Changes in Version 2010.03.18

Acknowledgments, second paragraph

Changed "has been" to "was" in the second sentence.

Acknowledgments, fourth paragraph

Changed "However, a" to "A" in the last sentence.

Preface, first paragraph

Changed "MBA" to "Stanford MBA" in the second sentence.

Preface, second paragraph

Changed "rules" to "decision rules" in the first sentence.

Chapter 1, Useful Frames, first paragraph, third sentence, footnote

Changed "self-similar, universal, and unvarying nature of the process" to "process" in the last sentence.

Chapter 1, Choosing Frames Well, second paragraph

Changed "resources" to "resources that are useful in deciding well" in the last sentence.

Chapter 1, *The Need for Timeless Frames*, first paragraph

Changed "timeless frame of deciding well" to "timeless frame for deciding well" in the third sentence.

Chapter 1, *The Need for Timeless Frames*, last paragraph

Changed "prepare for" to "address" in the fourth sentence.

Chapter 1, Temporal versus Timeless Values, title

Changed "Timeless" to "Invariant."

Chapter 1, Temporal versus Invariant Values, first paragraph

Changed "decide well" to "choose problems to solve" in the third sentence.

Chapter 1, *Substitutes for Wisdom*, last paragraph

Changed "deciding well" to "of pursuing the timeless end of deciding well" in the third sentence.

Chapter 1, *The Boundless Problem of Refining Knowledge*, first paragraph

Changed "infinity of infinite paths" to "infinite number of infinitely long paths" in the second sentence.

Chapter 1, *The Boundless Problem of Refining Knowledge*, second paragraph

Changed "good tools for pursuing the timeless factors of deciding well for a set of problems at the current time" to "good but limited tools for pursuing the Truth" in the last sentence.

Chapter 1, *The Boundless Problem of Refining Knowledge*, third paragraph

Changed "temporal problems to solve" to "problems to solve" in the seventh sentence.

Chapter 1, *The Special Case of the Natural Sciences*, entire subsection

"***The Special Case of the Natural Sciences***
We cannot refine knowledge without having beliefs about what we study and how best to study it. Our beliefs about these matters can hinder this process. Our beliefs about what we study can cause us to perceive things that are not real. One example of this was the many late nineteenth English-speaking astronomers who saw straight canals on Mars due to a mistranslation of the Italian term for channels (*canali*). They can also cause us to dismiss, overlook, or ignore things that are real. One example of this was how astronomers ignored how gravity bends light before they had a theory that predicted gravity would bend light. Our beliefs about how best to study can blind us to the best means of refining knowledge. One example of this is the belief that theories that cannot yet be tested by means of known empirical tests are not worthy of consideration by scientists. This ignores the benefit of considering logical stories that ring true but which no one has yet figured out how to test empirically. Another example of this is the tendency for people who lack a timeless view of the process of refining knowledge to believe that current scientific knowledge is a part of the Truth rather than simply a good tool for pursuing the timeless factors of deciding well for a given set of problems at the current time. This tends to blind these people to problems with current scientific knowledge.

"When we study people we encounter an especially difficult problem of belief. We base our beliefs about the world on the world. When we act on our beliefs, we change the world. One example of this problem concerns the study of the beliefs of other people. Our beliefs about what others believe tends to change what others believe, which in turn tends to change what we believe about what others believe, and so on to infinity. Further, timeless problems like this necessarily involve leaning, and so involve the pursuits of all of the timeless factors of deciding well. The only sure way that we can avoid such difficult problems is to avoid studying people.

"The natural sciences are members of the subset of sciences that excludes sciences that involve studying people. With this exclusion, caution, and training, we can safely pursue the timeless end of believing well without concern for the pursuits of the other timeless factors of deciding well."

was deleted.

Chapter 1, Overview, second paragraph

Changed "timeless" to "invariant" in the first and second sentences.

Chapter 1, Overview, third paragraph, last two sentences

"Next is a discussion of the timeless concept of science as the endless process of refining everyday thinking. The section ends with a discussion of the endless process of refining our beliefs about the invariant process of deciding well."

were changed to:

"Next is a discussion of the invariant concept of science as the endless process of refining everyday thinking, which includes an argument supporting the claim that what we currently call natural science is a special case in which we choose to ignore the role consciousness plays in the endless process of refining everyday thinking. The section ends with a discussion of the endless process of refining our beliefs about the invariant process of deciding well."

Chapter 1, Overview, last paragraph

Changed "timeless experiment is the belief that this system" to "experiment is the claim that this invariant system" in the second sentence.

Chapter 2, Timeless Tools for Deciding Well, title

Changed "Timeless" to "Invariant."

Chapter 2, Invariant Tools for Deciding Well, second paragraph

Changed "timeless" to "invariant" in the third and fourth sentences.

Deleted the last sentence: "In planning terms, we live well by planning our lives using strategic tools and working our plans using tactical tools."

Chapter 2, Invariant Tools for Deciding Well, last paragraph

Changed "timeless" to "invariant" in the last sentence.

Chapter 2, Timeless Wealth, title

Deleted "Timeless."

Chapter 2, Invariant Wealth, first paragraph

"From the temporal frame of modern economics, wealth is what people need to live well based on what they currently know. From the invariant frame of deciding well, wealth is what we need to live well based on all that can be known. Temporal wealth concerns what we currently want; timeless wealth concerns what we truly need."

were changed to:

"From the temporal frame of modern economics, wealth is what people need to live well based on what they currently know. Wealth concerns what we currently want. From the invariant frame of deciding well, wealth is what we need to live well based on all that can be known. Wealth concerns what we truly need to live well, hence to decide well."

Chapter 2, Timeless Consumption, title

Deleted "Timeless."

Chapter 2, *Chicago Screwdrivers*, first paragraph, first three sentences

"As we saw in the EOQ/RTS example, using temporal tools for the timeless task of finding problems to solve tends to blind us to the best problem to solve. Just as we ought never to use hammers to drive in screws, we ought never to use temporal tools that are not also timeless tools to find problems to solve. Perhaps the greatest danger of this comes from using modern economic terms to guide our actions."

were changed to:

"As we saw in the EOQ/RTS example, using temporal tools for finding problems to solve tends to blind us to the best problem to solve. Just as we ought never to use hammers to drive in screws, we ought never to use temporal tools that are not also timeless tools to find problems to solve. One of the greatest dangers of this comes from using modern economic tools that either concern or ought to concern consumption to guide our actions."

Chapter 2, Timeless Trade, title

Deleted "Timeless."

Chapter 2, Timeless Production, title

Deleted "Timeless."

Chapter 2, Timeless Taxation, title

Deleted "Timeless."

Chapter 2, Timeless Profit, title

Deleted "Timeless."

Chapter 2, The Need for Timeless Science, title

Changed "Timeless" to "Invariant."

Chapter 2, The Need for Invariant Science, first paragraph

Changed "a timeless science of deciding well" to "an invariant concept of science" in the sixth sentence.

Changed "this concept of science" to "this concept" in the last sentence.

Deleted the last footnote:

"[8] From the timeless view of trading well, the knowledge revolution is the transition from the geographical expansion of trade in non-knowledge products to the geographical and temporal expansion of trade of non-knowledge and knowledge products, including moral obligations. This is but one of many ways that we can describe this revolution. From the timeless liberal view, it is the synthesis of the classical liberal thesis and the modern liberal antithesis. From the timeless dialectical view, it is the synthesis of the dualist thesis and the materialist antithesis. All of these explanations focus our attention on some aspects of the knowledge revolution by blinding us to other aspects. Rather than putting forth one or more of these partial explanations of this phase transition in public affairs, this work puts forth a set of tools for refining the Truth."

Chapter 3, Pursuing the Ring of Truth, last paragraph

Changed "temporal science" to "modern science" in the second sentence.

Changed "the universal invariant of deciding well" to "pursuing the timeless end of deciding well" in the last sentence.

Chapter 3, *The Elephant in the Room*, first paragraph

"Perhaps the most beautiful story that emerges from the universal invariant of deciding well concerns the relation between the timeless factors of deciding well and the values that people claim to seek when they seek to link or re-link with something infinitely greater than themselves. In other words, it concerns the relation between transcendent factors and transcendent values."

was changed to:

"One of the most beautiful things to emerge from pursuing the invariant end of deciding well is the relation between the timeless factors of deciding well and the values that people claim to seek when they seek to link or re-link with something infinitely greater than themselves. In other words, it is the relation between transcendental factors and transcendental values."

Chapter 3, *The Elephant in the Room*, second paragraph

Changed "the need" to "a spiritual need" in the second sentence.

Changed "This" to "Seeking to satisfy this insatiable spiritual need" in the third sentence.

Changed "insatiable need" to "need" in the fourth sentence.

Chapter 3, *The Elephant in the Room*, third paragraph

Changed "seek these transcendent" to "pursue these transcendental" in the second sentence.

Chapter 3, Conclusion, first paragraph

Changed "timeless ends" to "transcendental ends" in the last sentence.

Chapter 3, Conclusion, second paragraph

Changed "timeless concept" to "invariant concept" in the first sentence.

Chapter 3, Conclusion, second paragraph

Changed "timeless concept" to "invariant concept" in the first sentence.

Changed "Timeless science" to "This concept of science" in the second sentence.

Chapter 3, Conclusion, last paragraph

Changed "timeless science" to "this boundlessly pragmatic approach to believing well" in the first sentence.

Changed "timeless science" to "this approach" in the second sentence.

Chapter 4, *The Explicit Experiment*, second paragraph

Changed "view of timeless science" to "invariant view of deciding well" in the fifth sentence.

Chapter 4, *The Explicit Experiment*, last paragraph

Changed "view of timeless science" to "invariant view of deciding well" in the sixth sentence.

Chapter 4, *A Sovereign Story of Timeless Science*, title

Changed "Timeless Science" to "Boundless Pragmatism."

Chapter 4, *A Sovereign Story of Boundless Pragmatism*, second paragraph

Changed "timeless concept of science" to "invariant view of deciding well" in the fifth sentence.

Chapter 4, *Promote Deciding Well, not Stability*, second paragraph

Changed "economic efficiency and political expedience over the timeless end of deciding well" to "the temporal values of economic growth and stability over the invariant values of the Good, the Truth, Wisdom, Justice, and Beauty" in the last sentence.

Chapter 4, *Promote Deciding Well, not Stability*, last paragraph

Changed "timeless end of deciding" to "invariant values" in the first sentence.

Deleted the last sentence: "Policymakers can help prepare people for living in such a civilization by promoting knowledge of timeless science."

Chapter 4, Timeless Liberalism, title

Deleted "Timeless."

Chapter 4, Liberalism, first paragraph

Changed "timeless science" to "boundless pragmatism" in the first sentence (2 occurrences).

Chapter 4, Liberalism, second paragraph

Changed "social justice, including sustainable social justice," to "social justice" in the fourth sentence.

Changes in Version 2010.03.30

Preface, eighth paragraph

Changed "pursuing these intertwined pursuits well" to "deciding well, so conceived," in the first sentence.

Preface, ninth paragraph, indent

Changed "deciding well, so conceived," to "deciding well" in the first sentence.

Changes in Version 2010.04.24

Preface, fourth paragraph

Changed "timeless values" to "values" in the fifth sentence.

Preface, seventh paragraph

"According to this concept of deciding well, inasmuch as we decide well, we learn ever more about deciding well. Over time, we collectively (1) learn that we ought to pursue factors of deciding well only to the point that they are useful to us; (2) learn to distinguish between factors that we can have in excess, which we may call *bounded factors of deciding well*, and factors that we can never have completely, which we may call *timeless factors of deciding well*; and (3) learn that the endless pursuits of all timeless factors of deciding well intertwine to form a single endless pursuit. The first two of these lessons are obvious. The third calls for an explanation:

For any timeless factor of deciding well (A) and any other timeless factor of deciding well (B), pursuing A well calls for us to decide well, which in turn calls for us to pursue B well. Further, pursuing B well calls for us to decide well, which in turn calls for us to pursue A well. Hence, the pursuit of A and the pursuit of B intertwine to form a single endless pursuit. Further, how tightly the pursuits of A and B intertwine depends on how well we pursue the timeless end of deciding well. Applying this logic to all timeless factors, the endless pursuits of all timeless factors of deciding well intertwine to form a single endless pursuit. Further, how tightly these endless pursuits intertwine depends on how well we pursue the timeless end of deciding well."

was changed to:

"According to this concept of deciding well, inasmuch as we decide well, we learn ever more about deciding well. Over time, we collectively learn (1) that we ought to pursue factors of deciding well only to the point that they are useful to us; (2) that there are some universal factors of deciding well that we can never have in excess; and (3) that the endless pursuits of all of these universal, boundless factors of deciding well intertwine to form a single endless pursuit. The first two of these lessons are obvious. The third calls for an explanation:

For any universal, boundless factor of deciding well (A) and any other universal, boundless factor of deciding well (B), pursuing A well calls for us to decide well, which in turn calls for us

to pursue B well. Further, pursuing B well calls for us to decide well, which in turn calls for us to pursue A well. Hence, the pursuit of A and the pursuit of B intertwine to form a single endless pursuit. Further, how tightly the pursuits of A and B intertwine depends on how well we decide. Applying this logic to all universal, boundless factors of deciding well, the endless pursuits of all universal, boundless factors of deciding well intertwine to form a single endless pursuit. Further, how tightly these endless pursuits intertwine depends on how well we decide."

Preface, eighth paragraph

Changed "the stress" to "stress" in the second to last sentence.

Preface, ninth paragraph, first sentence

"One conclusion we may draw from this simple analysis is that ignoring the mistakes we embed in our networks of knowledge-in-use will cause us to severely underestimate the probability of great turbulence."

was changed to:

"One conclusion we may draw from this simple model is that the modern, static concept of equilibrium based on what people currently know leads us to severely underestimate the probability of great turbulence. The cause of this great turbulence is the catastrophic release of embedded stress involved in moving toward a dynamic equilibrium based on pursuing the invariant end of deciding well. This claim is consistent with mathematician Benoit Mandelbrot's discovery that market price changes exhibit scale invariance."

Preface, tenth paragraph

Changed "embeds mistakes into our networks of knowledge-in-use, thereby creating" to "will create" in the first sentence.

Chapter 1, *The Need for Timeless Frames*, last paragraph

Changed "timeless values" to "invariant values" in the last sentence.

Chapter 1, Temporal versus Invariant Values, second paragraph

Changed "infinitely greater" to "greater" in the fifth sentence.

Chapter 1, Temporal versus Invariant Values, eighth paragraph

Deleted "which we may reasonably call the invariant frame of deciding well, " from the first sentence.

Chapter 1, Temporal versus Invariant Values, ninth and tenth paragraphs

"Over time, we learn to distinguish between two types of factors of deciding well. The first are those factors that we can have in excess. We may call these *bounded factors of deciding well*. Freedom, trust, and what modern economists call scarce resources are bounded factors of deciding well. For example, we do not need the freedom to cripple or kill our business competitors, boundless trust in the integrity of bankers, or a different luxury car for each day of the week. The second are those factors that we can never have completely. We may call these *timeless factors of deciding well*. For example, the Good, the Truth, and Wisdom are timeless factors of deciding well. We need the Good to avoid deprivation, which hinders us from deciding well. We need the Truth to avoid ignorance, which also hinders us from deciding well. Wisdom is knowledge of how to decide well. We can never have too much knowledge of how to decide well.[13]

"Over time, we learn that the endless pursuits of all of the timeless factors of deciding well intertwine to form a single endless pursuit. Consider the relation between the pursuit of the Good and the pursuit of the Truth. We pursue the Good by deciding well, which calls for us to pursue the Truth. We pursue the Truth by deciding well, which calls for us to pursue the Good. Thus the pursuit of the Good and the pursuit of the Truth intertwine to form a single pursuit. Further, the better we decide, the tighter we intertwine the pursuits of the Good and the Truth. By similar reasoning, all pursuits of timeless factors intertwine into a single pursuit, which we may call the invariant pursuit of deciding well. Further, the better we decide, the tighter we intertwine all pursuits of timeless factors into the invariant pursuit of deciding well."

"[13] The timeless end of deciding well calls for believing well in frames that range from the very short run to the infinitely long run. In Daoist terms, it calls for believing well about steps as well as paths, and paths as well as steps. A journey of a thousand miles starts from under our feet (*Daodejing*, chapter 64). Pursuing the timeless end of deciding well would benefit greatly from the ability to think in many frames simultaneously. For a witty explanation of the evolution of this ability, see Stewart, I. and Cohen, J., *Figments of Reality: The Evolution of the Curious Mind* (Cambridge, England: Cambridge University Press, 1997)."

was changed to:

"Over time, we learn that some factors of deciding well differ from the others in several important respects. First, we can never have enough of these factors, which is to say our need for these factors is *boundless*. Second, all people need these factors to decide well, which is to say that these factors are *universal*. Third, we can never possess these factors completely, which is to say our pursuit of these factors is *timeless*. These boundless, universal, and timeless factors include the timeless ends of living well (the Good), believing well (the Truth), and deciding well (Wisdom). We need the Good to avoid deprivation, which hinders us from deciding well. We need the Truth to avoid ignorance, which also hinders us from deciding well. Wisdom is knowledge of how to decide well. We can never have too much knowledge of how to decide well.

"Over time, we learn that the endless pursuits of all boundless, universal, and timeless factors of deciding well intertwine to form a single endless pursuit. Consider the relation between the pursuit of the Good and the pursuit of the Truth. We pursue the Good by deciding well, which calls for us to pursue the Truth. We pursue the Truth by deciding well, which calls for us to pursue the Good. Thus the pursuit of the Good and the pursuit of the Truth intertwine to form a single pursuit, which we may call *the invariant pursuit of deciding well*. Further, the better we decide, the tighter we intertwine the pursuits of the Good and the Truth. By similar reasoning, all pursuits of boundless, universal, and timeless factors of deciding well, which we may call *invariant factors of deciding well*, intertwine to form the invariant pursuit of deciding well. Further, the better we decide, the tighter we intertwine the pursuits of the invariant factors of deciding well.[13]"

"[13] Pursuing the timeless end of deciding well benefits greatly from the ability to think in many frames simultaneously. For a witty explanation of the evolution of this ability, see Stewart, I. and Cohen, J., *Figments of Reality: The Evolution of the Curious Mind* (Cambridge, England: Cambridge University Press, 1997)."

Chapter 1, Temporal versus Invariant Values, tenth paragraph

Changed "timeless factors" to "invariant factors" in all (3 occurrences).

Changed "endless pursuit" to "timeless pursuit" in the last two sentences (2 occurrences).

Chapter 1, Temporal versus Invariant Values, eleventh paragraph

Changed "a timeless factor" to "an invariant factor" in the last sentence.

Chapter 1, Temporal versus Invariant Values, last paragraph

Changed "timeless end of deciding well, hence the timeless factors deciding well" to "invariant end of deciding well, hence the invariant factors deciding well" in the fifth sentence.

Chapter 1, Boundless Pragmatism, first paragraph

"We have seen the usefulness of distinguishing between temporal ends and timeless ends. We have also seen the usefulness of extending this distinction to values. Timeless values are tools for helping us to choose among an infinite number of infinite paths. Thinking deeply about timeless values calls for us to leave behind our current mental models for explaining the world. In doing so, we become as sailors venturing beyond landfall. Fortunately, we can use more general versions of two mathematical concepts to help us navigate these potentially maddening seas.[14]"

"[14] We can see the effects of trying to navigate uncharted portions of these potentially maddening seas in the personal life of mathematician Georg Cantor. Although his efforts to chart these seas drove him mad, he provided us with useful ideas about how to navigate these

waters. From Cantor we may take the idea that there exist higher orders of infinity and that we can use sets to help us understand the nature of infinity. For more on this, read Amir Aczel's book, *The Mystery Of The Aleph: Mathematics, the Kabbalah, and the Search for Infinity* (New York: Four Walls Eight Windows, 2000)."

was changed to:

"Invariant values are tools for helping us to choose among a nearly infinite number of paths forward. Thinking deeply about these paths calls for us to leave behind our current mental models for explaining the world. In doing so, we become as sailors venturing beyond landfall. Fortunately, we can use more general versions of two mathematical concepts to help us navigate these potentially maddening seas.[14]"

"[14] We can see the effects of trying to navigate uncharted portions of these potentially maddening seas in the personal life of mathematician Georg Cantor. Although his efforts to chart these seas eventually drove him mad, he provided us with useful tools for navigating these waters, which include set theory and transfinite numbers. For more on this, read Amir Aczel's book, *The Mystery Of The Aleph: Mathematics, the Kabbalah, and the Search for Infinity* (New York: Four Walls Eight Windows, 2000)."

