deliberations when maybe it's not. Current opinion has it that, in fact, one's subconscious play a key role in making such decisions below the level of your awareness, and through generated emotions governs what you believe to be the actions dictated by your conscious mind.

"The crucial importance of our emotions—the fact that we can't make decisions without them—contradicts the conventional view of human nature," writes Jonah Lehrer is his book *How We Decide* (Mariner Books, 2009). In his comments on Lehrer's book, Daniel J. Levitin perhaps summarized this best: "The human brain has distinct rational and emotional circuits. When making decisions, we don't always know which one is in control, and we can't always influence the balance."

These considerations of decisions made on a subconscious or emotional basis beyond our cognitive thought brings us dangerously close here to the cusp of the bigger question: do humans possess *free will* in making such decisions or, instead, are these choices pre-determined by cultural, psychological, and genetic factors which are beyond the grasp of consciousness? This would take us far afield from the topic of this chapter, but for those whose appetites are so whetted, read *Free Will,* a concise discussion by Mark Balaguer (MIT Press, 2014).

How can we be assured that in making what we consider as common sense assessments of the reality surrounding us that we're not simply being fooled by a deceptive brain?[18] The answer is, distressingly, we can't, since the instrument we would use to make such a judgement is—alas—the brain itself. "We can know (and I think we do know) that aspects of reality exist that are permanently outside the possibility of human apprehension. We can raise questions about them which, as questions, have enormous significance; but unless we can make contact with a source of information which is

outside the range of human apprehension we cannot get answers on which we can rely. [That is,] in our attempts to understand ourselves as human beings we cannot get outside ourselves as human beings."[15]

The neurologist Robert Burton, writing in his book *A Skeptic's Guide to the Mind* (St. Marin's Griffin, 2013), contended that "common sense is merely the strong sense of what is familiar and right, not a truth or guarantee of fact….Feelings about our involuntarily generated subconscious thoughts often feel like deliberate actions of the conscious mind….Our brains possess involuntarily mechanisms that make unbiased thought impossible, yet create the illusion that we are rational creatures capable of fully understanding the same mechanisms….Hiring the mind as a consultant for understanding the mind feels like the metaphoric equivalent of asking a known con man for his self-appraisal and letter of reference."

Final Thoughts

So, is "reality" only, as Einstein suggested, just an illusion? Perhaps it depends on how reality is characterized. The "reality" created by the human mind is an extraordinary one—objective, predictable, and shared by others. It's a reality that permits us to conduct our daily lives in an organized, meaningful manner. Indeed, it is difficult to imagine any other form of human experience than the one that our brain has constructed and which is lived in the same way as our neighbors. It's a Darwinian construct, the outcome of millions of years of evolutionary pressures, one which is based how we can productively and safely live our lives.

But—and here is the unsettling thought—whether this constitutes a true version of an external reality of the natural world remains, surprisingly, open to serious question. We have seen in the discussions above the reality constructed by the human brain is, in fact based a narrow viewpoint and one that is highly vulnerable to errors in sensory reporting and interpretation. The inescapable suspicion must be that the reality that "works" for humans may not truly represent the reality of what's "out there."

> "The illusion of realism is built into the human condition, and is an inherent part of the logic of our situation….Reality is not, and cannot be, 'like' representations or thoughts. This realization is disturbing. We have a profound need, rooted in our survival, to believe that what exists does so in terms we can understand. The recognition that this is not so, and cannot be so, is disorienting."[15]

Notes

1. Alan Hirschfeld has proved an excellent recounting of the historical origins of the geocentric and heliocentric models of the solar system. Read his book *Parallax. The Race to Measure the Cosmos.* New York: W.H. Freeman and Company, 2001.
2. In Gregory Baker's book (see note #3) is included a delightful tongue-in-cheek letter to the editor in a modern-day issue of *Punch* magazine:

   > "Sir,—Allow me to call your serious and polite attention to the extraordinary phenomenon, demonstrating the rotation of the Earth, which I at this present moment experience, and you yourself or anybody else, I have not the slightest doubt, would be satisfied of, under similar circumstances. Some skeptical and obstinate individuals may doubt that the Earth's motion is visible, but I say from personal observation it's a positive fact. I don't care about latitude or longitude, or a vibratory pendulum revolving round the sine of a tangent on a spherical surface, nor axes, nor apsides, nor anything of the sort. That is all rubbish. All I know is, I see the ceiling of this coffee-room going round. I perceive this distinctly with the naked eye—only my sight has been sharpened by a slight stimulant. I write after my sixth go of brandy-and-water, whereof witness my hand, Swiggins."