Chapter 1, Boundless Pragmatism, first paragraph

Changed "timeless" to "invariant" in the first sentence (2 occurrences).

Chapter 1, Boundless Pragmatism, second paragraph

Changed "timeless factors" to "invariant factors" in first sentence.

Chapter 1, Boundless Pragmatism, third paragraph

Changed "endless process" to "process" in the second sentence.

Chapter 1, Boundless Pragmatism, last paragraph

Changed "timeless factor" to "invariant factor" in fifth sentence.

Chapter 1, *Substitutes for Wisdom*, last paragraph

Deleted ", which is to say of pursuing the timeless end of deciding well," from the last sentence.

Chapter 1, *The Boundless Problem of Refining Knowledge*, first paragraph

Changed "the problem of induction, and the problem of choosing among an infinite number of infinitely long paths" to "and the problem of induction" in second sentence.

Chapter 1, *The Boundless Problem of Refining Knowledge*, second paragraph

Changed "good but limited tools for pursuing the Truth" to "tools for pursuing the Truth" in last sentence.

Chapter 1, *The Boundless Problem of Refining Knowledge*, third paragraph, footnote

Changed "decision-maker" to "decider" in all (3 occurrences).

Chapter 1, *The Boundless Problem of Refining Knowledge*, last paragraph, last sentence

"In the fullness of time, these companies will create turbulence by converting or shutting down their modern systems."

was changed to:

"Over time, companies with modern production systems will create turbulence by shutting down these systems."

Chapter 1, Conclusion, second paragraph

Changed "tools meant to help us predict and tools meant to help us explain" to "tools meant to help us solve given problems and tools meant to help us find problems to solve" in last sentence.

Chapter 2, Pleasure and Pain, fifth paragraph

Deleted "an investment in" from the last two sentences (2 occurrences).

Chapter 2, *Chicago Screwdrivers*, first paragraph

Changed "timeless tools" to "invariant tools" in the second sentence.

Chapter 2, The Need for Invariant Science, title

Changed "Invariant Science" to "a Science of Deciding Well."

Chapter 3, Believing Well, entire section

Changed "timeless end of deciding well" to "invariant end of deciding well" in all (9 occurrences).

Chapter 3, Pursuing the Ring of Truth, first paragraph

Changed "timeless concepts" to "invariant concepts" and "a timeless concept" to "an invariant concept" in the second sentence.

Changed "*coherent whole*" to "*coherent whole that is useful in living ever more wisely*" in the last sentence.

Chapter 3, Pursuing the Ring of Truth, last paragraph

"This simple concept of beauty is itself beautiful. It works from the realm of modern science to the realm of timeless art. Such is the beauty that emerges from pursuing the invariant end of deciding well."

was deleted.

Chapter 3, *The Elephant in the Room*, first paragraph

Changed "timeless factors of deciding well" to "invariant factors of deciding well" in the first sentence.

Chapter 3, *The Elephant in the Room*, third paragraph

Changed "spiritual need" to "religious need" in the second sentence.

Changed "insatiable spiritual need" to "need" in the third sentence.

Chapter 3, *The Elephant in the Room*, last paragraph

Changed "invariant end of deciding well, which includes the timeless end of believing well," to "the timeless end of believing well" in the second sentence.

Chapter 3, *Beauty as a Guide to Believing Well*, first paragraph

Changed "timeless factors of deciding well" to "invariant factors of deciding well" in the first and last sentences (2 occurrences).

Chapter 3, *Beauty as a Guide to Believing Well*, second paragraph

Changed "timeless veil of ignorance" to "veil of complete ignorance" in the second to last sentence.

Chapter 3, *Beauty as a Guide to Believing Well*, third paragraph, second footnote, first three sentences

"This argument implies that the timeless end of revering life well is a timeless factor of deciding well. We may conceive of this timeless end as a good life for all living beings (the Good for all living beings). We may also conceive of this timeless end as linking or re-linking with something infinitely greater than ourselves for eternity (Bliss)."

were changed to:

"More accurately, this thought experiment calls for us to imagine what we would want if before we were born we had complete knowledge of everything except knowledge of the circumstances of our birth (or births)."

Chapter 3, *Pursuing the Truth Wisely*, last paragraph

Changed "would help us" to "aim to help us" in the last sentence.

Chapter 3, *Pursuing the Truth Wisely*, last paragraph

Changed "timeless categories" to "invariant categories" in the fourth sentence.

Chapter 3, *Three Approaches to Constraints*, second paragraph

Changed "theoretical problem" to "theoretical problem of computing π" in the last sentence.

Chapter 3, *Three Approaches to Constraints*, fourth paragraph

Changed "minds" to "people" in the second sentence.

Chapter 3, *Three Approaches to Constraints*, end

Inserted the following subsections:

"***Invariant Public Order***
The invariant end of deciding well is a transcendental end, which is to say that it is an end that we can define but can never achieve. Hence, the public order that emerges from pursuing the invariant end of deciding well is transcendental, which is to say it is a public order that we can define but can never achieve. The more we understand about the nature of this order, the more readily we can pursue it.

"Imagine a team cycling race in which we measure excellence by the average time it takes team members to complete a two hundred kilometer course. During this event, team members can interact only with one another and not with members of other teams. How should team members choose to order themselves?

"Imagine how a team taking an engineering approach to policymaking would approach the problem of ordering themselves in this situation. The first task would be to reduce the ill-defined problem to a problem or set of problems that members of the team can solve. The simplest solution would be to choose a single public order for all conditions expected along the course. A refinement to this solution would be to choose different public orders for different conditions. There might be an order for traveling over flat terrain, another for traveling up hills, and a third for traveling down hills. Another refinement would be to develop procedures for rotating cyclists from more tiring positions to less tiring positions as they become tired within a given type of order. Yet another refinement would be to develop procedures for rotating cyclists from more tiring positions to less tiring positions when the

team shifts between types of order. Over time, the team would refine their ability to maintain orders and to shift between these orders. To an outside observer, an accomplished team taking this approach would resemble an expert military drill team.

"Now imagine how a team taking a modern evolutionary approach to policymaking would approach the problem of ordering themselves in this situation. Team members would develop relatively simple rules for overcoming constraints. Over time, they would learn ever better rules for overcoming constraints. To an outside observer, an accomplished team taking this approach would resemble a school of fish or a flock of birds.

"Finally, imagine how a team taking the invariant evolutionary approach to policymaking would approach the problem of ordering themselves in this situation. Team members would distinguish between the tactical end of cycling as a team well based on what they currently know and the strategic end of deciding well. In addressing the tactical problem, they would choose to make the best use of current resources in addressing the tactical problem of cycling as a team well. In addressing the strategic problem, they would seek ever better means of replacing non-knowledge resources useful in deciding well with knowledge resources useful in deciding well. In short, they would seek ever better means of deciding well.

"In seeking ever better means of deciding well, the team would consider technological as well as organizational changes. One such change would be the combination of regenerative braking and boosting motors. This combination would allow cyclists to store otherwise wasted energy from cycling downhill to use when cycling uphill. Another such change would be a networked steering control system similar to experimental automated highway control systems that allow cars to travel bumper-to-bumper at high speeds. Such a system would execute tactical moves much more quickly and precisely than people can execute them. The combination of regenerative breaking, boosting motors, and automated steering would quickly lead to the development of a means of transferring power from one vehicle to another. This change would eliminate the need to rotate team members from tiring positions to less tiring positions. It would also allow the team to reduce wind resistance by putting cyclists who ride taller than others near the center of the pack. To a long-standing outside observer, an accomplished team taking the invariant evolutionary approach to constraints would resemble a liquid that undergoes phase changes as it becomes ever more fluid.

"***Zero Public Entropy***
Liquids that undergo phase changes as they become ever more fluid lie outside of our everyday experience. A dramatic example of such a liquid is that of the isotope of helium that has two neutrons and two electrons (helium-4). Helium-4 atoms are objects subject to quantum effects having integer spin, which physicists call bosons. Unlike objects subject to quantum effects having non-integer spin, which physicists call fermions, more than one boson can occupy the same quantum state. Statistically, this is unlikely to happen unless bosons enter their lowest energy state, which physicists call their *ground state*. As the temperature approaches absolute zero (0 degrees Kelvin), an ever larger number of ^{4}He atoms enter their ground state. At 2.172 degrees Kelvin, a large enough percentage of helium-4 atoms enter this state for the liquid to suddenly change from being only slightly more fluid than classical physics predicts to being much more fluid that classical physics predicts. In

other words, liquid helium suddenly changes from being a fluid (Helium I) to a superfluid (Helium II).

"One lesson that we can learn from studying liquids like helium-4 is the usefulness of the concept of entropy in pursuing transcendental ends. Entropy is a measure of the amount of potentially available useful resources of a given type in an object. In modern thermodynamics, entropy is a measure of the potentially useful energy resources in a part of the world isolated from other parts of the world.[13] We pursue the transcendental end of *absolute zero temperature* in the isolated part of the world by removing useful energy from it. In invariant decision science, entropy is a measure of the potentially available non-knowledge wealth (resources useful in deciding well) in the process of deciding well. We pursue the transcendental end of *zero public entropy* by removing non-knowledge wealth from the process of deciding well.[14]

"We can use the concept of zero public entropy to help us find problems to solve. As we saw in the EOQ example, the concepts we use to frame our problems tend to blind us to finding better problems to solve. In the team cycling example above, one such blinder is the association of "cycling" with "bicycling." This association tends tends to blind us to possibilities for substituting knowledge for non-knowledge resources in ways that would violate our concept of bicycling. These possibilities include regenerative breaking, boosting motors, and automated steering. A strategy based on lowering public entropy, which is to say a strategy based on removing ever more non-knowledge resources useful in deciding well from the endless process of deciding well, would reveal this problem.

"A more subtle blinder in the team cycling example is the false belief that we can separate the problem of cycling as a team well from the problem of deciding well. For a team of cyclists to take a truly invariant approach to constraints, its solution to the problem cycling as a team well must be part of the solution to the problem of deciding well. For this to be true, being part of the team must be something every team member needs to do in order to decide well rather than simply something every team member wants to do. Again, a strategy based on lowering public entropy, which is to say a strategy of removing ever more non-knowledge resources useful in deciding well from the process of deciding well, would reveal this problem. Here, we see how lowering public entropy creates a problem whose solution does not fit within the bounds of our chosen problem of cycling well as a team. In general, lowering public entropy reveals not only problems whose solutions fall within the bounds of our chosen problem, but also problems whose solutions surpass the bounds of our chosen problem, thereby overturning the belief system that led us to choose the problem we chose. We may call the problems whose solutions fall within the bounds of our chosen problem *normal problems* and those that surpass the bounds of our chosen problem *revolutionary problems*.

"***The Decision Tree Interpretation of Quantum Mechanics***
Another lesson that we can learn from studying liquids like helium-4 is that we can use the knowledge of what happens as we approach such natural boundaries as absolute zero temperature to help us understand subtle changes that happen far from these natural boundaries. By studying what happens in extreme cases, we can gain a deeper understanding

of our everyday world. By studying what happens as we approach the transcendental end of absolute zero temperature, we may refine our beliefs about how what happens at the microscopic level of quantum mechanics affects what happens on the macroscopic level of the true sciences. Similarly, by studying what happens as we approach the transcendental end of absolute zero public entropy, we may refine our beliefs about how what happens on the microscopic level of quantum mechanics affects what happens on the macroscopic level of the public sciences.

"Although quantum mechanical models provide us with incredibly accurate statistical predictions about what will happen on the microscopic level, it does not provide us with exact predictions about what will happen on this level. This uncertainty is due to two strange behaviors of objects on this level. First, these objects can act either like waves or like particles. Second, pairs of these objects may become entangled in such a way that changing the state of one object instantaneously changes the state of the other object regardless of how distant the other object is. Rigorous empirical testing over many decades has failed to disprove the existence of these two strange behaviors.

"For more than seven decades physicists have been trying to interpret the mathematical models of quantum mechanics in ways that ring true with what they believe they know about causation on the macroscopic level. Most of these interpretations fall into one of three basic categories. The first of these basic categories contains interpretations that claim we should not waste resources trying to explain how objects at this level behave. We may call this the *Copenhagen interpretation* category. The second of these categories contains interpretations that claim that in time we will be able to find currently hidden variables that explain how objects at this level behave. We may call this the *hidden-variables interpretation* category. The third of these categories contains interpretations that claim that every possible way that an object can transition irreversibly from acting like a wave to acting like a particle actually happens. When one of these irreversible events happens, the world[15] splits into a world in which the event occurs and into another world in which the event does not occur. Following this logic, everything that could possibly have happened since the beginning of time has actually happened. We may call this the *many worlds interpretation* category.

"We can use the model of a decision tree[16] to imagine how to interpret quantum mechanics in a way that is most useful in pursuing the invariant end of deciding well.[17] We may think of all people seeking to decide perfectly as a single public entity seeking to decide perfectly. This suggests an interpretation of quantum mechanics that resembles a temporal mirror image of the many worlds interpretation. Rather than an ever expanding number of actual parallel worlds that make up the universe, there exists an ever shrinking number of currently possible future states-of-the-world that make up a single world. This single world consists of (1) a sequence of once current states-of-the-world, (2) a current state-of-the-world, and (3) a nearly infinite set of currently possible states-of-the-world. In other words, it consists of a past, a present, and a nearly infinite number of possible futures. We may call this forward-looking, boundlessly-pragmatic approach to quantum mechanics the *decision tree interpretation*.

"From the modern view of physics, the decision tree interpretation of quantum mechanics appears to ignore such things as constraints on deciding well imposed by relativity theory and information theory. In contrast, from the invariant frame of decision science, the decision tree interpretation sacrifices details about the world as we currently understand it in order to consider what we might learn. When we expand the problem of explaining quantum mechanics based on what we currently know about physics to the problem of explaining quantum mechanics based on all that can be known about the world, we sacrifice details about what we currently know about physics. Among these details are constraints on deciding well that concern the transmission and processing of information imposed by relativity theory and information theory. These details disappear into uncertain event nodes in decision trees. This is consistent with the purpose of decision tree models, which is to help us find and solve problems within the domain of public science.

"For a problem that falls within the domain of quantum mechanics, we ought to think like engineers, which is to say we ought to use the tools of quantum mechanics to solve the problem. For a problem that falls within the domain of modern physics, we ought to think like modern physicists, which is to say we ought to seek the truth within the domain of modern physics. For a problem that falls outside the domain of modern physics but within the domain of true science, we ought to think like true scientists, which is to say we ought to pursue the timeless end of believing well without regard for the other invariant factors of deciding well. For a problem that falls outside the domain of true science but within the domain of public science, we ought to think like public scientists, which is to say we ought to pursue the timeless end of believing well by pursuing all of the invariant factors of deciding well.[18]

"Consider the problem of whether to invest in a research program that has a goal of directly overcoming the constraint on deciding well imposed by relativity theory. From the view of modern physics, communicating at greater than light speed is impossible, hence investing in a research program to discover a way of communicating at greater than light speed would be foolish. From the view of true science, communicating at greater than light speed does not ring true with what else we know about physics, hence investing in such a research program would likely be foolish. From the view of public science, not only does communicating at greater than light speed not ring true, but also the net present value of the benefits of communicating at greater than light speed are currently likely to be small relative to the net present value of the cost of the research program, hence investing in such a research program would be even more likely to be foolish.[19]"

"[13] Zero thermodynamic entropy is a transcendental object, which is to say something that we can define but can never achieve. To achieve zero thermodynamic entropy in a part of the world we would need to lower the temperature of that part of the world to absolute zero temperature. Lowering the temperature to absolute zero temperature in a part of the world calls for completely isolating that part of the world from the rest of the world, which is impossible."

"[14] Zero public entropy is the transcendental end of the process of inducing the creation of knowledge useful in deciding well, hence in governing ourselves well. As such, it is the

process-of-deciding-well in which it is not possible to make any person behind the veil of complete ignorance better off. Students of modern economics may recognize this as the invariant equivalent of the *state-of-the-world* in which it is not possible to make one person better off without making another person worse off (Pareto optimality). For more on the process of inducing the creation of knowledge, see Appendix A."

"[15] Note that the term 'world' here means what modern astronomers call the 'universe.' This use of the term 'world' allows us to reserve the term 'universe' for the set of parallel worlds created in the many worlds interpretation of quantum mechanics."

"[16] We may model deciding well as a tree consisting of events that change the course of events that the decider controls and events that change the course of events that the decider does not control. We may call the former *decision nodes* and the latter *uncertain event nodes*."

"[17] Implicit in this decision-oriented view of the world is belief that free will, which is to say in the power of people to change the course of history, exists. We currently have no empirical way of disproving that free will either exists or does not exist. However, we can logically determine that pursuing the invariant end of deciding well calls for us to believe that free will exists. If free will does not exist, we have no choice in what to believe; including whether to believe that free will exists or does not exist. We are as puppets in a shadow play. On the other hand, if free will exists, we have a choice in whether to believe that free will exists or does not exist. If we choose to believe that free will exists, we have a logical reason to try to pursue the invariant end of deciding well. If we choose to believe that free will does not exist, we will have no logical reason to try to pursue the invariant end of deciding well. From the invariant view of science, we ought to choose the research program that seeks to disprove the beautiful choice, which is that free will exists. This calls for us to act as if we believe that free will exists."

"[18] Following this reasoning, we can reconcile biological evolution with public science. If the problem we choose lies within the domain of modern biology, we ought to think like modern biologists. If this problem lies outside the domain of modern biology but within the domain of true science, we ought to think like true scientists. If the problem lies outside the domain of true science but within the domain of public science, we ought to think like public scientists. Choosing the right frames for solving our chosen problems is an important part of the process of pursuing the timeless end of believing well."

"[19] People on earth have little need to communicate with each other at greater than light speed. Arguably, if there are people elsewhere, they would be wise not to communicate with people on earth until people on earth learn what deciding well truly means."

Chapter 3, Refining Defining Well, first paragraph, second footnote

"[20] To students of Milton Friedman, these two rules will seem familiar. However, communication across frames is only partial. The distinction between theories that describe what is (positive science) and theories that prescribe what ought to be (normative science) is

not the same as the distinction between theories that predict and theories that explain. From the invariant view of deciding well, we use theories that explain to describe the world as it is in the process of becoming. Hidden in these theories is a descriptive statement of a prescriptive program, which is that we are programmed to pursue the timeless end of living well (the Good). Biologists call this a teleonomic program."

was deleted.

Chapter 3, Refining Defining Well, second paragraph

Changed "timeless concept of science" to "invariant concept of science" and "systems of people" to "public systems" in the first sentence.

Chapter 3, Refining Defining Well, third paragraph

Changed "timeless concept of science" to "invariant concept of science" and "systems" to "public systems" in the first sentence.

Chapter 3, Refining Defining Well, third paragraph, footnote

"[21] This is compatible with the instrumental interpretation of Milton Friedman's definition of positive economic science as "a body of tentatively accepted generalizations about economic phenomena that can be used to predict the consequences of changes in circumstances" (Friedman, Milton, "The Methodology of Positive Economics," *Essays in Positive Economics*, Chicago: University of Chicago Press, 1953, p. 39)."

was changed to:

"[21] This is compatible with the instrumental interpretation of Milton Friedman's definition of positive economic science as "a body of tentatively accepted generalizations about economic phenomena that can be used to predict the consequences of changes in circumstances" (Friedman, Milton, "The Methodology of Positive Economics," *Essays in Positive Economics*, Chicago: University of Chicago Press, 1953, p. 39). However, communication across frames is only partial. The distinction between theories that describe the world as it is (positive theories) and theories that prescribe the world as it ought to be (normative theories) is not the same as the distinction between theories that describe the world as it is (temporal theories) and theories that describe the world as it is in the process of becoming (timeless theories). Hidden in theories that describe the world as it is in the process of becoming is a description of a prescriptive program, which is living things are programmed to pursue the timeless end of living well (the Good). Biologists call this a teleonomic program."

Chapter 3, Refining Defining Well, fifth paragraph, last footnote

Changed "spiritual teachings" to "religious teachings" in the last sentence.

Chapter 3, Conclusion, first paragraph

Changed "transcendental ends" to "timeless ends" in the last sentence.

Chapter 3, Conclusion, second paragraph

Changed "boundlessly pragmatic" to "boundlessly-pragmatic" in the second sentence.

Chapter 3, Conclusion, last paragraph

Changed "the boundlessly pragmatic" to "this pragmatic" in the last sentence.

Chapter 4, *A Sovereign Story of Boundless Pragmatism*, last paragraph

Changed "timeless refinement" to "refinement" in the second sentence.

Chapter 4, Liberalism, first paragraph

Changed "deciding well, so conceived" to "pursuing the timeless end of deciding well" in the fourth sentence.

Chapter 4, Liberalism, second paragraph

Changed " John Rawls' veil of ignorance" to "the veil of complete ignorance" in the fourth sentence.

Chapter 4, Liberalism, last paragraph

Changed "timeless end of deciding well" to "invariant end of deciding well" in the last sentence.

Chapter 4, Summary and Conclusion, last paragraph

Changed "a structure of timeless values" to "a structure of invariant values" in the last sentence.

Appendix B, Revering Life Well, entire section

Changed "timeless end of deciding well" to "invariant end of deciding well" in all (4 occurrences).

Appendix B, Experiencing the Mysterious, second paragraph

Changed "view of timeless science" to "invariant view of deciding well" in second sentence.

Appendix B, *Einstein's Twin Warnings*, first paragraph

Changed "Albert Einstein" to "Einstein" in the third sentence.

Appendix B, *Einstein's Twin Warnings*, last paragraph

Changed "in terms of timeless science" to "in invariant terms" in fourth from last sentence.

Appendix B, A Common Timeless End, first paragraph

"From the invariant view of deciding well, materialists and dualists can find a common timeless end in the publicly proclaimed and practiced timeless end of revering life well. We can never be certain that we ought to pursue this public end. However, we can aspire to be wise by seeking to disprove that we ought to pursue it. Undertaking this research program calls for making a civil leap of faith. We base the decision to undertake this civil research program upon the ring of truth."

was changed to:

"Materialists and dualists can find a common timeless end in the publicly proclaimed and practiced timeless end of revering life well. We need to pursue this timeless end of revering life well in order to pursue the invariant end of deciding well. Further, we pursue the timeless end of revering life well by deciding well. Hence, this timeless end of revering life well is an invariant factor of deciding well. The timeless pursuit of revering life well intertwines with the timeless pursuits of all of the invariant factors of deciding well. We may call this common timeless end *Wholeness*. Pursuing Wholeness is part of pursuing the Good, the Truth, Wisdom, Justice, and Beauty; and pursuing the Good, the Truth, Wisdom, Justice, and Beauty are parts of pursuing Wholeness."

Changes in Version 2010.05.01

Preface, second paragraph

Changed "stories" to "descriptions of the world" in last sentence.

Preface, seventh paragraph

Moved "that" from inside the numbered clauses to before the numbered clauses in second sentence.

Preface, seventh paragraph

Moved "that" from inside the numbered clauses to before the numbered clauses in second sentence.

Changed last three sentences from:

"Hence, the pursuit of A and the pursuit of B intertwine to form a single endless pursuit. Further, how tightly the pursuits of A and B intertwine depends on how well we decide. Applying this logic to all universal, boundless factors of deciding well, the endless pursuits of all universal, boundless factors of deciding well intertwine to form a single endless pursuit. Further, how tightly these endless pursuits intertwine depends on how well we decide."

to:

"Hence, the pursuit of A and the pursuit of B intertwine to form a single endless pursuit in which the better we decide the more tightly the endless pursuits of these two factors intertwine. Applying this logic to all universal, boundless factors of deciding well, the endless pursuits of all universal, boundless factors of deciding well intertwine to form a single endless pursuit in which the better we decide the more tightly the endless pursuits of these factors intertwine."

Chapter 1, Boundless Pragmatism, last paragraph

Changed "timeless stories" to "timeless descriptions of the world", "story" to "description", and "temporal stories" to "temporal descriptions of the world" and in sixth sentence.

Changed "stories" to "descriptions" and "sets of stories" to "sets of descriptions" and in last sentence.

Chapter 1, *The Boundless Problem of Refining Knowledge*, second paragraph

Changed "stories" to "descriptions of the world" in all (2 occurrences).

Chapter 1, *The Boundless Problem of Refining Knowledge*, third paragraph

Changed "stories about" to "descriptions of" in the first sentence.

Chapter 1, *The Boundless Problem of Refining Knowledge*, last paragraph

Changed "stories" to "descriptions of the world" in the first sentence.

Chapter 1, Overview, third paragraph

Changed "role of consciousness play" to "the possible roles that consciousness and free will play" in the first sentence.

Chapter 2, Profit, entire section

"Profit is the return on acting wisely. From the temporal frame of modern economics, profit is what is left over from a stream of income after people have paid fair market value for all the resources they used to produce it. From the classical liberal view of modern economics,

people are free to spend the profits they earn as they please. From the modern liberal view, people owe part of their profits to society for the use of socially owned resources. Some modern liberals believe that this includes the debt people owe to others for the use of knowledge that they use freely. According to these modern liberals, people owe up to ninety percent of their profits to society.[6]

"From the invariant frame of deciding well, we owe a debt to those people who created the knowledge we use freely, and to the whole of life for providing us with the natural resources we use freely. We pay these debts by deciding well. In effect, we pay these debts to the stewards of life rather than to the stewards of society."

"[6] Alperovitz, G. and Daly, L., *Unjust Deserts: How the Rich Are Taking Our Common Inheritance and Why We Should Take It Back* (New York: The New Press, 2008)."

was changed to:

"From the temporal frame of modern economics, profit is what is left over from a stream of income after people have paid fair market value for all the resources they used to produce it. From the invariant view of deciding well, profit is simply the return on deciding well.

"From the classical liberal view, people are free to spend the profits they earn as they please. From the modern liberal view, people owe part of their profits to society for the use of socially-owned resources. According to some modern liberals, people owe up to ninety percent of their incomes to society to pay for the use of knowledge that they use freely.[6] As we shall see, from the timeless liberal view, we owe debts to those people who created the knowledge we use freely, and to the whole of life for providing us with the natural resources we use freely. We owe these debts to the stewards of life and to life itself, rather than to the stewards of society and to society itself. We pay these debts by deciding well."

"[6] Alperovitz, G. and Daly, L., *Unjust Deserts: How the Rich Are Taking Our Common Inheritance and Why We Should Take It Back* (New York: The New Press, 2008)."

Chapter 3, Believing Well, entire section

Changed "story" to "description" in all (4 occurrences).

Changed "stories about" to "descriptions of" in all (7 occurrences).

Changed "stories" to "descriptions" in all (39 occurrences).

Chapter 3, *The Decision Tree Interpretation of Quantum Mechanics*, end

Added the following subsection:

"***Judging Descriptions of the World***
The thermodynamically irreversible transition of any microscopic object from acting like a

wave to acting like a particle can potentially affect any other microscopic object in the world; hence we can neither predict nor explain with absolute certainty. From a reductionist view, all descriptions of the world are probabilistic. From a holistic view, all descriptions of the world are partial. How do we judge probabilistic/partial descriptions of the world?

"From the invariant view of deciding well, we judge descriptions of the world by how useful they are in helping us pursue the invariant end of deciding well. This calls for two types of descriptions. The first type helps us predict what will happen based on what we currently know about the world. We use descriptions of this type to help us solve given problems. The second type helps us find problems to solve.

"Pursuing the invariant end of deciding well is a process subject to constraints. To pursue the invariant end of deciding well wisely, we need to use resources wisely. A description of the world that provides us with the most accurate prediction is not necessarily the best tool for predicting what will happen. Using relativistic mechanics to predict the behavior of objects produces more accurate results than using classical mechanics. However, using classical mechanics is often the better choice. This is because the extra cost of using relativistic mechanics is often not worth the extra benefit of using it. Similarly, using the invariant technique of judging problems by how each rings true with what we know about pursuing all invariant factors of deciding well is likely to produce the best problems to solve. However, using other techniques is often the better choice. This is because the extra cost of using this invariant technique is often not worth the extra benefit of using it. To pursue the invariant end of deciding well wisely, we need to consider not only the benefits but also costs of using descriptions of the world.

"Over time, we develop rules for helping us decide which descriptions are best under various conditions. These rules are not perfect. For example, a widely-used rule in modern physics tells us to use classical mechanics to find and solve mechanical problems when the velocities of objects are small relative to the speed of light. However, because this rule ignores the accumulation of small errors over time, it fails in the case in satellite-based global positioning systems. This is the same reason that modern economics fails as a tool for explaining the world. In the case of the satellite-based global position systems, the cause of these errors concerns the slowing of satellite clocks relative to terrestrial clocks. In the case of modern economics, the cause of these errors concerns the creation and use of knowledge."

Chapter 4, *The Explicit Experiment*, first paragraph

Changed "sovereign rights story" to "description of sovereign rights" in the first sentence.

Chapter 4, Timeless Liberalism, fifth paragraph

Changed "world" to "earth" in the second sentence.

Appendix B, The Farther Reaches of Our Nature, first paragraph

Changed "stories" to "descriptions" in the first sentence.

Changes in Version 2010.05.04

Corrections for mistakes found by Pat Vaughn.

Chapter 3, Pursuing the Ring of Truth, fourth paragraph, third sentence

"If the object is not novel, we will not learn from it. If it is too novel, we will not be able to learn from it."

was changed to:

"If the object is not novel or too novel we will not learn from it."

Chapter 3, *The Elephant in the Room*, second paragraph, fifth sentence

"Over time, we collectively refine our means of deciding well by deciding well."

was changed to:

"We collectively refine our means of deciding well by deciding well over time."

Chapter 3, *The Elephant in the Room*, third paragraph, fourth sentence

" Over time, we collectively refine our means of deciding well by deciding well."

was changed to:

"We collectively refine our means of deciding well by deciding well over time."

Chapter 3, Refining Everyday Thinking, fourth paragraph

Inserted the following paragraph

"Two rules arise from the distinction between descriptions we use to predict and descriptions we use to explain. First, we ought to use the term 'cause' only with descriptions that we use to explain. We explain causes. 'Cause' is a cue for a tool for helping us to find problems to solve within a given set of conditions. Second, we need not worry about the realism of the descriptions that we use to predict. We need realism to help us find problems to solve, not to help us predict."

Chapter 3, *Three Approaches to Constraints*, second to last paragraph

Deleted ", which is to say too little freedom to act on beliefs about how best to live," from the third sentence.

Deleted ", which is to say too much freedom to act on beliefs about how best to live," from the fourth sentence.

Chapter 3, *Three Approaches to Constraints*, second to last paragraph

Changed "hinder increasing" to "hinder them from increasing" in the first sentence.

Chapter 3, *Three Approaches to Constraints*, last paragraph

Changed "hinder increasing" to "hinder them from increasing" in the first sentence.

Chapter 3, *Invariant Public Order*, first paragraph

Changed "transcendental, which is to say" to "transcendental:" in the second sentence.

Chapter 3, *Invariant Public Order*, fifth paragraph

Changed "cycling as a team well" to "cycling well" in the second and third sentences (2 occurrences).

Chapter 3, *Zero Public Entropy*, last paragraph

Changed "cycling as a team well" to "cycling well" in the first and second sentences (2 occurrences).

Changed "cycling well as a team" to "cycling well" in the fifth sentence.

Chapter 3, Refining Deciding Well, first paragraph

"The two-way relation between the world and the descriptions we use to guide our actions calls for us to distinguish between the descriptions we use to predict and the descriptions we use to explain. Two rules arise from this distinction. First, we ought to use the term 'cause' only with descriptions that we use to explain. We explain causes. 'Cause' is a cue for a tool for helping us to find problems to solve.[20] Second, we need not worry about the realism of the descriptions that we use to predict. We need realism to help us find problems to solve, not to help us predict."

"[20] More accurately, 'cause' is a cue for a tool for helping us to find problems to solve within a given set of conditions. Note that this claim concerns the demand side of believing well."

was deleted.

Chapter 3, *A Crude Look at the Whole*, first paragraph, first footnote

Changed "for deciding well in ways that create turbulence" to "for new programs, which tend to create additional turbulence" in the last sentence.

Changes in Version 2010.05.15

Chapter 1, Choosing Frames Well, last paragraph

Changed "*holistically*" to "holistically" in the last sentence.

Chapter 1, *The Need for Timeless Frames*, last paragraph

Changed "we can know something about what we need to address unexpected problems infinitely far into the future" to "*we can know about what we need to address unexpected problems infinitely far into the future*" in the fourth sentence.

Chapter 1, Boundless Pragmatism, last four paragraphs

"The mathematical constant π is a transcendental recursive object. It is transcendental in that we can define it but can never know it completely. It is recursive in that we can theoretically know it by means of a recursive process. Similarly, the timeless end of deciding well (Wisdom) is a transcendental recursive object. Wisdom is transcendental in that we can define it but we can never know it completely: It is the knowledge that allows a perfectly wise being to decide perfectly well. Wisdom is recursive in that we can theoretically know it by means of the recursive process of deciding well.

"We can think of the recursive processes by which we come to know ever more about transcendent recursive objects as having three elements. These are (1) the recursive process, (2) the *transcendental end* of the recursive process, and (3) the *timeless end* of the recursive process. The transcendental end of the recursive process is complete knowledge of the transcendental recursive object. The timeless end of the recursive process is that which we seek during the recursive process.

"For π, the recursive process is any one of many means of computing π. Regardless of which means of computing π we choose, the transcendental end is the ratio of the circumference of any Euclidean circle to its diameter. The form of this transcendental end is a number. Similarly, regardless of which means of computing π we choose, the timeless end is ever better approximations of π. The form of this timeless end is also a number.

"For Wisdom, the recursive process is the endless process of deciding well. The transcendental end of deciding well is the knowledge that makes a perfectly wise being perfectly wise. The form of this transcendental end is whatever form of knowledge is most useful to a perfectly wise being in deciding well. The timeless end of deciding well is ever better approximations of Wisdom. The form of this timeless end is whatever form of knowledge is most useful to us as we pursue the timeless end of deciding well. As we shall

see, this form is a set of timeless descriptions of the world with at least one description for each invariant factor of deciding well, which we use to help us find problems to solve, and a set of temporal descriptions of the world, which we use to help us solve temporal problems. These descriptions ought to be as simple as possible, but not simpler; and the sets of descriptions ought to be as small as possible, but not smaller."

were changed to:

"The mathematical constant π is a transcendental recursive object. It is transcendental in that we can define it but can never know it completely. It is recursive in that we can theoretically know it by means of a recursive process. Similarly, Wisdom is a transcendental recursive object. Wisdom is transcendental in that we can define it but we can never know it completely: Wisdom is the knowledge that allows a perfectly wise being to decide perfectly well. Wisdom is recursive in that we can theoretically know it by means of the recursive process of deciding well.

"We may think of the recursive processes by which we come to know ever more about transcendent recursive objects as having three elements. The first of these elements is the *recursive process* itself. In pursuing π, the recursive process is any one of many means of computing π. In pursuing Wisdom, the recursive process is the process of deciding well.

"The second of these elements is the *transcendental end*. The transcendental end is complete knowledge of the transcendental recursive object. In pursuing π, the transcendental end is the ratio of the circumference of a Euclidean circle to its diameter. The form of this transcendental end is a number. In pursuing Wisdom, the transcendental end is the knowledge that allows a perfectly wise being to decide perfectly well. The form of this transcendental end is whatever form of knowledge is most useful to a perfectly wise being in deciding well.

"The third of these elements is the *timeless end*. The timeless end is that which we seek during the recursive process. In pursuing π, the timeless end is ever better approximations of π. The form of this timeless end is a number. In pursuing Wisdom, the timeless end is ever better approximations of Wisdom. The form of this timeless end is whatever form of knowledge is most useful to us as we pursue the timeless end of deciding well. As we shall see, this form is a set of timeless descriptions of the world with at least one description for each invariant factor of deciding well, which we use to help us find problems to solve, and a set of temporal descriptions of the world, which we use to help us solve temporal problems. These descriptions ought to be as simple as possible, but not simpler; and the sets of descriptions ought to be as small as possible, but not smaller.[15]"

"[15] The inspiration for this belief about the timeless end of deciding well was Albert Einstein's belief about what he called the objective truth as expressed in his book, *The Evolution of Physics from Early Concepts to Relativity and Quanta* (New York: Simon and Schuster, 1966, p. 31): "Physical concepts are free creations of the human mind, and are not, however it may seem, uniquely determined by the external world. In our endeavor to understand reality we are somewhat like a man trying to understand the mechanism of a

closed watch. He sees the face and the moving hands, even hears its ticking, but he has no way of opening the case. If he is ingenious he may form some picture of a mechanism which could be responsible for all the things he observes, but he may never be quite sure his picture is the only one which could explain his observations. He will never be able to compare his picture with the real mechanism and he cannot even imagine the possibility or the meaning of such a comparison. But he certainly believes that, as his knowledge increases, his picture of reality will become simpler and simpler and will explain a wider and wider range of his sensuous impressions. He may also believe in the existence of the ideal limit of knowledge and that it is approached by the human mind. He may call this ideal limit the objective truth.""

Chapter 1, *The Boundless Problem of Refining Knowledge*, second paragraph

"This radically different strategy for refining knowledge calls for us to confront the modern belief that descriptions of the world that predict well also explain well. This insidious delusion arises from the belief that descriptions of the world that both predict well and explain well are part of the Truth rather than simply tools for pursuing the Truth."

was changed to:

"This radically different strategy for refining knowledge calls for us to confront the modern belief that descriptions of the world that help us predict well also help us explain well. This delusion arises from the modern belief that descriptions of the world that both predict well and explain well are part of the Truth rather than simply tools for pursuing the invariant factors of deciding well."

Chapter 1, *The Boundless Problem of Refining Knowledge*, third paragraph, second footnote

"[17] One way that we can think about the truth of this claim is to consider whether it is theoretically possible to reduce any decision-making situation to a decision-tree model. From within this type of model, better predictions help us improve our assessments of uncertain events and better explanations help us improve the decision structure. This is not to say that reducing all decision making situations to decision tree models would be wise. A generalized decision tree model would not only be infinitely large, but also insanely complex. It would need to capture how the decider's actions affect others and how others' reactions affect the decider. It would also need to capture how the decider's preferences might change with experience, especially those preferences that concern what modern economists call externalities. Regrettably, applying simple decision rules universally is only part of the answer to coping with such overwhelming complexity. As we shall see in the section on governing well, an approach in which governments use a few simple rules to set the bounds of just action combined with individuals using their judgment to act wisely within these bounds appears to be the best approach for pursuing the timeless end of deciding well."

was deleted.

Chapter 2, Refining Deciding Well, first paragraph, first sentence

"In this section, we apply the invariant concept of deciding well to the timeless end of living well, which is to say to the endless pursuit of the Good."

was deleted.

Chapter 3, Pursuing the Ring of Truth, third paragraph, fifth sentence

Added the sentence:

"As we learn more, objects that once were too hard often bring us pleasure and objects that once brought us pleasure often become boring."

Chapter 3, Pursuing the Ring of Truth, fourth paragraph

Deleted the fifth sentence: "This is especially true of scientific theories."

Changed "folk" to "pop" in the last sentence.

Chapter 3, *The Elephant in the Room*, first paragraph, last sentence

"In other words, it is the relation between transcendental factors and transcendental values."

was deleted.