   (An "apside", for the intellectually curious, is defined as the point in an astronomical orbit at which the distance of the body from the center of attraction is greatest or least (Webster's New Collegiate Dictionary, 1981).)
3. One can still witness today in the center of the Panthéon in Paris the dramatic silent swinging of Foucault's pendulum, one of the largest in the world (Figure 11.1). Before taking the trip, however, it is recommended that one read Gregory L. Baker's book *Seven Tales of the Pendulum* (Oxford Press, 2011).
4. Here is an excellent opportunity for those who wish to make some positive mark on the world, yet lack the means to finance their alma mater's new science building. Simply devise a school of thought on the nature of reality, importantly one whose veracity can never truly be established. So, you will have "According to the [insert your surname here] School, reality can be regarded as…" Instant immortality is yours.
5. For those seeking a palatable read that provides an overview of philosophical approaches to reality, read Law S. *Visual Reference Guides. Philosophy.* New York: Metro Books, 2016.
6. Baggott J. *A Beginner's Guide to Reality.* New York: Pegasus Books, 2006.
7. Moore AW. Immanuel Kant's metaphysics. In: Edmonds D, Warburton N. *Philosophy Bites Back.* Oxford: Oxford University Press, 2012, pp. 132-142.
8. Eagleman D. *The Brain. The Story So Far.* New York: Vintage Books, 2015.

9. Cole KC. *First You Build a Cloud and Other Reflections on Physics as a Way of Life.* San Diego: Harcourt Brace & Company, 1999.
10. An excellent description of how the eye and brain function together to provide for human vision can be found in Richard L. Gregory's fifth edition of *Eye and Brain. The Psychology of Seeing* (Princeton University Press, 1997). For those who would wish to delve further into the fascinating subject of how the brain interprets abstract visual input, particularly works of modern art, the following are stimulating references: Kandel ER. *The Age of Insight. The Quest to Understand the Unconscious in Art, Mind, and Brain.* New York: Random House, 2012; Kandel ER. *Reductionism in Art and Brain Science.* New York: Columbia University Press, 2016; Shlain L. *Art & Physics. Parallel Visions in Space, Time, and Light.* New York: Harper Collins, 1990.
11. Read about the fascinating concept of how retinal receptor cells act as photo-electric transducers via of quantum sensing in Werner R. Loewenstein's book *Physics in Mind. A Quantum View of the Brain* (Basic Books, 2013).
12. The concept that psychological influences serve as important contributors to the brain's interpretation of visual stimuli dates back to the ideas of the Nineteenth Century physicist Hermann von Helmholtz. Strongly influenced by Sigmund Freud, Helmholtz contended that the subconscious mind influences to a large degree to what we "see" in the outside world. These thoughts were prescient to modern-day interpretations of how the brain functions ins a "top-down" rather than "bottom-up" manner. This is to say that the brain does not serve simply as a passive reflex transducer of afferent-to-efferent nervous activity. Instead, it's a creative, active structure that works to *direct* neural function in resolving, learning, and constructing responses in response to such sources of incoming information. At the same time, we cannot ignore how effectively the brain appears—from the standpoint of our limits of human judgement, at least—to provide us with a predictable, accurate, high-density image of the real world. But here's where we need to take caution. E.R. Kandell (see note 14) wrote that "Firth summarizes Helmholtz's insight into the nature of visual perception in this way: 'We do not have direct access to the physical world. It may feel as if we have direct access, but this is an illusion created by our brain.'" (Firth C. *Making Up the Mind: How the Brain Creates our Mental World.* Oxford: Blackwell, 2007).
13. Richard Gregory has made the interesting observation (see note 10) that what we "see" in front of us is actually a "delayed image" of the reality we think we are viewing. "Because of the finite speed of light and, more important for terrestrial objects, the considerable delay while nervous messages reach the brain, we always sense the past. Our perception of the Sun is eight minutes late, and all we know of the furthest object visible to the unaided eye (the Andromeda nebula) is from before humans appeared on earth. For nearby objects, there is the neural delay of several hundredths of a second, which is significant for fast action."