Chapter 3, *Beauty as a Guide to Deciding Well*, first paragraph, footnote

"To people who believe that analytical tools are the only legitimate tools for believing well, this timeless advice is little more than religious nonsense. They understand that the problem of defining excellence in choosing frames is infinitely deep. In defining the concept of excellence in choosing frames, we must choose a frame. To choose this frame, we must choose a frame. To choose this frame, we must choose a frame. And so on to infinity. They fail to understand that the invariant means of addressing this problem is also infinitely deep. The best frame for choosing frames is the frame that best helps us decide well. The best frame for choosing this frame is the frame that best helps us pursue the timeless end of deciding well. The best frame for choosing this frame is the frame that best helps us pursue the timeless end of deciding well. And so on to infinity. Regardless of how many times we repeat this cycle, the best frame for choosing frames is the frame that best helps us pursue the timeless end of deciding well."

was changed to:

"The problem of defining excellence in choosing frames is infinitely deep, but so too is the invariant means of addressing this problem. In defining the concept of excellence in choosing frames, we must choose a frame. To choose this frame, we must choose a frame. To choose

this frame, we must choose a frame. And so on to infinity. The best frame for choosing frames is the frame that best helps us pursue the timeless end of deciding well. The best frame for choosing this frame is the frame that best helps us pursue the timeless end of deciding well. The best frame for choosing this frame is the frame that best helps us pursue the timeless end of deciding well. And so on to infinity. Regardless of how many times we repeat this cycle, the best frame for choosing frames is the frame that best helps us pursue the timeless end of deciding well."

Chapter 3, *Invariant Public Order*, third paragraph

Changed "Imagine" to "Now imagine" in the first sentence.

Chapter 3, *The Decision Tree Interpretation of Quantum Mechanics*, last paragraph

Changed "ring true" to "ring true with what else we know about physics" in the fourth sentence.

Chapter 3, *Judging Descriptions of the World*

"***Judging Descriptions of the World***
The thermodynamically irreversible transition of any microscopic object from acting like a wave to acting like a particle can potentially affect any other microscopic object in the world; hence we can neither predict nor explain with absolute certainty. From a reductionist view, all descriptions of the world are probabilistic. From a holistic view, all descriptions of the world are partial. How do we judge probabilistic/partial descriptions of the world?

"From the invariant view of deciding well, we judge descriptions of the world by how useful they are in helping us pursue the invariant end of deciding well. This calls for two types of descriptions. The first type helps us predict what will happen based on what we currently know about the world. We use descriptions of this type to help us solve given problems. The second type helps us find problems to solve.

"Pursuing the invariant end of deciding well is a process subject to constraints. To pursue the invariant end of deciding well wisely, we need to use resources wisely. A description of the world that provides us with the most accurate prediction is not necessarily the best tool for predicting what will happen. Using relativistic mechanics to predict the behavior of objects produces more accurate results than using classical mechanics. However, using classical mechanics is often the better choice. This is because the extra cost of using relativistic mechanics is often not worth the extra benefit of using it. Similarly, using the invariant technique of judging problems by how each rings true with what we know about pursuing all invariant factors of deciding well is likely to produce the best problems to solve. However, using other techniques is often the better choice. This is because the extra cost of using this invariant technique is often not worth the extra benefit of using it. To pursue the invariant end of deciding well wisely, we need to consider not only the benefits but also costs of using descriptions of the world.

"Over time, we develop rules for helping us decide which descriptions are best under various conditions. These rules are not perfect. For example, a widely-used rule in modern physics tells us to use classical mechanics to find and solve mechanical problems when the velocities of objects are small relative to the speed of light. However, because this rule ignores the accumulation of small errors over time, it fails in the case in satellite-based global positioning systems. This is the same reason that modern economics fails as a tool for explaining the world. In the case of the satellite-based global position systems, the cause of these errors concerns the slowing of satellite clocks relative to terrestrial clocks. In the case of modern economics, the cause of these errors concerns the creation and use of knowledge."

was deleted.

Chapter 3, *Judging Descriptions of the World*, first paragraph

"The thermodynamically irreversible transition of any microscopic object from acting like a wave to acting like a particle can potentially affect any other microscopic object in the world; hence we can neither predict nor explain with absolute certainty. From a reductionist view, all descriptions of the world are probabilistic. From a holistic view, all descriptions of the world are partial. How do we judge probabilistic/partial descriptions of the world?"

was changed to:

"It is impossible to describe any part of the world completely.[20] From a reductionist view, incomplete descriptions of the world are probabilistic. From a holistic view, they are partial. How do we judge probabilistic/partial descriptions of the world?"

"[20] In the first section, we saw how the linguistic (logical and conceptual) problems raised by David Hume and W. V. O. Quine create the need to expand the scope of the problem of believing well to the limits imagination. In this section, we also saw how quantum entanglement and deterministic chaotic systems create the need to expand the scope of the problem of believing well to the limits of imagination. From this boundlessly-pragmatic view, both local realism ("modernism") and local pragmatism ("postmodernism") are myopic."

Chapter 3, *Judging Descriptions of the World*, last paragraph, last three sentences

"This is the same reason that modern economics fails as a tool for explaining the world. In the case of the satellite-based global position systems, the cause of these errors concerns the slowing of satellite clocks relative to terrestrial clocks. In the case of modern economics, the cause of these errors concerns the creation and use of knowledge."

was changed to:

"The cause of these ever-accumulating errors is the failure to account for the slowing of time in satellite inertial frames relative to terrestrial inertial frames. As we shall see, the cause of

similar errors in modern economies is the failure of people to choose to pursue the invariant end of deciding well."

Chapter 3, Conclusion, last paragraph

Changed "pragmatic" to "boundlessly-pragmatic" in the first sentence.

Chapter 4, Sovereignty, first paragraph, first sentence

"In this section, we apply the invariant concept of deciding well to the timeless end of governing ourselves well, which is to say to the endless pursuit of Justice."

was deleted.

Chapter 4, Sovereignty, last paragraph

Changed "From the invariant view of deciding well, governments" to "Governments" in the first sentence.

Chapter 4, *The Explicit Experiment*, second paragraph

Changed "Arguably," to "According to most scholars, fellow member of the drafting committee" in the third sentence.

Chapter 4, Liberalism, third paragraph

Changed "Modern economic models" to "These "capitalist" models" in the second sentence.

Changes in Version 2010.09.20

Preface, first paragraph

Changed "essay" to "book" and "thirty" to "thirty-two" in the first sentence.

Preface, fourth paragraph

Changed "values" to "timeless ends" in the second to last sentence.

Changed "timeless ends" to "ends" in the last sentence.

Preface, fifth paragraph

"I wrote this essay to help people find better problems to solve, particularly those that concern how to prepare for unexpected problems. In the first section, I explain why it is important to distinguish between temporal and timeless ends. I go on to develop a timeless concept of deciding well that is independent of our beliefs and circumstances. In the balance of the essay, I apply this universal, unvarying concept of deciding well to the endless pursuits of living well, believing well, and governing ourselves well."

was deleted.

Preface, new fifth paragraph

Deleted the phrase ", which serves as the core of a theory of cultural evolution in people" from the first sentence.

Preface, new fifth paragraph, last two sentences

"If deciding well were not subject to constraints, there would be neither the need to distinguish between deciding and deciding well, nor the need to learn from experience. Deciding well, so conceived, is also a *self-similar universal invariant*, which is to say that it is useful in pursuing the timeless end of deciding well regardless of the scale of the temporal problem people choose, and useful in pursuing the timeless end of deciding well for all people regardless of their circumstances and beliefs."

were changed to:

"These constraints concern not only solving temporal problems, but also learning how to solve temporal problems ever better."

Preface, new sixth paragraph, first sentence

Changed "are some universal factors" to "exist universal factors" in the second sentence.

Preface, new seventh paragraph

"Over time, we also collectively learn that we ought to accept the timeless end of deciding well, so conceived, as our publicly proclaimed and practiced ultimate end. We can never be certain of this belief. However, we can aspire to be wise by attempting to disprove it, which we can do by forming a government based upon it. Undertaking this civil research program, like undertaking all other research programs, calls for making a leap of faith. Over time, we learn that we ought to base such leaps of faith upon the ring of truth."

was deleted.

Preface, new seventh paragraph, first sentence

Changed "economics" to "allocating resources" in the second sentence.

Preface, new eighth paragraph

Changed "invariant" to "timeless" in the second sentence.

Preface, last paragraph

Merged last paragraph into second to last paragraph

Preface, last paragraph, last sentence

"The current debacle may prove to be such an event."

was replaced by the following paragraphs:

"This simple model of deciding well has as profound implications for how we think about believing well as it does for how we think about allocating resources well. The timeless end of believing well is one of the universal, boundless factors of deciding well. Following this simple model of deciding well, pursuing the timeless end of believing well calls for neither faith in experience per se, nor faith in something that transcends experience, but rather faith in the pursuit of the timeless end of believing well. If we call the endless process of pursing the timeless end of believing well *science*, the basis of science is science. The whole of science is not, as Albert Einstein famously claimed, a refinement of everyday thinking, but rather the endless process of refining everyday thinking, which includes the process of refining the process of refining everyday thinking.

"One reason to believe that science ought to be an endless process concerns the logical problem of induction. Until we have experienced everything that can be experienced, we can never be certain that the general beliefs we induce from experience are true. On a deeper level, until we have experienced everything that can be experienced, we can never be certain that the concepts we invent to describe the world are the best concepts for describing the world. Consider the belief that all crows are black. The veracity of this belief depends on how we define the concepts we use to form this belief. Imagine that we encounter a new bird that appears to be a non-black crow. We can choose either to call this bird a crow, which would make the belief that all crows that exist are black false, or we can choose to call this bird something other than a crow, which would allow us to continue believing that all crows are black. Further, this uncertainty concerns not only the concepts we use to formulate the belief we are testing, but also the concepts we use to define these concepts, and the concepts we use to define these concepts, and the concepts we use to define these concepts, and so on. For example, the veracity of the belief that all crows are black depends on the meaning of "to be." Does this concept concern existence in (1) the current state of the world; (2) the history that led from the initial state of the world to the current state, the current state, and all future states accessible from the current state; or (3) the initial state of the world and all possible states accessible from the initial state?

"Another reason to believe that science ought to be an endless process concerns the physical problem that entangled pairs of quantum-level objects create for our ability to explain what

happens in part of the world. What makes this especially important is the existence of systems in which the smallest of changes may lead to ever larger changes over time. An event as apparently inconsequential as a butterfly flapping its wings may not only change the weather on a distant continent, but also the planetary structure of a distant solar system.

"A third reason to believe that science ought to be an endless process concerns the practical problem of motivation. If we believe that free will does not exist, we believe that we are not free to choose either what to pursue or how best to pursue it. This belief does not motivate us to decide well, hence to explain what causes sensations of the world. On the other hand, if we believe that free will exists, we believe that we are free to choose what to pursue and how best to pursue it motivates us to decide well, hence to explain what causes sensations of the world. It also calls for us to expand the scope of this endless pursuit to include mental as well as physical objects. These mental objects include mental models of mental objects, hence mental models of mental models of mental objects, mental models of mental models of mental models of mental objects, and so on to infinity.

"From the timeless view of science put forth in this work, deciding well calls for us to find and solve problems well. Models that help us predict sensations of the world help us solve given problems. Models that help us explain sensations of the world help us find problems to solve. The distinction between solving given problems and finding problems to solve depends on the scale of the problem we choose to solve. If we choose the smallest problems we can imagine, we choose to deal with our ignorance of the world in the form of uncertain predictions. Today, this is the realm of quantum mechanics. If instead we choose the largest problem we can imagine, which is the problem that contains all other problems, we choose to deal with our ignorance of the world in the form of incomplete explanations. As we shall see, this is the realm of the public sciences. Choosing the best problem to solve is a matter of balancing the costs of these two types of ignorance. These costs depend on the quality of the models we use to predict and explain sensations of the world.

"To improve the quality of the models we use to predict and explain our sensations of the world, we need means of judging these models. The pragmatic means of judging models that we use to predict sensations is to judge how well these models help us solve given problems. The pragmatic means of judging models that we use to explain sensations is to judge how well these models help us find problems to solve.

"From the temporal view of modern science, judging the models that we use to find problems to solve calls for us to judge models for helping us judge these models, judge models for helping us judge models for helping us judge these models, judge models for helping us judge models for helping us judge models for helping us judge these models, and so on to infinity. In contrast, from the timeless view of science put forth in this work, judging these models well calls for us to decide well in pursuing the timeless end of judging models well. Deciding well calls for us to judge both models that help us predict sensations of the world within the realm of the problem we choose to solve and models that explain sensations of the world. This holds true regardless of the size of the problem we choose to solve.

"Students of Western thought may find in this timeless concept of science a synthesis of the Platonic pursuit of knowledge of ideal forms and the Aristotelian pursuit of knowledge of natural forms. Like the Platonic pursuit, the pursuit of knowledge of universal, boundless factors of deciding well involves pursuing knowledge of ideal forms. Unlike the Platonic pursuit, it recognizes that its ideal forms are objects that we can never know completely. Like the Aristotelian pursuit, the pursuit of knowledge of these factors involves replicable patterns of reasoning. Unlike the Aristotelian pursuit, its rules for reasoning include not only rules that bind beliefs together into logical frameworks, but also rules for binding logical frameworks together into a coherent whole. These rules for reasoning concern not only logic but also symmetry.

"The timeless concept of deciding well put forth in this work exhibits two types of symmetry. First, the relations between the universal, boundless factors of deciding well have rotational symmetry. We can picture this symmetry in a diagram that uses line segments to represent the relations between universal, boundless factors of deciding well spaced equally around the circumference of a circle. Second, the pursuit of the timeless end of deciding well has translational symmetry with respect to reference frames defined by beliefs and circumstances. When we expand the problems we face to the limits of imagination, our problems become part of the problem that contains all other problems. The solution to this universal problem, which is pursuing the timeless end of deciding well, is the same for all of us.

"From temporal views of science that conflate replicable reasoning and logic, a concept of reasoning that includes both logic and symmetry surpasses rationality. To use a term coined by Douglas Hofstadter to describe his strategy for competing well by cooperating well, it is *superrational*. In contrast, from the timeless view of invariant science, temporal views that conflate reasoning and logic are shortsighted. They concern learning about Plato's cave for its own sake rather than learning about it in order to learn how best to climb ever upward toward the timeless end and invariant factors of deciding well."

Chapter 1, Setting Words Aright, last paragraph

Changed "map" to "map hanging on a wall" in the third sentence.

Chapter 1, Choosing Frames Well, third paragraph

Changed "using resources that are useful in deciding well" to "in using resources" in the last sentence.

Chapter 1, Useful Frames, second paragraph

Changed "temporal problem" to "subordinate problem" in all (4 occurrences).

Changed "temporal problem" to "subordinate problem" in the first sentence of the footnote.

Changed "temporal problem scale" to "problem scale" in the second sentence of the footnote.

Chapter 1, Useful Frames, last paragraph

Changed "finding a temporal problem to solve" to "finding a subordinate problem to solve" in the third sentence.

Chapter 1, *The EOQ/RTS Example*, first paragraph

Changed "*rationally*" to ""rationally"" and "*wisely*" to ""wisely"" in the third sentence.

Chapter 1, Timeless versus Invariant Values, second paragraph

"In discussing temporal and timeless values, we can avoid much tedium and confusion by capitalizing timeless values. Using this convention, (1) to pursue the timeless end of living well is to pursue the Good; (2) to pursue the timeless end of believing well is to pursue the Truth; (3) to pursue the timeless end of deciding well is to pursue Wisdom; and (4) to pursue the timeless end of governing ourselves well is to pursue Justice. To many modern readers, this convention will have theistic overtones. Properly conceived, it has religious overtones that may or may not be theistic. As we shall see, we ought to distinguish between 'theism' ("belief in the existence of the divine"); 'religion' ("the pursuit of linking or re-linking with something greater than ourselves"); and 'faith' ("certainty beyond reason"). We ought never to fall into the habit of using the terms 'theism,' 'religion,' 'faith' as synonyms for the zealous pursuit of linking or re-linking with the divine."

was changed to:

"In discussing temporal and timeless values, we can avoid much tedium and confusion by capitalizing timeless values. Using this convention, we may call the timeless end of deciding well *Wisdom*, the timeless end of living well *the Good*, the timeless end of believing well *the Truth*, and the timeless end of governing ourselves well *Justice*. If we define 'theism' to mean belief in the existence of the divine and 'religion' to mean the pursuit of linking or re-linking with something greater than ourselves, this convention has religious overtones that may or may not be theistic."

Chapter 1, Timeless versus Invariant Values, third paragraph, last three sentences

"The timeless concept of deciding well includes learning ever more about values. We learn ever more about values by pursuing the timeless end of deciding well (Wisdom). As we shall see, pursuing the timeless end of deciding well calls for us to pursue the timeless end of believing well (the Truth)."

was changed to:

"We learn ever more about values by pursuing the timeless end of believing well (the Truth)."

Chapter 1, Timeless versus Invariant Values, fourth paragraph

Changed "a universal invariant" to "invariant with respect to inertial frames" in the last sentence.

Chapter 1, Timeless versus Invariant Values, ninth through eleventh paragraphs

"Over time, we learn that some factors of deciding well differ from the others in several important respects. First, we can never have enough of these factors, which is to say our need for these factors is *boundless*. Second, all people need these factors to decide well, which is to say that these factors are *universal*. Third, we can never possess these factors completely, which is to say our pursuit of these factors is *timeless*. These boundless, universal, and timeless factors include the timeless ends of living well (the Good), believing well (the Truth), and deciding well (Wisdom). We need the Good to avoid deprivation, which hinders us from deciding well. We need the Truth to avoid ignorance, which also hinders us from deciding well. Wisdom is knowledge of how to decide well. We can never have too much knowledge of how to decide well.

"Over time, we learn that the endless pursuits of all boundless, universal, and timeless factors of deciding well intertwine to form a single endless pursuit. Consider the relation between the pursuit of the Good and the pursuit of the Truth. We pursue the Good by deciding well, which calls for us to pursue the Truth. We pursue the Truth by deciding well, which calls for us to pursue the Good. Thus the pursuit of the Good and the pursuit of the Truth intertwine to form a single pursuit, which we may call *the invariant pursuit of deciding well*. Further, the better we decide, the tighter we intertwine the pursuits of the Good and the Truth. By similar reasoning, all pursuits of boundless, universal, and timeless factors of deciding well, which we may call *invariant factors of deciding well*, intertwine to form the invariant pursuit of deciding well. Further, the better we decide, the tighter we intertwine the pursuits of the invariant factors of deciding well.[13]

"Over time, we learn that the timeless end of governing ourselves well (Justice) is a matter of cooperating well in the pursuit of the timeless end of deciding well. We need the help of others to pursue the timeless end of deciding well. We can never cooperate too well with other people, which includes people separated from us by great distances or long periods of time. Today, the idea of cooperating with people separated by great distances is common. However, the idea of cooperating with people separated by long periods is not. The ancient Chinese provide us with a simple model for cooperating over long periods: "The debts that we owe to our ancestors we pay to our descendants." Following this model, we can cooperate in deciding well across great distances and long periods with the universal moral rule: "The debts we cannot pay to whom they are due we pay to others by deciding well." This includes the debts that we owe to those who provided us with the knowledge that we use freely. Hence, the timeless end of governing ourselves, which is to say the timeless end of cooperating well, is an invariant factor in deciding well."

"[13] Pursuing the timeless end of deciding well benefits greatly from the ability to think in many frames simultaneously. For a witty explanation of the evolution of this ability, see Stewart, I. and Cohen, J., *Figments of Reality: The Evolution of the Curious Mind* (Cambridge, England: Cambridge University Press, 1997)."

were changed to:

"Over time, we learn that there exist universal factors of deciding well that we can never have in excess. These universal, boundless factors include the timeless ends of living well (the Good) and believing well (the Truth). We need the Good to avoid deprivation, which hinders us from deciding well. We need the Truth to avoid ignorance, which also hinders us from deciding well.

"Over time, we learn that the endless pursuits of all universal, boundless factors of deciding well intertwine to form a single endless pursuit. Consider the relation between the pursuit of the Good and the pursuit of the Truth. We pursue the Good by deciding well, which calls for us to pursue the Truth. We pursue the Truth by deciding well, which calls for us to pursue the Good. Thus the pursuit of the Good and the pursuit of the Truth intertwine to form a single pursuit, which we may call the pursuit of Wisdom. The better we decide, the tighter we intertwine the pursuits of the Good and the Truth into the pursuit of Wisdom. By similar reasoning, all pursuits of universal, boundless factors of deciding well intertwine to form the pursuit of Wisdom. The better we decide, the tighter we intertwine the pursuits of these factors of deciding well into the pursuit of Wisdom.