14. Kandell ER. *The Age of Insight. The Quest to Understand the Unconscious in Art, Mind, and Brain.* New York: Random House, 2012.
15. Magee B. *Ultimate Questions.* Princeton: Princeton University Press, 2016.
16. Rowland TW. *Biological Regulation of Physical Activity.* Champaign, IL: Human Kinetics Publishers, 2017.
17. Rowland TW. *The Athlete's Clock.* Champaign, IL: Human Kinetics Publishers, 2011.
18. The vulnerability—or perhaps, better, the capacity—of the conscious mind to be deceived is illustrated in disease conditions in which the individual is convinced of a reality that is, in fact, objectively completely false. This is termed "confabulation" and is comprehensively described in Armin Schnider's excellent book *The Confabulating Mind: How the Brain Creates Reality (*Oxford University Press, 2008). Being convinced of false truths regarding events, place, time, and relationships can be exhibited by persons with deranged cerebral processes in those with alcoholism, syphilis, carbon monoxide intoxication, cerebrovascular accidents (stroke), brain trauma, and senile dementia (Alzheimer's disease). These patients are not lying—they truly believe that their minds are in touch with these "realities." Too, Schnider points out that "to conclude from this that falsifications of memory and confabulating phenomena require a sick brain would be erroneous. False memories, even those held with full conviction, also occur in healthy people and constitute one of the 'sins of memory.' Indeed, an immense literature on false memories has accrued over many decades, in particular with regard to their impact on eyewitness testimony." (For further information on this point, see Schacter DL. *The Seven Sins of Memory. How the Mind Forgets and Remembers.* Boston: Houghton Mifflin Company, 2001; Brainerd CJ, Reyna VF. *The Science of False Memory.* Oxford: Oxford University Press, 2005.

12. Regret

A One-Act Play

Cast of Characters

John	mid 40's adult
Sally	mid 40's adult
Johnny	(John as teenage boy)
Sally	(as teenage girl)
Vincent	classmate of adult John and Sally

Several VOICES from the audience

[Scene One]

Darkened stage. Single folding chair is downstage, facing audience. Edith Piaf is heard singing "Je ne regrette rien" as man walks casually on stage toward the chair, followed by spotlight. John is about 45 years old, clean-cut, casually dressed. The year is 1985. Music fades.

JOHN (*addressing audience)*: Hear that music? That's Edith Piaf saying she regrets nothing. (*He sits.)* Me, I regret everything. My lousy life, all those things that weren't supposed to happen. Regret is a very painful emotion. Two days ago my wife Diane left me. Just packed up and left. Said she couldn't take it any more. Said I didn't have a sense of humor. It took her 20 years of marriage to find that out? She ran away with our dentist. Dr. Makowitz. Now, he's a bundle of laughs! And then yesterday I thought I was going to find out about my big promotion. Instead I learn I'm being transferred to Peoria. Peoria! Who goes to Peoria unless you're under subpoena? And my kids! I don't want to talk about them. Just a lot of disappointments. I hear people saying that what happens to you in life is, well, it has a lot to do with luck. Little pieces of fate that determine which way your life will go. Maybe. But I don't think so. Looking back on it, there were a lot of decisions I made, or didn't make, that just might have made the difference. I think the problem is that life was just flowing by, and I just didn't take the time to make the right decisions. If I just could have said

Stop, wait a minute, let me look at this, let me look at the big picture. (*Pause)* Hmpf. What I'd give to be able to go back and live it again. Now that would be something. There are a lot of things I would have done differently, that's for sure.

VOICE #1 (from back of the audience): Ha!

JOHN: Did I hear somebody laugh?

VOICE #1: Ah, yes. *Je m'excuse.* I must apologize, but I just couldn't help it. I laughed because you know, and I know, and everybody here knows, that if you were given the opportunity to go back and live your life again you'd make the same stupid mistakes that you did the first time around.

JOHN: *Mais, non!* I assure you. With that chance I would…wait, I have a list here (*pulls out list, reads out loud).* Back in school, I wouldn't worry about being popular. I'd be confident, not concerned about others thought of me. I'd be my own man. Take everything positively, let the bad roll off my back. I'd pay more real attention to who other people really were, care about what they were thinking, what made them unique. People wouldn't push me around. I'd be strong and independent. Think carefully about what *I myself* want to do before making a decision. I wouldn't get trapped into things. I'd take advantage of all the freedom I had—free to choose my goals, and then work towards them. Goals that were really important to me. For sure, I'd—well, some of this is a bit personal. (*looks up)* What I'm saying is that I would run my life, not let life run me. That would be a life without regrets.