"Over time, we learn that the timeless end of governing ourselves well (Justice) is a matter of cooperating well in the pursuit of the timeless end of deciding well. We need the help of others to pursue the timeless end of deciding well. We can never cooperate too well with other people, including people separated from us by great distances or long periods of time. Hence, the timeless end of governing ourselves well, which is also the timeless end of cooperating well, is a universal, boundless factor of deciding well.

"The ancient Chinese provide us with a simple model for cooperating over great distances and long periods: "The debts that we owe to our ancestors we pay to our descendants." Extending this model to all people, we can cooperate well across great distances and long periods with the universal moral rule: "The debts we cannot pay to whom they are due we pay to others by deciding well." This includes the debts that we owe to those who provided us with the knowledge that we use freely. Following this rule, we ought to pursue the timeless end of deciding well regardless of our current beliefs and circumstances. When we expand the problems we face to the limits of imagination, our problems become part of the problem that contains all other problems. The solution to this universal problem, which is pursuing the timeless end of deciding well, is the same for all of us. In the language of mathematics, the pursuit of the timeless end of deciding well is invariant with respect to reference frames based on beliefs and circumstances. Further, the universal, boundless factors of deciding well are invariant with respect to reference frames based on beliefs and circumstances.

"Consider how we can use the invariant frame of deciding well to help us choose the best frame for judging how well we govern ourselves. From within each frame we consider, the frame we are in looks to be the best frame. We find ourselves in a mental hall of mirrors from which analytical techniques cannot help us escape. Twentieth-century philosopher John Rawls provides us with a timeless technique that can help us reason our way out of this

quandary. He asks us to imagine what we should choose if we were ignorant of the circumstances of our birth.[13] For this imagined original position of ignorance to produce a *completely just* end, we must consider to what end we should want to guide people if we were *completely ignorant* of the circumstances of our birth, which includes ignorance of what species we will be and into what era we will be born. From behind this veil of complete ignorance, we should want all people to pursue the timeless end of revering life well.[14]We pursue this timeless end by deciding well."

"[13] Rawls, John, *A Theory of Justice* (Cambridge, MA: The Belknap Press of Harvard University, 1971), chapter III."

"[14] More accurately, this thought experiment calls for us to imagine what we would want if before we were born we had complete knowledge of everything except knowledge of the circumstances of our birth or births. For more on revering life well, see Appendix B."

Chapter 1, Temporal versus Invariant Ends, last paragraph

Inserted the paragraph:

"Over time, we learn that the more our beliefs about pursuing the invariant end of deciding well fit together into a coherent whole and the better the problem we are considering fits this coherent whole, the more likely the problem we are considering is a good problem to solve. We may call the endless process of thinking deeply about how our beliefs about pursuing the invariant end of deciding well fit together into a coherent whole and of thinking deeply about how the problems we are considering fit this coherent whole the endless process of contemplating well. So conceived, the timeless end of contemplating well is an invariant factor of deciding well. We may call this timeless end *Beauty*."

Changed "(the Good), believing well (the Truth), and governing ourselves well (Justice)" to ", believing well, governing ourselves well, and contemplating well" in the last sentence.

Chapter 1, Boundless Pragmatism, entire section

"**Boundless Pragmatism**
Invariant values are tools for helping us to choose among a nearly infinite number of nearly infinite paths. Thinking deeply about these paths calls for us to leave behind our current mental models for explaining the world. In doing so, we become as sailors venturing beyond landfall. Fortunately, we can use more general versions of two mathematical concepts to help us navigate these potentially maddening seas.[13]

"From the frame of mathematics, there is a set of numbers that resembles the set of invariant factors of deciding well. This is the set of numbers that are both *transcendental* and *recursive*. These numbers are transcendental in that they are not algebraic, which is to say that they are not the solution of any integer polynomial. They are recursive in that they are the solution of at least one recursive process, which is to say they are the result of at least one

endlessly repeating cycle of steps in which the result of one cycle becomes the basis for the next cycle.

"From the invariant frame of deciding well, we can imagine a set of transcendental recursive concepts. The members of this set of concepts are transcendental in that they are concepts that we can never know completely. They are recursive in that we can theoretically know them by means of at least one recursive process.

"The mathematical constant π is a transcendental recursive concept. It is transcendental in that we can never know it completely. It is recursive in that we can theoretically know it by means of a recursive process. Similarly, Wisdom is a transcendental recursive concept. Wisdom is transcendental in that we can never know it completely. Wisdom is recursive in that we can theoretically know it by means of the recursive process of deciding well.

"We may think of the recursive processes by which we come to know ever more about transcendent recursive concepts as having three elements. The first of these elements is the *recursive process* itself. In pursuing π, the recursive process is any one of many means of computing π. In pursuing Wisdom, the recursive process is the process of deciding well.

"The second of these elements is the *transcendental end*. The transcendental end is complete knowledge of the transcendental recursive object. In pursuing π, the transcendental end is the ratio of the circumference of a Euclidean circle to its diameter. The form of this transcendental end is a number. In pursuing Wisdom, the transcendental end is the knowledge that allows a perfectly wise being to decide perfectly well. The form of this transcendental end is whatever form of knowledge is most useful to a perfectly wise being in deciding well.

"The third of these elements is the *timeless end*. The timeless end is that which we seek during the recursive process. In pursuing π, the timeless end is ever better approximations of π. The form of this timeless end is a number. In pursuing Wisdom, the timeless end is ever better approximations of Wisdom. The form of this timeless end is whatever form of knowledge is most useful to us as we pursue the timeless end of deciding well. As we shall see, this form is a set of timeless descriptions of the world with at least one description for each invariant factor of deciding well, which we use to help us find problems to solve, and a set of temporal descriptions of the world, which we use to help us solve temporal problems. These descriptions ought to be as simple as possible, but not simpler; and the sets of descriptions ought to be as small as possible, but not smaller.[14]"

"[13] We can see the effects of trying to navigate uncharted portions of these potentially maddening seas in the personal life of mathematician Georg Cantor. Although his efforts to chart these seas eventually drove him mad, he provided us with tools for navigating these waters, which include set theory and transfinite numbers. For more on this, read Amir Aczel's book, *The Mystery Of The Aleph: Mathematics, the Kabbalah, and the Search for Infinity* (New York: Four Walls Eight Windows, 2000)."

"[14] The inspiration for this belief about the timeless end of deciding well was Albert Einstein's belief about what he called the objective truth as expressed in his book, *The Evolution of Physics from Early Concepts to Relativity and Quanta* (New York: Simon and Schuster, 1966, p. 31): "Physical concepts are free creations of the human mind, and are not, however it may seem, uniquely determined by the external world. In our endeavor to understand reality we are somewhat like a man trying to understand the mechanism of a closed watch. He sees the face and the moving hands, even hears its ticking, but he has no way of opening the case. If he is ingenious he may form some picture of a mechanism which could be responsible for all the things he observes, but he may never be quite sure his picture is the only one which could explain his observations. He will never be able to compare his picture with the real mechanism and he cannot even imagine the possibility or the meaning of such a comparison. But he certainly believes that, as his knowledge increases, his picture of reality will become simpler and simpler and will explain a wider and wider range of his sensuous impressions. He may also believe in the existence of the ideal limit of knowledge and that it is approached by the human mind. He may call this ideal limit the objective truth.""

was deleted.

Chapter 1, *Substitutes for Wisdom*, entire section

"***Substitutes for Wisdom***
Studying what we can know and communicate about π can provide us with insights into what we can know and communicate about Wisdom. We can never know the value of π. The most we can know is either an approximate value of π or a means of computing π. Both of these substitutes for π have disadvantages.

"A major disadvantage of using an approximate value of π is that using it well calls for us to know under what circumstances it is useful in deciding well. For example, the approximate value of 22/7 is useful for some problems but not all problems. By similar reasoning, a major disadvantage of using approximations of Wisdom is that using them well calls for us to know under what circumstances they are useful in deciding well. For example, a decision rule that tells us always to tell the truth is wise for some situations but not for all situations. Telling a murderer where he can find his next victim is not wise.

"A major disadvantage of using a means of computing π is our limited ability to use this means. A calculus formula for computing π is useless to a person without knowledge of calculus; an arithmetic series for computing π is useless to a person without knowledge of arithmetic; and a geometric means of computing π is useless to a person without knowledge of geometry. By similar reasoning, a major disadvantage of using the means of pursuing Wisdom is our limited ability to decide well."

was deleted.

Chapter 1, *The Boundless Problem of Refining Knowledge*, entire section

"***The Boundless Problem of Refining Knowledge***
When we study the beliefs of others, our beliefs about their beliefs can affect their beliefs, which can in turn affect our beliefs about their beliefs, and so on to infinity. This, combined with the inexhaustibility of knowledge, the problem of choosing frames, and the problem of induction point to the need to expand the problems we face to the limits of imagination, hence to a universal problem that contains all other problems. We can address this universal problem by pursuing the timeless end of deciding well.

"This radically different strategy for refining knowledge calls for us to confront the modern belief that descriptions of the world that help us predict well also help us explain well. This delusion arises from the modern belief that descriptions of the world that both predict well and explain well are part of the Truth rather than currently useful tools for pursuing the invariant factors of deciding well.

"We use descriptions of the world to predict and explain. A prediction is knowledge of what is likely to happen. An explanation is knowledge of why things happen as they do.[15] Predictions and explanations help us decide well in different ways. Predictions help us to assign probabilities to uncertain events, which helps us to evaluate alternatives. Explanations help us to understand how our actions may change the world, which helps us to formulate alternatives. Better predictions help us better solve temporal problems, and better explanations help us find better problems to solve. Better predictions help us become more *efficient*, and better explanations help us become more *effective.*

"When we use descriptions of the world that predict well but do not explain well to find problems to solve, we embed mistakes in our networks of knowledge-in-use. These embedded mistakes tend to hinder our progress toward the timeless end of deciding well. Releasing these embedded mistakes creates turbulence in the flow of resources. We can see both of these effects in the EOQ/RTS example. Companies with modern production systems learn to produce well less quickly than those companies with learning-based systems. Over time, companies with modern production systems will create turbulence by shutting down these systems."

"[15] Some stories predict better than they explain. Quantum mechanics provides incredibly accurate statistical predictions of subatomic events without explaining their causes equally well. Rather than better means of predicting what quantum mechanics predicts, physicists today seek to explain what links the subatomic to the cosmological. Other stories explain better than they predict. Chaos theory provides a means of explaining *deterministic chaotic systems* without being able to predict these systems equally well. Predicting the long-term "weather" (trajectory in phase space) calls for knowing initial conditions with infinite precision, which is impossible. The best we can hope to do is to predict the "climate" (trajectory pattern in phase space)."

was deleted.

Chapter 1, Overview, all paragraphs

"In this section, we saw how the invariant concept of deciding well can help us pursue the invariant end of deciding well, and so all of the invariant factors of deciding well. In the remaining three sections, we will see how this invariant concept can help us pursue the timeless ends of living well, believing well, and governing ourselves well. Each of these sections presents a different aspect of the invariant process of deciding well.

"The section on living well begins with a brief discussion of how we ought to use both temporal and invariant tools in our pursuit of the timeless end of living well. The rest of the section defines invariant alternatives to the modern economic concepts of wealth, consumption, trade, production, taxation, and profit. These often striking juxtapositions not only help us see the world from the timeless frame of living well, but also highlight the difference between tools meant to help us solve given problems and tools meant to help us find problems to solve.

"The section on believing well begins with a discussion of contemplating well. Next is a discussion of the invariant concept of science as the process of refining everyday thinking, which includes an argument supporting the claim that what we currently call natural science is a special case in which we choose to ignore the possible roles that consciousness and free will play in the endless process of refining everyday thinking. The section ends with a discussion of the endless process of refining our beliefs about the invariant process of deciding well.

"The section on governing ourselves well explains how we may test the system of beliefs that supports the invariant process of deciding well. The hypothesis of this experiment is the claim that this invariant system of beliefs can help us govern ourselves better than any other. The section ends with a brief discussion of how this system of beliefs differs from modern and classical liberalism."

were changed to:

"In this chapter, we saw how the invariant concept of deciding well can help us pursue the invariant end of deciding well, and so all of the invariant factors of deciding well. In the remaining four chapters, we will see how this invariant concept can help us pursue the timeless ends of living well, contemplating well, believing well, and governing ourselves well. Each of these chapters presents a different aspect of the invariant process of deciding well."

Chapter 2, Invariant Tools for Living Well, last paragraph

Changed "section" to "chapter" in the second sentence.

Chapter 2, Profit, last paragraph

"From the classical liberal view, people are free to spend the profits they earn as they please. From the modern liberal view, people owe part of their profits to society for the use of socially-owned resources. According to some modern liberals, people owe up to ninety

percent of their incomes to society to pay for the use of knowledge that they use freely.[6] As we shall see, from the timeless liberal view, we owe debts to those people who created the knowledge we use freely, and to the whole of life for providing us with the natural resources we use freely. We owe these debts to the stewards of life and to life itself, rather than to the stewards of society and to society itself. We pay these debts by deciding well."

"[6] Alperovitz, G. and Daly, L., *Unjust Deserts: How the Rich Are Taking Our Common Inheritance and Why We Should Take It Back* (New York: The New Press, 2008)."

was changed to:

"From the classical liberal view, people are free to spend the profits they earn as they please. In contrast, from the invariant view of deciding well, we owe debts to those people who created the knowledge we use freely, and to the whole of life for providing us with the natural resources we use freely. We pay these debts by deciding well.[6]"

"[6] From the modern liberal view, people owe part of their profits to society for the use of socially-owned resources. According to modern liberals Gar Alperovitz and Lew Daly (*Unjust Deserts: How the Rich Are Taking Our Common Inheritance and Why We Should Take It Back*, New York: The New Press, 2008), people owe up to ninety percent of their incomes to society to pay for the use of knowledge that they use freely. Ought we to pay the debts we owe to the stewards of society in money or to the whole of life in good deeds?"

Chapter 2, The Need for a Science of Deciding Well, entire section

"**The Need for a Science of Deciding Well**
In 1776, Adam Smith's example of a pin factory showed the wisdom of pursuing the virtuous circle of the division of labor and the expansion of market size.[7] Today, Toyota's strategy for learning shows the wisdom of pursuing the virtuous circle of good people and good products. Good people, deciding well, produce good products. Good products, used well, produce good people. Given the success of this strategy, we ought to learn more about good people and good products. To do so well, we need an invariant concept of science. The next section describes this concept."

was changed to:

"**A Strategy for Learning Well**
In 1776, Adam Smith's example of a pin factory showed the wisdom of pursuing the virtuous circle of the division of labor and the expansion of market size.[7] Today, Toyota's strategy for learning shows the wisdom of pursuing the virtuous circle of good people and good products. Good people, deciding well, produce good products. Good products, used well, produce good people. Given the success of this strategy, we ought to learn ever more about good people and good products. To do so well, we need to pursue the invariant end of deciding well."

Chapter 3, Pursuing the Ring of Truth, entire section

"**Pursuing the Ring of Truth**

There is an ancient belief that equates truth with beauty. Nineteenth-century poet John Keats expressed this belief in the closing lines of his poem, "Ode on a Grecian Urn":

"Beauty is truth, truth beauty, — that is all ye know on earth, and all ye need to know."[1]

"Combining this ancient belief with the invariant concepts of pleasure and joy yields an invariant concept of beauty: *beauty is the quality of objects whose contemplation yields not only pleasure but also the joy that comes from improving how well our beliefs fit together into a coherent whole that is useful in living ever more wisely*.

"To give us pleasure, an activity must not be too easy or too hard. Too easy an activity bores us; too hard an activity overwhelms us. When the activity is contemplation, the object of contemplation must not be too simple or too hard to contemplate. Contemplating too simple an object bores us; contemplating too hard an object overwhelms us. Between what is boring and what is overwhelming is a level of difficulty that allows us to lose ourselves in contemplation. As we learn more, objects that once were too hard may bring us pleasure; and objects that once brought us pleasure may become boring. Learning about the structure of classical music may turn Beethoven's symphonies from being overwhelming to being beautiful. It may also turn pop music from being beautiful to being boring.

"To give us joy, an activity must improve our state of being. When the activity is contemplation, the object of contemplation must be just novel enough for us to learn from it. If the object is not novel or too novel we will not learn from it. As we learn more, objects that once brought us joy become mundane and objects that were once too novel become beautiful. Before we learn calculus, Newton's theory of gravity is too novel to bring us joy. After we learn calculus, it has the potential to bring us joy. With use, it becomes just another tool.

"***The Elephant in the Room***

One of the most beautiful things to emerge from pursuing the invariant end of deciding well is the relation between the invariant factors of deciding well and the values that people claim to seek when they seek to link or re-link with something infinitely greater than themselves.

"The essential biological explanation of this coincidence is simple and straightforward. We evolved to have a religious need to become a part of something infinitely greater than ourselves. Seeking to satisfy this need is useful in securing the best chances of survival for our offspring and ourselves. We seek to satisfy this need by deciding well. We collectively refine our means of deciding well by deciding well over time. Deciding well and our understanding of deciding well co-evolve.

"The essential theological explanation of this coincidence is as simple and straightforward. The Divine created us with the need to seek the Good, the Truth, Justice, Wisdom, and Beauty. We pursue these transcendental values by deciding well. We collectively refine our means of deciding well by deciding well over time. Deciding well and our understanding of deciding well co-evolve.

"Although these two essential explanations of this coincidence differ in their assumptions, they share the same means. Regardless of what core set of currently untestable beliefs, what personal faith, we choose to help us find the best problem to solve, the timeless end of believing well is the same for all of us. We are all as blind men seeking to know an infinitely large elephant.

"***Beauty as a Guide to Believing Well***
From the invariant frame of deciding well, pursuing the timeless end of believing well (the Truth) calls for us to pursue all of the invariant factors of deciding well (the Good, Wisdom, Justice, etc.). This is a benefit, not a burden. It provides us with a more certain way of testing problems before we attempt to solve them. If a problem is consistent with all of our beliefs about the invariant factors of deciding well, then it rings true. We have found a beautiful problem to solve.[2]

"Consider how we can use the invariant frame of deciding well to help us choose the best frame for judging how well we govern ourselves. From within each frame we consider, the frame we are in looks to be the best frame. We find ourselves in a mental hall of mirrors from which analytical techniques cannot help us escape. Twentieth-century philosopher John Rawls provides us with a timeless technique that can help us reason our way out of this quandary. He asks us to imagine what we should choose if we were ignorant of the circumstances of our birth.[3] For this imagined original position of ignorance to produce a *completely just* end, we must consider to what end we should want to guide people if we were *completely ignorant* of the circumstances of our birth, which includes ignorance of what species we will be and into what era we will be born. From behind this veil of complete ignorance, we should want all people to pursue the timeless end of revering life well.[4] We pursue this timeless end by deciding well.

"We can never be certain that the invariant frame of deciding well is the best frame for finding problems to solve. We can either pretend to be certain that it is or is not the best frame for finding problems to solve, or aspire to be wise by seeking to disprove that it is not the best frame for finding problems to solve, which we do by acting as if it is the best frame for finding problems to solve. Undertaking this research program calls for making a leap of faith. Over time, we learn to base such leaps of faith upon the ring of truth."

"[1] Keats, John "Ode on a Grecian Urn" in *The Oxford Book of English Verse 1250–1900*, A. T. Quiller-Couch, ed. (Oxford: Clarendon, 1919), reprinted in Bartelby.com, <http://www.bartelby.com/101/625.html> (15 September 2010)."

"[2] The problem of defining excellence in choosing frames is infinitely deep, but so too is the invariant means of addressing this problem. In defining the concept of excellence in choosing frames, we must choose a frame. To choose this frame, we must choose a frame. To choose this frame, we must choose a frame. And so on to infinity. The best frame for choosing frames is the frame that best helps us pursue the timeless end of deciding well. The best frame for choosing this frame is the frame that best helps us pursue the timeless end of deciding well. The best frame for choosing this frame is the frame that best helps us pursue the timeless end of deciding well. And so on to infinity. Regardless of how many times we

repeat this cycle, the best frame for choosing frames is the frame that best helps us pursue the timeless end of deciding well."