VOICE #1: That sounds good, but, you know, it's just a fantasy. I would think everybody here in the audience would make up the same list, right? (*Everyone in audience holds up paper with list, nodding their heads.)*

JOHN: You're saying that making mistakes, making bad decisions, in life is fixed? A done deal?

VOICE #1: Sadly, it would seem so. We all have regrets. It's the human condition. We would all like to turn back the clock. But there is no way. (*Audience sadly agrees, nodding their heads sadly.)*

VOICE #2 FROM AUDIENCE: But maybe there is!

JOHN: What's that?

VOICE #2: Sir, I represent the Back-In-A-Flash Time Machine Company, and I propose that with one of our latest model time travel vehicles, I can—for a reasonable fee—propel you back to any time in the past to any occasion that you so desire. From your momentous breech delivery 42 years ago to that fiasco with the dentist and your wife last week.

JOHN: What!?

VOICE #2: Why have regrets?? They're just heavy baggage that's making you miserable. My time machine, fully equipped with lane violation and blind spot detectors, will take you back and undo all those dumb behaviors and decisions so you can live in peace with yourself.

JOHN: And just how would this, this machine, work?

VOICE #2: Think about an old-fashioned movie projector. You have one reel—that's the future—-which feeds film past the projector's light onto the screen—that's the present—and then it gets wound up on the lower reel—that's the past. All you have to do is have the projector run backwards and time reverses itself. That, for most part, is how our time machine works. The rest I can't tell you because it's a trade secret. And be assured that this is all just according to the laws of physics, which don't have any time direction. If you take the laws of astronomical motion described by Sir Isaac Newton, you could apply them to the planets moving forward or backward—it works in both directions.

VOICE #1: That might be true, except for one, the Second Law of Thermodynamics. This holds that everything in the universe proceeds over time from order to disorder. Never do things become more organized with time, just more disorganized. And, therefore, time cannot move backwards. If you drop a coffee cup onto the floor and it smashes into a thousand pieces, it cannot be made to recombine those pieces back into a cup. Out in the heavens the stars are born of gas and stellar dust, grow, evolve, and ultimately burn out as a dark death. Never the other way around. *Entropy* dictates that time can only move forward.

VOICE #2. You, sir, may have passed Physics 101 at Oberlin, but you never made it to Physics 202, which explains that the Second Law of Thermodynamics only holds for closed systems, that is, those without input

of energy. If you supply energy to a system the Second Law can be avoided, and in fact, disorder can become more ordered. The classic example is that of living beings. Consider what happens between the moment of conception of a baby and when he or she is 18 years old. The incomprehensible degree of complexity of a living behind evolves—chemical disorder proceeds into the development of a human being characterized by an amazing order, and that's because energy is being supplied—by what you eat and more ultimately from the sun. So, the arrow of time as being inexorably forward cannot be argued from the direction dictated by entropy as long as an external source of energy is provided. And our time machine is driven by just that energy. Unfortunately, I am not at liberty to disclose how this fuel works.

VOICE #3: Hey, don't listen to him. It's all just a scam. You can't travel back in time. Think about it. What would happen if you traveled back 100 years and you shot and killed your grandmother before she gave birth to your mother? You would never have existed! How could you exist to travel backwards in time? There's no making sense of that!

VOICE #2: Well, first of all, our machine is only going to take this man as far back in the past as his youth. So, he'll already be born. No problem there. Shooting his grandmother, bless her departed soul, would have no effect on him, assuming he got away with the deadly deed. Frankly, I'm not sure why anyone would want to shoot the nice lady in the first place. Now, I should add that for those desiring to go back much farther, say 100 years, there's still no problem. That's because if, in a pique, say, over some disagreement of where to spend the family summer vacation, you tried to shoot your 10-year old grandmother, of course, you would not be able to accomplish it. Obviously if you killed her, you wouldn't now exist. But, in fact, you do exist. Thus, there is no possibility that you could go back in the past and kill her before she gave birth to your mother. (Afterwards, well, no problem.) If you tried, the gun would jam. Or you'd have a last- minute change of mind. But you couldn't kill her.

JOHN: All this talk of murdering innocent grandmothers is getting me upset.

VOICE #2: For those time travelers who are still uneasy on this issue we offer our multiple universe plan.

JOHN: Say again?

VOICE #2: By this option, there are a number of parallel universes of reality in your past. These seem similar, but you can jump from one to the other. So, go ahead and shoot your grandmother in universe A, then jump to Universe B where she can go ahead and give birth to your mother. No problem here that I see.