"[3] Rawls, John, *A Theory of Justice* (Cambridge, MA: The Belknap Press of Harvard University, 1971), chapter III."

"[4] More accurately, this thought experiment calls for us to imagine what we would want if before we were born we had complete knowledge of everything except knowledge of the circumstances of our birth (or births). For more on revering life well, see Appendix B."

was deleted.

Chapter 3, Refining Everyday Thinking, third paragraph

Changed "Again, we" to "We" in the first sentence.

Chapter 3, Refining Everyday Thinking eleventh paragraph

"From the modern view of believing well, science concerns what the producers of knowledge are able to supply under current constraints. In contrast, from the invariant view of deciding well, science concerns not only what we are able to supply, but also what we need to decide well: We can never solve the problem of believing well. However, we can address it. In the words of Dwight Eisenhower, "If a problem cannot be solved, enlarge it." Enlarging the problem of believing well to the limits of imagination calls for considering what we need to believe well. These needs include the Good, Wisdom, Justice, and Beauty."

was changed to:

"From the modern view of believing well, science concerns what the producers of knowledge are able to supply under current constraints. In contrast, from the invariant view of deciding well, science concerns not only what we are able to supply, but also what we need to decide well. These needs include the invariant factors of deciding well."

Chapter 3, Refining Everyday Thinking, last paragraph

Changed "the timeless end of contemplating well (Beauty), and so the timeless ends of living well (the Good), believing well (the Truth), deciding well (Wisdom), and governing ourselves well (Justice)" to "Beauty, and so the Good, the Truth, Wisdom, and Justice" in the last sentence.

Chapter 3, *Pursuing the Truth Wisely*, title and first paragraph

"***Pursuing the Truth Wisely***
As we saw in the EOQ/RTS example, temporal views tend to blind us to timeless ends. In the case of believing well, the modern, temporal view tends to blind us to the timeless end of

believing well (the Truth), and so to the timeless ends of living well (the Good), deciding well (Wisdom), governing ourselves well (Justice), and contemplating well (Beauty)."

were changed to:

"As we saw in the EOQ/RTS example, temporal views tend to blind us to timeless ends. In the case of believing well, the modern, temporal view tends to blind us to the Truth, and so to the Good, Wisdom, Justice, and Beauty."

Chapter 3, *Invariant Academic Fields*, last paragraph

"The arts would include all fields that aim at the ring of Truth rather than the Truth itself. Like the humanities, the arts would include what human beings create. Unlike the humanities, the arts aim to help us pursue ~~the timeless end of contemplating well (~~Beauty), hence the timeless ends of living well (the Good), believing well (the Truth), deciding well (Wisdom), and governing ourselves well (Justice)."

was changed to:

"The arts would include all fields that aim at the ring of Truth rather than the Truth itself. Like the humanities, the arts would include what human beings create. Unlike the humanities, the arts aim to help us pursue Beauty, hence the Good, the Truth, Wisdom, and Justice."

Chapter 3, *Three Approaches to Constraints*, entire section

"***Three Approaches to Constraints***
From the invariant view of deciding well, deciding well calls for us to think beautifully. The concept of thinking beautifully will likely seem strange to most modern readers. This is in large part due to the modern habit of confusing reality with our mental maps of reality. We saw this in the EOQ example, in which modern managers confused the EOQ model with reality. We can also see it in the claim that we can compute π.

"From the frame of mathematics, π is *computable*, which is to say that we can program all of the steps for computing π into a machine that does nothing more than follow logical instructions. In contrast, from the invariant frame of deciding well, π is not computable. The false claim that π is computable arises from reducing the actual problem of computing π to a theoretical problem of computing π.

"Imagine giving the greatest scientific minds of 1776 the task of computing the value of π to one trillion (10^{12}) decimal places. The most likely result would be a description of the best tool for computing π in 1776 and the explanation that computing π to one trillion decimal places was possible in theory but impossible in practice. No one in 1776 imagined what we currently call supercomputers.[11]

"Now imagine giving the greatest scientific minds of today the task of computing π to one googol (10^{100}) decimal places. Based on how they respond to this challenge, these people will likely fall into one of two basic groups. The first group will report how computing π to one googol decimal places might be done using currently existing or imagined tools. The second group will report that it is currently impossible to imagine what tools will first make computing π to one googol decimal places possible.[12]

"From the invariant frame of deciding well, there is a third group. This group will report that the best means of computing π to one googol decimal places is to pursue the invariant end of deciding well, hence to pursue the virtuous circle of good people and good products. Over time, pursuing this virtuous circle will yield general purpose computing tools capable of computing π to far beyond one trillion decimal places.

"These three responses to constraints we currently face in computing π suggest three distinct ways of thinking about policymaking. The first way suggests that policymakers ought to promote solutions to problems based on current or imagined knowledge. From this view, excellence in means concerns *efficiency at solving given problems*. We may call this the *engineering approach to policymaking*. The second way suggests that policymakers ought to leave the problem of overcoming constraints to people to work out for themselves. From this view, excellence in means concerns *fitness relative to the current state of an ever-changing environment*. We may call this the *biological approach to policymaking*. The third way suggests that policymakers ought to promote the invariant process of deciding well. From this view, excellence in means concerns *willingness and ability to pursue the invariant end of deciding well*. We may call this the *invariant approach to policymaking*.

"Associated with each of these three ways of thinking about policymaking is a distinct way of thinking about public order. From the engineering view, the role of policymakers is to find and solve public problems. The way policymakers define the problem and its solution provides them with a concept of order. In addressing their chosen problem and solution, policymakers impose their sense of order on the world. From this view, increasing public order is always good.

"From the biological view, the role of policymakers is to promote an environment that helps people find and solve problems that hinder them from increasing their ability to survive and thrive. Here, public order concerns the freedom of people to act on their current beliefs about how best to survive and thrive. Too much order shuts down the experimentation needed to increase fitness. Too little order also shuts down the experimentation needed to increase fitness. The best environment for increasing fitness calls for neither too much nor too little order. From this view, increasing public order is good when there is too little order and bad when there is too much order.

"From the invariant view, the role of policymakers is to promote an environment that helps people find and solve problems that hinder them from increasing their ability to survive and thrive. This goal of surviving and thriving is the same as that of the biological view. The difference is that policymakers understand that increasing our collective ability to survive and thrive involves improving our individual ability to pursue the invariant end of deciding

well. From this view, increasing *temporal public order* may be good or bad, but increasing *invariant public order* is always good."

"[11] Computer scientists Kanada, Ushio, and Kuroda computed pi to over 1.24 trillion decimal places in December 2002. See the Wolfram MathWorld entry on π digits <http://mathworld.wolfram.com/PiDigits> (26 August 2009)."

"[12] According to Thomas Sowell, when confronted with the complexities of life, those in the first group will tend to put their faith in the wisdom of experts and those in the second group will tend to put their faith in the wisdom of crowds, especially in the accumulated wisdom of the ages handed down to us in the form of language, culture, case law, and economic relations. For more on this see Thomas Sowell, *A Conflict of Visions: Ideological Origins of Political Struggles* (New York: William Morrow, 1987)."

was deleted.

Chapter 3, *Zero Public Entropy*, entire section

"***Zero Public Entropy***
Liquids that undergo phase changes as they become ever more fluid lie outside of our everyday experience. A dramatic example of such a liquid is that of the isotope of helium that has two neutrons and two electrons (helium-4). Helium-4 atoms are objects subject to quantum effects having integer spin, which physicists call bosons. Unlike objects subject to quantum effects having non-integer spin, which physicists call fermions, more than one boson can occupy the same quantum state. Statistically, this is unlikely to happen unless bosons enter their lowest energy state, which physicists call their *ground state*. As the temperature approaches absolute zero (0 degrees Kelvin), an ever larger number of ^{4}He atoms enter their ground state. At 2.172 degrees Kelvin, a large enough percentage of helium-4 atoms enter this state for the liquid to suddenly change from being only slightly more fluid than classical physics predicts to being much more fluid that classical physics predicts. In other words, liquid helium suddenly changes from being a fluid (Helium I) to a superfluid (Helium II).

"One lesson that we can learn from studying liquids like helium-4 is the usefulness of the concept of entropy in pursuing transcendental ends. Entropy is a measure of the amount of potentially available useful resources of a given type in an object. In modern thermodynamics, entropy is a measure of the potentially useful energy resources in a part of the world isolated from other parts of the world.[13] We pursue the transcendental end of *absolute zero temperature* in the isolated part of the world by removing useful energy from it. In invariant decision science, entropy is a measure of the potentially available non-knowledge wealth (resources useful in deciding well) in the process of deciding well. We pursue the transcendental end of *zero public entropy* by removing non-knowledge wealth from the process of deciding well.[14]

"We can use the concept of zero public entropy to help us find problems to solve. As we saw in the EOQ example, the concepts we use to frame our problems tend to blind us to finding

better problems to solve. In the team cycling example above, one such blinder is the association of "cycling" with "bicycling." This association tends to blind us to possibilities for substituting knowledge for non-knowledge resources in ways that would violate our concept of bicycling. These possibilities include regenerative breaking, boosting motors, and automated steering. A strategy based on lowering public entropy, which is to say a strategy based on removing ever more non-knowledge resources useful in deciding well from the endless process of deciding well, would reveal this problem.

"A more subtle blinder in the team cycling example is the false belief that we can separate the problem of cycling well from the problem of deciding well. For a team of cyclists to take a truly invariant approach to constraints, its solution to the problem cycling well must be part of the solution to the problem of deciding well. For this to be true, being part of the team must be something every team member needs to do in order to decide well rather than simply something every team member wants to do. Again, a strategy based on lowering public entropy, which is to say a strategy of removing ever more non-knowledge resources useful in deciding well from the process of deciding well, would reveal this problem. Here, we see how lowering public entropy creates a problem whose solution does not fit within the bounds of our chosen problem of cycling well. In general, lowering public entropy reveals not only problems whose solutions fall within the bounds of our chosen problem, but also problems whose solutions surpass the bounds of our chosen problem, thereby overturning the belief system that led us to choose the problem we chose. We may call the problems whose solutions fall within the bounds of our chosen problem *normal problems* and those that surpass the bounds of our chosen problem *revolutionary problems*."

"[13] Zero thermodynamic entropy is a transcendental object, which is to say something that we can define but can never achieve. To achieve zero thermodynamic entropy in a part of the world we would need to lower the temperature of that part of the world to absolute zero temperature. Lowering the temperature to absolute zero temperature in a part of the world calls for completely isolating that part of the world from the rest of the world, which is impossible."

"[14] Zero public entropy is the transcendental end of the process of inducing the creation of knowledge useful in deciding well, hence in governing ourselves well. As such, it is the process-of-deciding-well in which it is not possible to make any person behind the veil of complete ignorance better off. Students of modern economics may recognize this as the invariant equivalent of the state-of-the-world in which it is not possible to make one person better off without making another person worse off (Pareto optimality). For more on the process of inducing the creation of knowledge, see Appendix A."

was deleted.

Chapter 3, *The Decision Model Interpretation of Quantum Mechanics*, entire section

"***The Decision Model Interpretation of Quantum Mechanics***
Another lesson that we can learn from studying liquids like helium-4 is that we can use the knowledge of what happens as we approach such natural boundaries as absolute zero

temperature to help us understand subtle changes that happen far from these natural boundaries. By studying what happens in extreme cases, we can gain a deeper understanding of our everyday world. By studying what happens as we approach the transcendental end of absolute zero temperature, we may refine our beliefs about how what happens at the microscopic level of quantum mechanics affects what happens on the macroscopic level of the true sciences. Similarly, by studying what happens as we approach the transcendental end of absolute zero public entropy, we may refine our beliefs about how what happens on the microscopic level of quantum mechanics affects what happens on the macroscopic level of the public sciences.

"Although quantum mechanical models provide us with incredibly accurate statistical predictions about what will happen on the microscopic level, it does not provide us with exact predictions about what will happen on this level. This uncertainty is due to two strange behaviors of objects on this level. First, these objects can act either like waves or like particles. Second, pairs of these objects may become entangled in such a way that changing the state of one object instantaneously changes the state of the other object regardless of how distant the other object is. Rigorous empirical testing over many decades has failed to disprove the existence of these two strange behaviors.

"For more than seven decades physicists have been trying to interpret the mathematical models of quantum mechanics in ways that ring true with what they believe they know about causation on the macroscopic level. Most of these interpretations fall into one of three basic categories. The first of these basic categories contains interpretations that claim we should not waste resources trying to explain how objects at this level behave. We may call this the *Copenhagen interpretation* category. The second of these categories contains interpretations that claim that in time we will be able to find currently hidden variables that explain how objects at this level behave. We may call this the *hidden-variables interpretation* category. The third of these categories contains interpretations that claim that every possible way that an object can transition irreversibly from acting like a wave to acting like a particle actually happens. When one of these irreversible events happens, the world[15] splits into a world in which the event occurs and into another world in which the event does not occur. Following this logic, everything that could possibly have happened since the beginning of time has actually happened. We may call this the *many worlds interpretation* category.

"We can use the model of a decision tree[16] to imagine how to interpret quantum mechanics in a way that is most useful in pursuing the invariant end of deciding well.[17] We may think of all people seeking to decide perfectly as a single public entity seeking to decide perfectly. This suggests an interpretation of quantum mechanics that resembles a temporal mirror image of the many worlds interpretation. Rather than an ever expanding number of actual parallel worlds that make up the universe, there exists an ever shrinking number of currently possible future states-of-the-world that make up a single world. This single world consists of (1) a sequence of once current states-of-the-world, (2) a current state-of-the-world, and (3) a nearly infinite set of currently possible states-of-the-world. In other words, it consists of a past, a present, and a nearly infinite number of possible futures. We may call this forward-looking, boundlessly-pragmatic approach to quantum mechanics the *decision tree interpretation*.

"From the modern view of physics, the decision tree interpretation of quantum mechanics appears to ignore such things as constraints on deciding well imposed by relativity theory and information theory. In contrast, from the invariant frame of decision science, the decision tree interpretation sacrifices details about the world as we currently understand it in order to consider what we might learn. When we expand the problem of explaining quantum mechanics based on what we currently know about physics to the problem of explaining quantum mechanics based on all that can be known about the world, we sacrifice details about what we currently know about physics. Among these details are constraints on deciding well that concern the transmission and processing of information imposed by relativity theory and information theory. These details disappear into uncertain event nodes in decision trees. This is consistent with the purpose of decision tree models, which is to help us find and solve problems within the domain of public science.

"For a problem that falls within the domain of quantum mechanics, we ought to think like engineers, which is to say we ought to use the tools of quantum mechanics to solve the problem. For a problem that falls within the domain of modern physics, we ought to think like modern physicists, which is to say we ought to seek the truth within the domain of modern physics. For a problem that falls outside the domain of modern physics but within the domain of true science, we ought to think like true scientists, which is to say we ought to pursue the timeless end of believing well without regard for the other invariant factors of deciding well. For a problem that falls outside the domain of true science but within the domain of public science, we ought to think like public scientists, which is to say we ought to pursue the timeless end of believing well by pursuing all of the invariant factors of deciding well.[18]

"Consider the problem of whether to invest in a research program that has a goal of directly overcoming the constraint on deciding well imposed by relativity theory. From the view of modern physics, communicating at greater than light speed is impossible, hence investing in a research program to discover a way of communicating at greater than light speed would be foolish. From the view of true science, communicating at greater than light speed does not ring true with what else we know about physics, hence investing in such a research program would likely be foolish. From the view of public science, not only does communicating at greater than light speed not ring true with what else we know about physics, but also the net present value of the benefits of communicating at greater than light speed are currently likely to be small relative to the net present value of the cost of the research program, hence investing in such a research program would be even more likely to be foolish.[19]"

"[15] Note that the term 'world' here means what modern astronomers call the 'universe.' This use of the term 'world' allows us to reserve the term 'universe' for the set of parallel worlds created in the many worlds interpretation of quantum mechanics."

"[16] We may model deciding well as a tree consisting of events that change the course of events that the decider controls and events that change the course of events that the decider does not control. We may call the former *decision nodes* and the latter *uncertain event nodes*."

"[17] Implicit in this decision-oriented view of the world is belief that free will, which is to say in the power of people to change the course of history, exists. We currently have no empirical way of disproving that free will either exists or does not exist. However, we can logically determine that pursuing the invariant end of deciding well calls for us to believe that free will exists. If free will does not exist, we have no choice in what to believe; including whether to believe that free will exists or does not exist. We are as puppets in a shadow play. On the other hand, if free will exists, we have a choice in whether to believe that free will exists or does not exist. If we choose to believe that free will exists, we have a logical reason to try to pursue the invariant end of deciding well. If we choose to believe that free will does not exist, we will have no logical reason to try to pursue the invariant end of deciding well. From the invariant view of science, we ought to choose the research program that seeks to disprove the beautiful choice, which is that free will exists. This calls for us to act as if we believe that free will exists."

"[18] Following this reasoning, we can reconcile biological evolution with public science. If the problem we choose lies within the domain of modern biology, we ought to think like modern biologists. If this problem lies outside the domain of modern biology but within the domain of true science, we ought to think like true scientists. If the problem lies outside the domain of true science but within the domain of public science, we ought to think like public scientists. Choosing the right frames for solving our chosen problems is an important part of the process of pursuing the timeless end of believing well."

"[19] People on earth have little need to communicate with each other at greater than light speed. Arguably, if there are people elsewhere, they would be wise not to communicate with people on earth until people on earth learn what deciding well truly means."

was deleted.

Chapter 3, Conclusion, first paragraph

Changed "it calls for us to see" to "to see" in the last sentence.

Chapter 3, Conclusion, last paragraph

Changed "section" to "chapter" in the last sentence.

Chapter 3, Conclusion, last paragraph

Changed "section" to "chapter" in the last sentence.

Chapter 4, Promote Savings for Welfare, second paragraph, third through fifth sentences

"The universal welfare savings account would allow consumption tax-free withdrawals for qualified welfare expenses. These expenses would include retirement, medical, unemployment, and educational expenses for the owners of the account and their dependants. They would also include unlimited giving to private charities.[16]"

were changed to:

"The universal welfare savings account would allow tax-free withdrawals for medical, educational, and hardship-related expenses for the owners of the account and their dependants. They would also include unlimited giving to private charities.[16] All other withdrawals would be treated as consumption."

Appendix A, Less is More, first paragraph

Changed "efficiency experts" to "modern efficiency experts" in the fourth sentence.

Changes in Version 2010.09.30

Preface, second paragraph

Changed "actions" to "actions well" in the last sentence.

Preface, third and fourth paragraphs

"Some people will likely claim that I confuse seeking the truth with seeking wisdom . In making this claim, they confuse the temporal problem of seeking the truth and the temporal problem of seeking wisdom with the timeless problem of seeking both the truth and wisdom. In doing so, they confirm Albert Einstein's observation, "Perfection of means and confusion of ends seem to characterize our age."

"The spirit of our age concerns breaking unwieldy wholes into parts in order to solve problems better. We can see this process in modern science (reductionism), philosophy (analysis), and economics (the division of labor). A major disadvantage of using this process is forgetting to consider the infinitely greater whole. Although definite knowledge of this infinite whole, like definite knowledge of the transcendental number π, will remain forever beyond our grasp, we must not pass over it in silence. When we expand the scope of the problems we face to the limits of imagination, a structure of timeless ends emerges. Understanding the process by which we progress toward these ends can help us progress ever more readily."

were changed to:

"Some modern thinkers will claim that I confuse seeking the truth with seeking wisdom. In making this claim, they confuse the temporal problem of seeking the truth and the temporal problem of seeking wisdom with the timeless problem of seeking both the truth and wisdom. In doing so, they confirm Albert Einstein's observation, "Perfection of means and confusion of ends seem to characterize our age." This confusion arises from a deeply-ingrained cultural bias toward pursuing what we currently want rather than pursuing what we need to decide well. This temporal bias tends to blind us to making the best use of what we currently know."

Preface, new fourth paragraph

Changed "From a scientific view" to "To help us overcome this temporal bias" in the first sentence.

Preface, new sixth through thirteenth paragraphs

"To the extent that we decide well, so conceived, there is a direction to cultural evolution in people. This simple insight has profound implications for how we think about allocating resources:

Deciding well creates economic stress, the need to reallocate resources. If we decided perfectly, this stress would flow smoothly through the economic system until the system fully adjusted to the change that created it. Regrettably, we do not decide perfectly. Deciding less than perfectly creates or transfers wasteful stress, which in turn creates turbulence in the flow of economic resources. As the amount of such turbulence rises, we spend more time responding to it and less time deciding well in ways that create it. Conversely, as the amount falls, we spend less time responding to it and more time deciding well in ways that create it. If deciding imperfectly only created turbulence in the flow of resources, the amount of turbulence would tend toward a "natural" level. However, deciding imperfectly also embeds new mistakes into, or reinforces existing mistakes in, our networks of knowledge-in-use. Over time, deciding well releases stress "frozen" in these networks. These unpredictable releases of "frozen" stress tend to disrupt the "natural" level of turbulence.

"One conclusion we may draw from this simple model is that the modern, static concept of equilibrium based on what people currently know leads us to severely underestimate the probability of great turbulence. The cause of this great turbulence is the catastrophic release of embedded stress involved in moving toward a dynamic equilibrium based on pursuing the timeless end of deciding well. This claim is consistent with Benoit Mandelbrot's discovery that market price changes exhibit scale invariance.

"Another conclusion that we may draw is that responding to periods of great turbulence with policies that lower the quality of decision-making will create the conditions for even greater releases of stress in the future. Seeking to extend good times by lowering the quality of decisions is as shortsighted as seeking to prevent all forest fires. The choice we face is not between good times and bad times. It is rather between cycles of good times and bad times, and longer cycles of good times and wretched times. It took a devastating forest fire in Yellowstone National Park to change the prevailing view of how we ought to manage forests. It will likely take an equally devastating human catastrophe to change the prevailing view of how we ought to manage ourselves.

"This simple model of deciding well has as profound implications for how we think about believing well as it does for how we think about allocating resources well. The timeless end of believing well is one of the universal, boundless factors of deciding well. Following this simple model of deciding well, pursuing the timeless end of believing well calls for neither faith in experience per se, nor faith in something that transcends experience, but rather faith

in the pursuit of the timeless end of believing well. If we call the endless process of pursing the timeless end of believing well *science*, the basis of science is science. The whole of science is not, as Albert Einstein famously claimed, a refinement of everyday thinking, but rather the endless process of refining everyday thinking, which includes the process of refining the process of refining everyday thinking.

"One reason to believe that science ought to be an endless process concerns the logical problem of induction. Until we have experienced everything that can be experienced, we can never be certain that the general beliefs we induce from experience are true. On a deeper level, until we have experienced everything that can be experienced, we can never be certain that the concepts we invent to describe the world are the best concepts for describing the world. Consider the belief that all crows are black. The veracity of this belief depends on how we define the concepts we use to form this belief. Imagine that we encounter a new bird that appears to be a non-black crow. We can choose either to call this bird a crow, which would make the belief that all crows that exist are black false, or we can choose to call this bird something other than a crow, which would allow us to continue believing that all crows are black. Further, this uncertainty concerns not only the concepts we use to formulate the belief we are testing, but also the concepts we use to define these concepts, and the concepts we use to define these concepts, and the concepts we use to define these concepts, and so on. For example, the veracity of the belief that all crows are black depends on the meaning of "to be." Does this concept concern existence in (1) the current state of the world; (2) the history that led from the initial state of the world to the current state, the current state, and all future states accessible from the current state; or (3) the initial state of the world and all possible states accessible from the initial state?

"Another reason to believe that science ought to be an endless process concerns the physical problem that entangled pairs of quantum-level objects create for our ability to explain what happens in part of the world. What makes this especially important is the existence of systems in which the smallest of changes may lead to ever larger changes over time. An event as apparently inconsequential as a butterfly flapping its wings may not only change the weather on a distant continent, but also the planetary structure of a distant solar system.

"A third reason to believe that science ought to be an endless process concerns the practical problem of motivation. If we believe that free will does not exist, we believe that we are not free to choose either what to pursue or how best to pursue it. This belief does not motivate us to decide well, hence to explain what causes sensations of the world. On the other hand, if we believe that free will exists, we believe that we are free to choose what to pursue and how best to pursue it motivates us to decide well, hence to explain what causes sensations of the world. It also calls for us to expand the scope of this endless pursuit to include mental as well as physical objects. These mental objects include mental models of mental objects, hence mental models of mental models of mental objects, mental models of mental models of mental models of mental objects, and so on to infinity. If we choose the smallest problems we can imagine, we choose to deal with our ignorance of the world in the form of uncertain predictions. Today, this is the realm of quantum mechanics. If instead we choose the largest problem we can imagine, which is the problem that contains all other problems, we choose to deal with our ignorance of the world in the form of incomplete explanations. As we shall see,

this is the realm of the public sciences. Choosing the best problem to solve is a matter of balancing the costs of these two types of ignorance. These costs depend on the quality of the models we use to predict and explain sensations of the world."

were deleted.

Preface, new seventh through last paragraphs

"From the timeless view of science put forth in this work, deciding well calls for us to find and solve problems well. Models that help us predict sensations of the world help us solve given problems. Models that help us explain sensations of the world help us find problems to solve. The distinction between solving given problems and finding problems to solve depends on the scale of the problem we choose to solve.

"To improve the quality of the models we use to predict and explain our sensations of the world, we need means of judging these models. The pragmatic means of judging models that we use to predict sensations is to judge how well these models help us solve given problems. The pragmatic means of judging models that we use to explain sensations is to judge how well these models help us find problems to solve.

"From the temporal view of modern science, judging the models that we use to find problems to solve calls for us to judge models for helping us judge these models, judge models for helping us judge models for helping us judge these models, judge models for helping us judge models for helping us judge models for helping us judge these models, and so on to infinity. In contrast, from the timeless view of science put forth in this work, judging these models well calls for us to decide well in pursuing the timeless end of judging models well. Deciding well calls for us to judge both models that help us predict sensations of the world within the realm of the problem we choose to solve and models that explain sensations of the world. This holds true regardless of the size of the problem we choose to solve.

"Students of Western thought may find in this timeless concept of science a synthesis of the Platonic pursuit of knowledge of ideal forms and the Aristotelian pursuit of knowledge of natural forms. Like the Platonic pursuit, the pursuit of knowledge of universal, boundless factors of deciding well involves pursuing knowledge of ideal forms. Unlike the Platonic pursuit, it recognizes that its ideal forms are objects that we can never know completely. Like the Aristotelian pursuit, the pursuit of knowledge of these factors involves replicable patterns of reasoning. Unlike the Aristotelian pursuit, its rules for reasoning include not only rules that bind beliefs together into logical frameworks, but also rules for binding logical frameworks together into a coherent whole. These rules for reasoning concern not only logic but also symmetry.

"The timeless concept of deciding well put forth in this work exhibits two types of symmetry. First, the relations between the universal, boundless factors of deciding well have rotational symmetry. We can picture this symmetry in a diagram that uses line segments to represent the relations between universal, boundless factors of deciding well spaced equally around the circumference of a circle. Second, the pursuit of the timeless end of deciding well has

translational symmetry with respect to reference frames defined by beliefs and circumstances. When we expand the problems we face to the limits of imagination, our problems become part of the problem that contains all other problems. The solution to this universal problem, which is pursuing the timeless end of deciding well, is the same for all of us.

"From temporal views of science that conflate replicable reasoning and logic, a concept of reasoning that includes both logic and symmetry surpasses rationality. To use a term coined by Douglas Hofstadter to describe his strategy for competing well by cooperating well, it is *superrational*. In contrast, from the timeless view of invariant science, temporal views that conflate reasoning and logic are shortsighted. They concern learning about Plato's cave for its own sake rather than learning about it in order to learn how best to climb ever upward toward the timeless end and invariant factors of deciding well."

were changed to:

"This essential process of pursuing the timeless end of deciding well calls for us to find and solve problems well. Models that help us explain sensations of the world help us find problems to solve. Models that help us predict sensations of the world help us solve given problems.

"To improve the quality of the models we use to predict and explain our sensations of the world, we need means of judging these models. The pragmatic means of judging models is to judge them by their usefulness. We use models that help us explain sensations to find problems to solve. We ought to judge these models by how well they help us find problems to solve. We can do so by judging how well these models ring true with what we currently know about pursuing the timeless end of deciding well. This is *not* consistent with modern science. We use models that help us predict sensations to solve given problems. We ought to judge these models by how well they help us predict sensations. This is consistent with modern science.

"Students of Western thought may find in the pursuit of the timeless end of deciding well a synthesis of the Platonic pursuit of knowledge of ideal forms and the Aristotelian pursuit of knowledge of natural forms. Like the Platonic pursuit, the pursuit of the timeless end of deciding well involves pursuing knowledge of ideal forms. Unlike the Platonic pursuit, this pursuit is endless. We can never see the whole truth by the light of all that is good. Like the Aristotelian pursuit, the pursuit of the timeless end of deciding well involves replicable patterns of reasoning. Unlike the Aristotelian pursuit, this pursuit involves not only rules that bind beliefs together into logical frameworks, but also rules for binding logical frameworks together into a coherent whole. It involves not only logic but also symmetry across logical frameworks.

"From the timeless concept of deciding well put forth in this work, the essential pursuit of the timeless end of deciding well has translational symmetry with respect to reference frames defined by beliefs and circumstances. When we expand the scope of the problems we face to the limits of imagination, our problems become part of the problem that contains all other

problems. The solution to this universal problem, which is the essential process of pursuing the timeless end of deciding well, is the same for all of us. In mathematical terms, the essential pursuit of the timeless end of deciding well is *invariant* with respect to reference frames defined by beliefs and circumstances. As such, it is something that we discover rather than create.

"In this little book, I have tried to provide people with the intellectual tools they need to discover and use the essential process of pursuing the timeless end of deciding well. In the first chapter, I explain why making the most of what we know in pursuing the timeless end of living well calls for us to pursue the timeless end of deciding well. In the remaining four chapters, I describe logical frameworks useful in pursuing the timeless end of deciding well.

"In the chapter titled *Living Well*, I provide invariant alternatives to the modern economic concepts of wealth, consumption, trade, production, and profit. I go on to describe what I believe to be the information age equivalent of Adam Smith's virtuous circle of the division of labor and expansion of market size.

"In the chapter titled *Contemplating Well*, I explore the role of constraints in the pursuit of the timeless end of deciding well. This yields a number of unexpected tools. Notable among these "surprises" are a dynamic alternative to Pareto optimality and a decision-oriented interpretation of quantum mechanics.

"In the chapter titled *Believing Well*, I describe the process of refining everyday thinking. This includes invariant alternatives to the modern concepts of the natural sciences, the social sciences, and the humanities. Next I describe the process of refining the process of deciding well. This includes explanations of why the modern economic concept of equilibrium leads us to underestimate the probability of great turbulence and why seeking to extend good times by lowering the quality of decisions is as shortsighted as seeking to prevent all forest fires. I end the chapter with some brief reminders about pursuing the timeless end of believing well.

"In the chapter titled *Governing Ourselves Well*, I argue that it is useful to think of governments as timeless experiments that test the stories that we use to assign rights and responsibilities. I go on to argue that the best such story is the one that calls for us to pursue the timeless end of living well ever more wisely. I end the chapter with a brief description of the differences between timeless, modern, and classical liberalism.

"My hope in writing such a short book is that people will read it more than once, and that on each reading they will understand ever more of their own experiences in a better way."

Chapter 1, Useful Frames, second paragraph, footnote

Changed "(versus effectiveness) changes with the size of the subordinate problem chosen" to "changes with the size of the problem" in the first sentence.

Chapter 1, Temporal versus Invariant Values, fourth paragraph

Changed "Truth" to "timeless end of believing well" in the first sentence.

Changed "question" to "problem" in the seventh sentence.

Chapter 1, Overview, entire section

"**Overview**
In this chapter, we saw how the invariant concept of deciding well can help us pursue the invariant end of deciding well, and so all of the invariant factors of deciding well. In the remaining four chapters, we will see how this invariant concept can help us pursue the timeless ends of living well, contemplating well, believing well, and governing ourselves well. Each of these chapters presents a different aspect of the invariant process of deciding well."

was deleted.

Chapter 2, A Strategy for Learning, first paragraph

Changed "Toyota's" to "Today, Taiichi Ohno's" in the second sentence.

Chapter 3

Inserted a new chapter titled "Contemplating Well":

Contemplating Well

"Beauty is truth, truth beauty, — that is all ye know on earth, and all ye need to know." — *John Keats*

Pursuing the Ring of Truth

There is an ancient belief that equates truth with beauty. Nineteenth-century poet John Keats expressed this belief in the closing lines of his poem, "Ode on a Grecian Urn":

> "Beauty is truth, truth beauty, — that is all ye know on earth, and all ye need to know."[1]

Combining this ancient belief with the invariant concepts of pleasure and joy yields an invariant concept of beauty: *beauty is the quality of objects whose contemplation yields not only pleasure but also the joy that comes from improving how well our beliefs fit together into a coherent whole that is useful in pursuing the invariant end of deciding well.*

To give us pleasure, an activity must not be too easy or too hard. Too easy an activity bores us; too hard an activity overwhelms us. When the activity is contemplation, the object of contemplation must not be too simple or too hard to contemplate. Contemplating too simple an object bores us; contemplating too hard an object overwhelms us. Between what is boring and what is overwhelming is a level of difficulty that allows us to lose ourselves in contemplation. As we learn more, objects that once were too hard may bring us pleasure; and objects that once brought us pleasure may become boring. Learning about the structure of classical music may turn Beethoven's symphonies from being overwhelming to being beautiful. It may also turn pop music from being beautiful to being boring.

To give us joy, an activity must improve our state of being. When the activity is contemplation, the object of contemplation must be just novel enough for us to learn from it. If the object is not novel or too novel we will not learn from it. As we learn more, objects that once brought us joy become mundane and objects that were once too novel become beautiful. Before we learn calculus, Newton's theory of gravity is too novel to bring us joy. After we learn calculus, it has the potential to bring us joy. With use, it becomes just another tool.

From the invariant view of deciding well, pursuing the timeless end of believing well calls for us to pursue all of the invariant factors of deciding well. This is a benefit, not a burden. It provides us with a more certain way of testing problems before we attempt to solve them. If a problem is consistent with all of our beliefs about the invariant factors of deciding well, then it rings true. We have found a beautiful problem to solve.

Leaving Behind Modern Explanations

Pursuing the invariant end of deciding well calls for us to choose among a nearly infinite number of nearly infinite paths forward. Thinking deeply about these paths calls for us to leave behind modern models for explaining the world. In doing so, we become as sailors venturing beyond landfall. Fortunately, we can use the linguistic equivalent of transcendental recursive numbers to help us navigate these potentially maddening seas.

Transcendental recursive numbers are transcendental in that we cannot reduce them to algebraic expressions. In this sense, we can never know them completely. They are recursive in that they are the solution of at least one endlessly repeating cycle of steps in which the result of one cycle becomes the basis for the next cycle. The mathematical constant π is a transcendental recursive number. It is transcendental in that we cannot reduce it to an algebraic expression. It is a recursive in that we can theoretically know it by means of at least one endlessly repeating cycle of steps in which the result of one cycle becomes the basis for the next cycle.

We can imagine a set of transcendental recursive objects. These objects are transcendental in that we cannot reduce them to logical expressions. In this sense, we can never know them completely. They are recursive in that we can theoretically know them by means of at least one endlessly repeating cycle of steps in which the result of one cycle becomes the basis for the next cycle. Wisdom is a transcendental recursive object. Wisdom is transcendental in that we cannot reduce it to logical expressions. It is recursive in that we can theoretically know it by means of at least one endlessly repeating cycle of steps in which the result of one cycle becomes the basis for the next cycle.

We may think of the processes by which we come to know ever more about recursive numbers or objects as having three elements. The first of these elements is the process itself. In pursuing π, this process is any one of many means of computing π. In pursuing Wisdom, this process is deciding well.

The second of these elements is the transcendental end of the process. This end is complete knowledge of the recursive number or object. In computing π, the transcendental end is the ratio of the circumference of a Euclidean circle to its diameter. The form of this end is a number. In deciding well, the transcendental end is the knowledge that allows a perfectly wise being to decide perfectly well. The form of this end is the form of knowledge that is most useful to a perfectly wise being in deciding well.

The third of these elements is the timeless end of the process. The timeless end is that which we seek during the process. In computing π, the timeless end is ever better approximations of π. The form of this end is a number. In deciding well, the timeless end is ever better approximations of Wisdom. The form of this end is a set of incomplete descriptions of the world. These descriptions ought to be as simple as possible, but not simpler; and the set of descriptions ought to be as small as possible, but not smaller.[2]

Three Approaches to Overcoming Constraints

Pursuing the invariant end of deciding well calls for us to choose problems well, which in turn calls for us to think beautifully. The concept of thinking beautifully will likely seem strange to most modern readers. This is in part due to the modern habit of confusing our mental models with reality. We saw this in the EOQ example, in which modern managers confused the EOQ model with reality. We can also see it in the claim that we can compute π.

From the frame of mathematics, π is *computable*, which is to say that we can program all of the steps for computing π into a machine that does nothing more than follow logical instructions. In contrast, from the invariant frame of deciding well, π is not computable. The false claim that π is computable arises from reducing the actual problem of computing π to a theoretical problem of computing π.

Imagine giving the greatest scientific minds of 1776 the task of computing the value of π to one trillion (10^{12}) decimal places. The most likely result would be a description of the best tool for computing π in 1776 and the explanation that computing π to one trillion decimal places was possible in theory but impossible in practice. No one in 1776 imagined what we currently call supercomputers.[3]

Now imagine giving the greatest scientific minds of today the task of computing π to one googol (10^{100}) decimal places. Based on how they respond to this challenge, these people will likely fall into one of two basic groups. The first group will report how computing π to one googol decimal places might be done using currently existing or imagined tools. The second group will report that it is currently impossible to imagine what tools will first make computing π to one googol decimal places possible.[4]

From the invariant frame of deciding well, there is a third group. This group will report that the best means of computing π to one googol decimal places is to pursue the invariant end of deciding well, hence to pursue the virtuous circle of good people and good products. Over time, pursuing this virtuous circle will yield general purpose computing tools capable of computing π to far beyond one trillion decimal places.

Public Order

These three responses to constraints we currently face in computing π suggest three distinct ways of thinking about policymaking. The first way suggests that policymakers ought to promote solutions to problems based on currently existing or imagined knowledge. From this view, excellence in means concerns *efficiency at solving given problems*. We may call this the *engineering approach to policymaking*.

The second way suggests that policymakers ought to leave the problem of overcoming constraints to people to work out for themselves by means of the recombination of existing knowledge, the random creation of new knowledge, and unbounded competition in the marketplace of knowledge. From this view, excellence in means concerns *fitness for the environment*. We may call this the *biological approach to policymaking*.

The third way suggests that policymakers ought to promote the invariant process of deciding well. From this view, excellence in means concerns *willingness and ability to pursue the invariant end of deciding well*. We may call this the *invariant approach to policymaking*.

Associated with each of these three ways of thinking about policymaking is a distinct way of thinking about public order. From the engineering view, the role of policymakers is to find and solve public problems. The way policymakers define the problem and its solution provides them with a concept of order. In addressing their chosen problem and solution, policymakers impose their sense of order on the world. Hence, increasing public order is always good.

From the biological view, the role of policymakers is to promote an environment that helps people find and solve problems that hinder them from increasing their ability to survive and thrive. Here, public order concerns the freedom of people to act on their current beliefs about how best to survive and thrive. Either too much or too little public order shuts down the experimentation needed to increase fitness. Hence, increasing public order is good when there is too little of it and bad when there is too much of it.