VOICE #4. What about wormholes?

JOHN: Wormholes?

VOICE #4. Right. I read about that in Carl Sagan's book *Contact*, where the heroine travels through a tunnel which transports her to parallel universe. According to Einstein, time and space are part of a continuum, and since we can travel in space—and in any direction—by such tunnels we should be able to do the same thing with time.

VOICE #3. But wormholes are just an abstract construct—a thought experiment. There's no evidence they actually exist.

VOICE #4. But they *could* exist. If we bend a flattened space-time continuum back on itself and provide some anti-gravity so the two folds wouldn't fly apart, such a tunnel between the two sides should enable us to travel backwards (or forwards) in time.

JOHN: I don't have a clue as to what you're talking about.

VOICE #2. Well, I didn't want to mention this possibility, because we haven't quite got the wormhole version of our time machine worked out just yet. That is to say, we don't yet quite understand it either. We're planning on it for next year's model loaded with options.

JOHN: Between all this talk about wormholes and assassinated grandmothers and parallel universes I'm highly skeptical this is going to work. And then there's the anxiety knowing that it might work in one direction, but fail on the return trip, so I'd be stuck in my youth with no way out. There were a number of events then that I really wouldn't want to go through again. (*Pause, looks at watch)* Well. So maybe I can't travel back in time. But tonight's maybe the best alternative, I'm heading off to my high school reunion. Been going for the past 25 years. I guess I might as well attend. I can wallow in my misery a little more. And, maybe she'll be there this year. Let's see what happens…

[Scene Two]

He stands and walks upstage where he sits at a table at the reunion with two chairs. Drinks are on the table. He puts on his name tag. Rock music of 25 years ago is playing in the background. After a moment, a woman walks by, carrying a drink.

JOHN: (*startled)* Sally??!!

SALLY: John??!!

JOHN: Is it really you?

SALLY: It most surely is!

JOHN: Please have a seat!
(*She sits)* Can I get you something to drink?

SALLY: No, thanks. I may have had too much already.

JOHN: I didn't expect to see you here.

SALLY: Well, after missing reunions for 25 years I thought I better finally show up!

JOHN: You look great!

SALLY: So do you!

JOHN: Well, you know that in high school reunion language that means you look "pretty well preserved!"

SALLY: You don't mean……

JOHN (*laughs)*: No, no. I was talking about me, not you.

SALLY: So, how has life been treating you?

JOHN: Not bad. Not bad at all. You know I married Diane.

SALLY: Yes, I had heard that.

JOHN: We've got three kids. Doing great. Mark's our oldest. He'd like to be an engineer. He got a great start at Rensselaer, but right now he's back home for a while. Planning to go to MIT in the fall. I'm a tax accountant—always plenty of business! Yeh, all in all, things are pretty great. How about you?

SALLY: Yes, same with me. Bill's running for selectman this year. But I'm not sure it's going to work. We spend so much time in Europe. Karen's graduating from medical school this spring. We're so proud of her.

(*Awkward pause.)*

JOHN: I can't believe it's been 25 years.

SALLY: Yeh.

(*Another pause.)*

JOHN: Do you….do you ever think back to when we were together?

SALLY: Yes, that sure was an exciting time.

JOHN: Yes, but, I mean, do you every really *think* about it?
(*Short pause)*

SALLY (*slowly, seriously)*: Sometimes. Sometimes I do.

JOHN: I remember the party when we met. You kept winking at me.

SALLY: Well, actually, that was because I had just got my new contact lenses.
(*They laugh).*

JOHN: Well, after 25 years that information comes as quite a shock!

[Scene Three]

Lights fade, come up on party. The year is 1960. Rock music in background. Sally, a pretty teenage girl in a plain dress, is standing next to punchbowl. Johnny, a nerdy teenage boy, clean cut like his father, dressed in an

expensive sweater and slacks, enters the scene, accompanied by John. As the two enter, Sally glances at them and winks.

JOHN (*speaking to Johnny, who can't hear him. As he speaks, Johnny and Sally are frozen)*: She's pretty cute, huh? So, ask her to dance! Go on! Take control!

If you won't talk her tonight, you won't next week, and before you know it the school year will be over and you will have missed a golden opportunity to get to know her. Go talk to her. Who knows how it might turn out?

(*Boy and girl come alive.)*

SALLY: Hi, Johnny. Or should I say "Bonjour!" *(She winks)*

BOY (*shyly*): Ah, bonjour, Sally.

JOHN (*To the audience)*: Say, I actually *did* make some positive decisions in my life. Well, sort of. But, I know how this is going to turn out.

BOY: Somehow you look a lot different out of French class.

SALLY: I'll take that as a compliment, I guess. Do you like this song? (*Paul Anka's "Puppy Love" is playing)*

BOY: Uh, Paul Anka. Yeh, yeh, he's one of my favorites.

SALLY: Oh, mine, too! I heard that you went to the camp up at Clear Lake last summer.

BOY: Yeh, I was there in August.

SALLY: I went, too. In July. Did you like it? Weren't the counselors just swell?

BOY (*growing enthusiasm with each other):* Yeh, yeh. I really thought the swim director was totally cool.

SALLY: I'll bet you like football. I just *love* football. How do you think we're going to stack up against Millford High's backfield this Friday? With Jason out we're really going to be hurting on defense.

BOY: Naw, we'll pulverize 'em.
(*Pause)*

SALLY: Would you like to dance?

BOY: I guess so.

(*They start to dance, not too close. Lights out on scene.)*

JOHN (*in spotlight, to audience. Music fades):* What a wimp. No wonder my life turned out to be such a disaster. It's amazing that we ever got together.

We were really from different worlds. Talk about the other side of the tracks! We were country club, her dad worked in the mines. We were BMW, they were VW. (*Pause)* But there was something very special between us…..

[Scene Four]

(*Night time on Sally's doorstep. John is watching from side.)*

SALLY: Johnny, I had a real nice time tonight.

JOHNNY: Me, too.

SALLY: I'm glad you called me.

JOHNNY: I think actually you called me.

SALLY (*(smiles):* Oh, yeh.
(*They smile shyly at each other. An awkward moment.)*

JOHN: Hold it! Hold it! (*Sally and Johnny freeze in position. Speaking to Johnny).* Are you going to kiss this girl or what!? It's amazing to think you're actually going to have children! For heaven's sake! Take Charge! Get in the game! (*Pause)* You only get one chance.

(Johnny and Sally kiss awkwardly)

JOHN: Ahh!

SALLY: Johnny, do you believe in destiny?

JOHNNY: Destiny?

SALLY: Yeh, like something or somebody up there is guiding our lives. Making things turn out. Everything that happens to us has a meaning. Like me meeting you.

JOHNNY: And like your Dad flicking the porch light on and off?
(*Just as he says this the light goes off and on several times quickly. They laugh.)*

JOHNNY: Right.

SALLY (*suddenly serious)* Johnny, you know, well, we're very different...

JOHNNY: What do you mean?

SALLY: You know very well what I mean. Not just where we live, but our friends, our families, what we need in our lives.

JOHNNY: I don't think that matters. (*They kiss again as the lights fade.)*

(Spotlight on John, who is speaking to audience)
JOHN: I hope this isn't making you all a little bit nauseated. Well, after that night we couldn't get enough of each other. Sort of like joined at the hip for at least a couple of years. Awfully innocent we were. I know we did change each other. But I guess I just couldn't see how much that all really mattered to me.

[Scene Five]

(Spotlight off, lights up on Sally and Johnny entering, holding hands. He is now dressed more in style, relaxed, confident. She wears a very plain dress).

JOHNNY: Last night was really embarrassing. Backing up over your parents' garbage can like that.

SALLY: Oh, I don't know. There was something cool about watching the new junior class president on his hands and knees picking up trash in my driveway. Not often seen in *our* neighborhood, that's for sure!

JOHNNY: A great way to celebrate an election victory!

SALLY *(snuggles up against him):* I am *so* proud of you!

JOHNNY: I couldn't have done it without you.

SALLY: You mean backing up over the garbage? (*They laugh)*

JOHNNY: You know, you've really changed me.

SALLY: For the good, I hope!

JOHNNY: You are magical! Wave your magic wand! Poof! A new man is born!

SALLY: A new man I'm crazy about!

JOHNNY: You've made me realize there's more to life than just studying and football. That people are important. That your friends and family mean a lot.

SALLY: You know, my folks really like you. Dad was a bit unsure to start with—not really pleased that I was going out with you. Didn't think it was smart. But he told me just this morning that, now that he's gotten to know you, what a down-to earth guy you really are.

JOHNNY: Was that before or after the Big Garbage Incident?
(They laugh.)

SALLY: You know, you've changed me, too.

JOHNNY: Oh, yeh?

SALLY: Yeh! You've made me want to be somebody, to do something with my life. I never've felt that way before.

JOHNNY: You should sing! That's what you should do!

SALLY: You really think so? Mrs. Gordon—she's our choir director—she tells me I have a fine voice. I love to sing. Yes, yes, I could really be a singer. Oh, Johnny!! (S*he hugs him with happiness.)*

JOHNNY: You know what I think? I think we were together in another life. Right! Long, long ago. Probably France!

SALLY: And that's why we sit next to each other in French class!

JOHNNY: No, I'm serious. You were a beautiful young damsel, I a gallant knight. We rode together, through the fields, the wind in our hair. The world was ours! We were in control of our own destiny. And now, we're taking over where we left off. (*He gets on a knee and gallantly kisses her hand)* Precious lady, I am at your service. My life is at your command. I am yours! At least until the end of fourth period (*he looks at his watch),* which, if I am not mistaken, begins in exactly two minutes.

SALLY: Yikes! (*They run offstage together)*

JOHN (*after watching all this, to the audience, while walking to the reunion table):* I don't remember being quite that eloquent. I guess love does that to you. No, it was Sally that did it to me. (*Thoughtful pause.)* I thought we were going to be together forever. So, what happened? We were young. I was just taking life where it took me. I was just waiting for something to happen. Listening to what I *should* be doing. Not really thinking about what I was really feeling. So, why not go West to college? I had a scholarship. The future was bright! I remember, Sally, she was pretty devastated.

[Scene Six]

(Lights up on scene of JOHNNY and SALLY)

SALLY (*angrily, tearfully)*: How can you do this? Just pack up and leave me!!

JOHNNY (*awkwardly, surprised by her anger)*: It's only for a couple of years. I'll come back and visit, and we can be together in the summer. That would be really neat, right? We could even go to camp together.

SALLY (*almost screaming):* No! No! You know it won't happen that way!! It will be the end of us if you go. My life—our life—is here!!! This where we belong! I'm not following you to California! Don't I mean anything to you??!! Doesn't our future…

JOHNNY: Sure, but...

SALLY: (*Angrily, bursting into tears).* Johnny!!

(*He is embarrassed, turns his back to her. As he does, she throws her purse at him. It lands at his feet and items fall out onto the floor with a crash. He bends down and starts picking up the items and putting them back in the purse. She sits on the floor, crying)*

JOHNNY: Golly, Sally. You'll get over it. I'll write—and I'll call! It'll be all right. I don't see why you're so upset. We've had lots of fun together.

SALLY: You're just scared!!

JOHNNY: Scared of what?

SALLY: (*Yelling at him)* You're afraid to follow your own heart! Afraid to grow up and be what *you* want to be!.....Okay, okay. Go to your fancy school. Meet the "right" girl. Do what you're supposed to. (*They freeze in position)*

JOHN (*talking to audience)*: This is a lot more painful than I thought it was going to be. I couldn't say it to her face, but she was right. My instincts were shouting at me, too, but I just didn't listen. I couldn't see what really counted. *(shrugs shoulders, sadly)* Ah, but we were very young.

[Scene Nine]

(*John and Sally at reunion table.)*

JOHN: Yeh, you were pretty angry.

SALLY: I'm not sure I ever got over it. But I don't think I blame you anymore.

(*Pause)*

JOHN: So, it's great to see you. And you've been doing so well!

SALLY: Yeh, you, too.
(Pause)

JOHN (*slowly)*: Sally, I have a bit of confession to make. I wasn't really telling you the truth before. My life hasn't turned out so great. Diane's left me. My career seems about over. The kids haven't turned out so well. To tell the truth, I'm really on the skids…..
(*Pause)*

SALLY: Me, too, John. Bill and I have been separated since September. We don't talk to the kids. In fact, we haven't seen them for two years. They're in Mexico somewhere.
(*Pause)*

JOHN: And your singing?

SALLY: That just didn't work out either. Too many other things were in the way.

JOHN: I'm sorry to hear that. Some bad decisions?

SALLY: I'm not sure. I think I did my best.
(*Pause)*

JOHN: I wonder what it would be like if we could start again. If we *knew* that life is not something that just happens to you. That life is something you make. That you don't wimp out. No excuses! I'd sure like to do it over. Things would be different. I'd listen to myself, to what I really feel. *(Staring meaningfully at Sally)* Why didn't I…..

SALLY (*interrupting, gently)*: John, you're being too hard on yourself. What happens to us, it all just seems to me just to be a matter of good luck or bad luck. You pick a mate, a career, a car, a house. How do you know if you're making the right decision? Maybe the plumbing's bad. Maybe the guy's a louse. We just don't have the ability to *know.* We have to just take our best shot and go with it. Sometimes it turns out all right. Sometimes it doesn't. It's not our fault. We're actors in a play, but it's somebody else's script, not ours. We don't get to call the lines. We simply play our roles, and

we do it the best we can. Some nights are better than others. But that's all we can ask of ourselves.

(*Pause)*

JOHN: It's been a long time since Paul Anka, Sally. You still look great.

SALLY: I was just thinking the same thing about you.

(*Pause. They stare at each other. Slowly their heads tilt forward, and they almost kiss, but stop.)*

SALLY: John, will you excuse me? I'll be right back. (*She leaves.)*

(John is puzzled, follows her with his eyes as she leaves, takes a drink. Classmate Vincent approaches table with drink in his hand and sits.)

VINCENT (*Loud, obnoxious, shirt tail hanging out, a little drunk):* Whoa! What's wrong with ya, sitting over here talking to yourself?

JOHN (*distracted)*: Oh, hi, Vincent.

VINCENT: Hey! I didn't think you'd recognize me. We've all changed a lot in 25 years!

JOHN: That's for sure. How've you been?

VINCENT: Just great! Doing great! How about you?

JOHN: Can't complain.

VINCENT: You know, I'm not sure I really enjoy these reunions very much. Most of these people I didn't like back in high school. It sure doesn't make any sense that I'd like them now! And I keep hearing sad news. Did you hear about Sally—you must have, huh? You two were pretty tight in school. It's just so tragic that she had to pass away so young.

JOHN (*suddenly alert)*: What?!

VINCENT: You didn't hear? She died of cancer last summer. August, I think it was. The sad part was that she was in Europe, all by herself. They found her in a hotel room in Paris.

JOHN: In….in Paris?

VINCENT: Yeh. Terrible shame.

JOHN (*stunned)*: I didn't know.

VINCENT: Yeh. Well, gotta go! (*Stands and slaps John on the back.)* Really great seein' ya again! (*He leaves.)*

(*John stares ahead. End of music "Puppy Love" rises. As the song finishes, John rises, spotlight follows him in the silence as he walks slowly to center stage. He looks wistfully into the darkness on the left, from which Sally emerges to join him. She smiles sadly as he kneels slowly and kisses her hand. Lights slowly dim to out.)*

Concluding Comments

It's grand theatre.

How human beings play out their roles of behavior in their daily lives reflects a fine balance between the desire to achieve personal goals and the opportunities and constraints offered by the society in which they live. And, in accordance with the script, how they act towards each other—as individuals or collectively as social groups—is driven by both the cognitive conscious and the mysteriously-hidden subconscious.

Behind the scene on the stage, however, imperceptible to the audience, the play of human life is directed by certain biological realities. Humans are members of the animal kingdom and share with their fellow beings the evolutionary baggage of biological drives, most of which are selfish and self-serving (at least as expressed by sub-human animals) and which need in human society to be suppressed in the name of cultural conformity. (One has learned by age two that biting another child who is holding a desired toy will not work.)

Human behavior also reflects emotions—jealousy, anger, sadness, happiness, and so forth—which are presumed to reflect biological processes as well (as evidenced by neuroimaging studies and the recognition that such emotions are as old as recorded history, shared, at least to some extent, by higher animals). In the pages of this book, we have seen that the biological bases for emotion-driven behavior is beginning to be revealed. Certainly, such inquiries have triggered a revelation that the biology of human behavior is extraordinarily complex, and joins with a multitude of cultural influences which determine how we conduct our lives.

We end, finally, by acknowledging that we cannot escape the obvious question—the proverbial elephant in the room: What, in the end, is the purpose of the play? As members of the audience file out of the theatre one hears a buzz of ideas. What was it all about? What did it mean? Some are disappointed: Is this all there is? Others, equally frustrated, demand an answer: What was the message, the moral of the play? For these questions there is no one to supply the answers. But tomorrow these human beings will fall in love, become jealous of a co-worker, make travel plans to London, encounter depression, suffer nostalgia for *temps perdu*, lust after the neighbor's wife, and, then, just grow a day older. The best that can be said, then, is that, quoting the Bard, "the play's the thing."