From the invariant view, the role of policymakers is to promote an environment that helps people pursue the invariant end of deciding well. This gives rise to a timeless concept of public order, which we may call *invariant public order*. Pursuing invariant public order is always good.[5]

Invariant Public Order

Imagine a team cycling race in which we measure excellence by the average time it takes team members to complete a two hundred kilometer course. During this event, team members can interact only with one another and not with members of other teams. How should team members choose to order themselves?

Imagine how a team taking an engineering approach to policymaking would approach the problem of ordering themselves in this situation. The first task would be to reduce the ill-defined problem to a problem or set of problems that members of the team can solve. The simplest solution would be to choose a single public order for all conditions expected along the course. A refinement to this solution would be to choose different public orders for different conditions. There might be an order for traveling over flat terrain, another for traveling up hills, and a third for traveling down hills. Another refinement would be to develop procedures for rotating cyclists from more tiring positions to less tiring positions as they become tired within a given type of order. Yet another refinement would be to develop procedures for rotating cyclists from more tiring positions to less tiring positions when the team shifts between types of order. Over time, the team would refine their ability to maintain orders and to shift between these orders. To an outside observer, an accomplished team taking this approach would resemble an expert military drill team.

Imagine how a team taking a biological approach to policymaking would approach the problem of ordering themselves in this situation. Team members would develop relatively simple rules for overcoming constraints. Over time, they would learn ever better rules for overcoming constraints. To an outside observer, an accomplished team taking this approach would resemble a school of fish or a flock of birds.

Finally, imagine how a team taking the invariant approach to policymaking would approach the problem of ordering themselves in this situation. Team members would distinguish between the tactical end of cycling well based on what they currently know and the strategic end of deciding well. In addressing the tactical problem, they would choose to make the best use of current resources in addressing the tactical problem of cycling well. In addressing the strategic problem, they would seek ever better means of replacing non-knowledge resources useful in deciding well with knowledge resources useful in deciding well. In short, they would seek ever better means of deciding well.

In seeking ever better means of deciding well, the team would consider technological as well as organizational changes. One such change would be the combination of regenerative braking and boosting motors. This combination would allow cyclists to store otherwise wasted energy from cycling downhill to use when cycling uphill. Another such change would be a networked steering control system similar to experimental automated highway control systems that allow cars to travel bumper-to-bumper at high speeds. Such a system would execute tactical moves much more quickly and precisely than people can execute them. The combination of regenerative breaking, boosting motors, and automated steering would quickly lead to the development of a means of transferring power from one vehicle to another. This change would eliminate the need to rotate team members from tiring positions to less tiring positions. It would also allow the team to reduce wind resistance by putting cyclists who ride taller than others near the center of the pack. To a long-standing outside observer, an accomplished team taking the invariant approach to constraints would resemble a liquid that undergoes phase changes as it becomes ever more fluid.

Zero Public Entropy

Liquids that undergo phase changes as they become ever more fluid lie outside of our everyday

experience. A dramatic example of such a liquid is that of the isotope of helium that has two neutrons and two electrons (helium-4). Helium-4 atoms are objects subject to quantum effects having integer spin, which physicists call bosons. Unlike objects subject to quantum effects having non-integer spin, which physicists call fermions, more than one boson can occupy the same quantum state. Statistically, this is unlikely to happen unless bosons enter their lowest energy state, which physicists call their *ground state*. As the temperature approaches absolute zero (0 degrees Kelvin), an ever larger number of ^{4}He atoms enter their ground state. At 2.172 degrees Kelvin, a large enough percentage of helium-4 atoms enter this state for the liquid to suddenly change from being only slightly more fluid than classical physics predicts to being much more fluid that classical physics predicts. In other words, liquid helium suddenly changes from being a fluid (Helium I) to a superfluid (Helium II).

One lesson that we can learn from studying liquids like helium-4 is the usefulness of the concept of entropy in pursuing transcendental ends. Entropy is a measure of the amount of potentially available useful resources in an object. In modern thermodynamics, entropy is a measure of the potentially useful energy resources in a part of the world. We pursue the transcendental end of *zero thermodynamic entropy* by removing useful energy from a part of the world. In invariant decision science, entropy is a measure of the potentially available non-knowledge resources useful in deciding well in a process of deciding well. We pursue the transcendental end of *zero public entropy* by removing available non-knowledge resources useful in deciding well from a process of deciding well, thereby inducing the creation of knowledge resources useful in deciding well.[6]

We can use the concept of zero public entropy to help us find problems to solve. As we saw in the EOQ example, the concepts we use to frame our problems tend to blind us to finding better problems to solve. In the team cycling example above, one such blinder is the association of "cycling" with "bicycling." This association tends to blind us to possibilities for substituting knowledge for non-knowledge resources in ways that would violate our concept of bicycling. These possibilities include regenerative breaking, boosting motors, and automated steering. A strategy based on lowering public entropy, a strategy based on removing ever more non-knowledge resources useful in deciding well from the endless process of deciding well, would reveal this problem.

A more subtle blinder in the team cycling example is the false belief that we can separate the problem of cycling well from the problem of deciding well. For a team of cyclists to take a truly invariant approach to constraints, its solution to the problem cycling well must be part of the solution to the problem of deciding well. For this to be true, being part of the team must be something every team member needs to do in order to decide well rather than simply something every team member wants to do. Again, a strategy based on lowering public entropy, which is to say a strategy of removing ever more non-knowledge resources useful in deciding well from the process of deciding well, would reveal this problem. Here, we see how lowering public entropy creates a problem whose solution does not fit within the bounds of our chosen problem of cycling well. In general, lowering public entropy reveals not only problems whose solutions fall within the bounds of our chosen problem, but also problems whose solutions surpass the bounds of our chosen problem, thereby overturning the belief system that led us to choose the problem we chose. We may call the problems whose solutions fall within the bounds of our chosen

problem *normal problems* and those that surpass the bounds of our chosen problem *revolutionary problems*.

A Decision-Oriented Interpretation of Quantum Mechanics

Another lesson that we can learn from studying liquids like helium-4 is that we can use the knowledge of what happens as we approach such natural boundaries as absolute zero temperature to help us understand subtle changes that happen far from these natural boundaries. By studying what happens in extreme cases, we can gain a deeper understanding of our everyday world. By studying what happens as we approach the transcendental end of absolute zero temperature, we may refine our beliefs about how what happens at the microscopic level of quantum mechanics affects what happens on the macroscopic level of what we currently call the natural sciences. Similarly, by studying what happens as we approach the transcendental end of absolute zero public entropy, we may refine our beliefs about how what happens on the microscopic level of quantum mechanics affects what happens on the macroscopic level of decision science.

Although quantum mechanical models provide us with incredibly accurate statistical predictions about what will happen on the microscopic level, it does not provide us with exact predictions about what will happen on this level. This uncertainty is due to two strange behaviors of objects on this level. First, these objects can act either like waves or like particles. Second, pairs of these objects may become entangled in such a way that changing the state of one object instantaneously changes the state of the other object regardless of how distant the other object is. Rigorous empirical testing over many decades has failed to disprove the existence of these two strange behaviors.

For more than seven decades physicists have been trying to interpret the mathematical models of quantum mechanics in ways that ring true with what they believe they know about causation on the macroscopic level. Most of these interpretations fall into one of three basic categories. The first of these basic categories contains interpretations that claim we should not waste resources trying to explain how objects at this level behave. We may call this the *Copenhagen interpretation* category. The second of these categories contains interpretations that claim that in time we will be able to find currently hidden variables that explain how objects at this level behave. We may call this the *hidden-variables interpretation* category. The third of these categories contains interpretations that claim that every possible way that an object can transition irreversibly from acting like a wave to acting like a particle actually happens. When one of these irreversible events happens, the world[7] splits into a world in which the event occurs and into another world in which the event does not occur. Following this logic, everything that could possibly have happened since the beginning of time has actually happened. We may call this the *many worlds interpretation* category.

From the invariant view of deciding well, there is a fourth way we can interpret the quantum mechanics. It involves creating a new way of thinking about how we collectively decide well. If all people pursue the invariant end of deciding well, and do so well, we can treat all people as if they were a single decider. This allows us to use a decision tree model[8] to relate quantum mechanics to everyday thinking.[9] In this model the world consists of (1) a sequence of once current states-of-the-world, (2) a current state-of-the-world, and (3) a nearly infinite set of

currently possible states-of-the-world. In short, the world consists of a past, a present, and a nearly infinite number of possible futures. Every time a quantum object irreversibly transitions from acting like a wave to acting like a particle, the current state-of-the-world changes and a nearly infinite number of possible states-of-the-world cease to be possible states-of-the-world. We may call this forward-looking, boundlessly-pragmatic approach to interpreting quantum mechanics *the decision tree interpretation*.

From the modern view of physics, the decision tree interpretation of quantum mechanics appears to ignore such things as constraints on deciding well imposed by relativity theory and information theory. In contrast, from the invariant view of decision science, this interpretation hides details about the world as we currently understand it inside uncertain event objects (branch points). This is consistent with the purpose of decision tree models, which is to help us find and solve problems within the domain of the public sciences.

Consider the problem of whether to invest in a research program that has a goal of overcoming the constraint of communicating at greater than light speed. From the view of modern physics, communicating at greater than light speed is impossible; hence investing in a research program to discover a way of communicating at greater than light speed would be foolish. From the view of what we currently call the natural sciences, communicating at greater than light speed does not ring true with what else we currently know about physics; hence investing in such a research program would likely be foolish. From the view of decision science, the net present value of the benefits of communicating at greater than light speed are currently likely to be small compared to the net present value of the cost of the research program; hence investing in such a research program would likely be foolish. From the invariant view of deciding well, the most beautiful solution to the problem of whether to invest in this research program is the decision science solution.

The Elephant in the Room

One of the most beautiful things to emerge from pursuing the invariant end of deciding well is the relation between the invariant factors of deciding well and the values that people claim to seek when they seek to link or re-link with something infinitely greater than themselves.

The essential biological explanation of this coincidence is simple and straightforward. We evolved to have a religious need to become a part of something infinitely greater than ourselves. Seeking to satisfy this need is useful in securing the best chances of survival for our offspring and ourselves. We seek to satisfy this need by deciding well. We collectively refine our means of deciding well by deciding well over time. Deciding well and our understanding of deciding well co-evolve.

The essential theological explanation of this coincidence is as simple and straightforward. The Divine created us with the need to seek the Good, the Truth, Justice, Wisdom, and Beauty. We pursue these invariant values by deciding well. We collectively refine our means of deciding well by deciding well over time. Deciding well and our understanding of deciding well co-evolve.

Although these two essential explanations of this coincidence differ in their assumptions, they share the same means. Regardless of what core set of currently untestable beliefs, what personal faith, we choose to help us find the best problem to solve, the essential process of deciding well is the same for all of us. We are all as blind men seeking to know an infinitely large elephant.

[1] Keats, John "Ode on a Grecian Urn" in *The Oxford Book of English Verse 1250–1900*, A. T. Quiller-Couch, ed. (Oxford: Clarendon, 1919), reprinted in Bartelby.com, <http://www.bartelby.com/101/625.html> (30 September 2010).

[2] The inspiration for this belief about the timeless end of deciding well was Albert Einstein's belief about what he called the objective truth as expressed in his book, *The Evolution of Physics from Early Concepts to Relativity and Quanta* (New York: Simon and Schuster, 1966, p. 31): "Physical concepts are free creations of the human mind, and are not, however it may seem, uniquely determined by the external world. In our endeavor to understand reality we are somewhat like a man trying to understand the mechanism of a closed watch. He sees the face and the moving hands, even hears its ticking, but he has no way of opening the case. If he is ingenious he may form some picture of a mechanism which could be responsible for all the things he observes, but he may never be quite sure his picture is the only one which could explain his observations. He will never be able to compare his picture with the real mechanism and he cannot even imagine the possibility or the meaning of such a comparison. But he certainly believes that, as his knowledge increases, his picture of reality will become simpler and simpler and will explain a wider and wider range of his sensuous impressions. He may also believe in the existence of the ideal limit of knowledge and that it is approached by the human mind. He may call this ideal limit the objective truth."

[3] In December 20002, computer scientists Kanada, Ushio, and Kuroda computed pi to over 1.24 trillion decimal places. See the Wolfram MathWorld entry on π digits <http://mathworld.wolfram.com/PiDigits> (30 September 2010).

[4] According to Thomas Sowell, when confronted with the complexities of life, those in the first group will tend to put their faith in the wisdom of experts and those in the second group will tend to put their faith in the wisdom of crowds, especially in the accumulated wisdom of the ages handed down to us in the form of language, culture, case law, and economic relations. For more on this see Thomas Sowell, *A Conflict of Visions: Ideological Origins of Political Struggles* (New York: William Morrow, 1987).

[5] Zero public entropy is the transcendental end of the process of inducing the creation of knowledge useful in deciding well. It is the space-time equivalent of the state-of-the-world in which it is not possible to make one person better off without making another person worse off (Pareto optimality). From the view of a person behind the veil of complete ignorance, it is the ideal process of deciding well. For more on the process of inducing the creation of knowledge, see Appendix A.

[6] Note that the term 'world' here means what we commonly call the universe. This use of the term 'world' allows us to reserve the term 'universe' for the set of parallel worlds created in the many-worlds interpretation of quantum mechanics.

[7] We may model deciding well as a tree consisting of decision events and uncertain events. Decision events are events that change the course of events that the decider controls. Uncertain events are events that change the course of events that the decider does not control.

[8] Implicit in this decision-oriented model of the world is belief that free will exists. We currently have no empirical way of disproving that free will either exists or does not exist. However, we can logically determine that we ought to act as if free will exists: If free will does not exist, we have no choice in what to believe; including whether to believe that free will exists or does not exist. We are as puppets in a shadow play. On the other hand, if free will exists, we have a choice in whether to believe that free will exists or does not exist. If we choose to believe that free will exists, we have a logical reason to try to pursue the invariant end of deciding well. If we choose to believe that free will does not exist, we will have no logical reason to try to pursue the invariant end of deciding well. From the invariant view of deciding well, we ought to choose the research program that seeks to disprove the beautiful choice, which is that free will exists. This calls for us to act as if we believe that free will exists.

Chapter 4, Refining Everyday Thinking, ninth paragraph

Changed "living well" to "pursuing the timeless end of deciding well" in the fifth sentence.

Added the following footnote to the end of the last sentence:

"[3] In modern economic terms, this argument for a holistic approach to believing well concerns the demand side of believing well. Readers looking for supply-side arguments for a holistic approach to believing would do well to start with W. V. O. Quine's "Two Dogmas of Empiricism.""

Chapter 4, Refining Everyday Thinking, eleventh paragraph, last two sentences

"In contrast, from the invariant view of deciding well, science concerns not only what we are able to supply, but also what we need to decide well. These needs include the invariant factors of deciding well.[5]"

"[5] In modern economic terms, this argument for a holistic approach to believing well concerns the demand side of believing well. Readers looking for supply-side arguments for a holistic approach to believing would do well to start with W. V. O. Quine's "Two Dogmas of Empiricism.""

were changed to:

"In contrast, from the invariant view of deciding well, science concerns not only what we are able to supply, but also what we need to decide well.[5] Science is the self-similar, self-referential process of refining everyday thinking.[6]"

"[5] In modern economic terms, the argument for a holistic approach to believing well put forth in this book concerns the demand as well as the supply side of believing well. Readers

looking for supply-side arguments for a holistic approach to believing would do well to start with W. V. O. Quine's "Two Dogmas of Empiricism.""

"[6] The essential process of refining everyday thinking is self-similar in that it is the same regardless of what size problem we choose. It is self-referential in that it refers to itself. We may think of the essential process of refining everyday thinking as the essential process of ridding ourselves of ever more ignorance about the world. At the smallest problem scale that we can imagine, which currently is the problem scale of quantum mechanics, our ignorance takes the form of uncertain predictions. At the largest problem scale we can imagine, which is the problem that contains all other problems, our ignorance takes the form of incomplete descriptions of what we need to do in order to rid ourselves of ever more ignorance of the world. Between these two extremes, our ignorance takes the form of both uncertain predictions and incomplete descriptions of what we need to do in order to rid ourselves of ever more ignorance. In seeking to rid ourselves of ever more ignorance, we need to address both of these types of ignorance."

Chapter 4, Refining Everyday Thinking, last three paragraphs

"We can see the tendency of the modern view to blind us to timeless ends in the modern way of organizing academic fields into the *natural sciences*, the *social sciences*, and the *humanities*. From the modern view, which concerns what producers are able to supply under current constraints, this scheme makes sense. In contrast, from the invariant view of deciding well, this scheme does not make sense. To carve nature at its joints, we ought to replace these temporal categories with invariant categories. One possibility is to replace them with the *true sciences*, the *public sciences*, and the *arts*. Like the natural sciences, the true sciences would include all fields that seek to refine our beliefs about the Truth without concern for the Good, Justice, or Wisdom. Unlike the natural sciences, the true sciences would not imply that the beliefs and actions of people are not a part of nature.

"The public sciences would include all fields that seek to refine our beliefs about the Good, Justice, and Wisdom. The *moral sciences* would refine our beliefs about the Good; the *political sciences* would refine our beliefs about Justice; and the *decision sciences* would refine our beliefs about Wisdom. Unlike the social sciences, the public sciences would embrace the timeless end of revering life well.

"The arts would include all fields that aim at the ring of Truth rather than the Truth itself. Like the humanities, the arts would include what human beings create. Unlike the humanities, the arts aim to help us pursue Beauty, and so the Good, the Truth, Wisdom, and Justice.[7]"

were changed to:

"We can see the tendency of the modern view to blind us to timeless ends in the modern way of organizing academic fields into the *humanities*, the *social sciences*, and the *natural sciences*. From the modern view, which concerns what producers are able to supply under current constraints, this scheme makes sense. In contrast, from the invariant view of deciding

well, this scheme does not make sense. To carve nature at its joints, we ought to replace these temporal categories with invariant categories. One possibility is to replace them with the *arts*, the *public sciences*, and the *true sciences*. The arts would include all fields that aim at the ring of Truth rather than the Truth itself. Like the humanities, the arts would include what human beings create. Unlike the humanities, the arts aim to help us pursue Beauty, and so the Good, the Truth, Wisdom, and Justice.[7]

"The public sciences would include all fields that aim at the Truth about the invariant factors of deciding well other than the Truth. The *moral sciences* would refine our beliefs about living well; the *political sciences* would refine our beliefs about governing ourselves well; and the *decision sciences* would refine our beliefs about deciding well. Unlike the social sciences, the public sciences would embrace the timeless end of revering life well.

"The true sciences would include all fields that aim at the Truth about the Truth. Like the natural sciences, the true sciences would include all fields that seek to refine our beliefs about believing well without concern for the other invariant factors of deciding well. Unlike the natural sciences, the true sciences would not imply that the beliefs and actions of people are not a part of nature."

Chapter 4, Refining Deciding Well, first two paragraphs

"The invariant concept of science described above calls for us to refine the set of descriptions that we use to predict what will happen in public systems by how well they help us predict what will happen in these systems. We may begin to refine these descriptions by weeding out all descriptions that are not clear, concise, and logical. What remains is a set of precise descriptions that we use to predict what will happen in these systems. We may then refine this set by weeding out descriptions that fail to meet our (evolving) standards for helping us predict what will happen. What remains is a set of refined descriptions that we use to predict what will happen in these systems.[8]

"The invariant concept of science also calls for us to refine the set of descriptions that we use to explain what happens in the public systems we build to live and work together by how well they help us find temporal problems to solve. The rub is that we do not know exactly what it is that we ought to seek."

were changed to:

" The invariant concept of science described above calls for us to refine our beliefs about deciding well. This in turn calls for us to refine the models we use to help us predict how people will decide and the models we use to explain deciding well. We refine the models we use to help us predict how people will decide by weeding out all models that are not clear, concise, and logical. What remains is a set of precise models that we use to predict how people will decide. We further refine this set by weeding out models that fail to meet our (evolving) standards for helping us predict what will happen. What remains is a set of refined models that we use to predict how people will decide.[8]

"We refine the models we use to help us explain deciding well by weeding out all models that are not clear, concise, and logical. What remains is a set of precise descriptions that we use to explain deciding well. We further refine this set by weeding out models that fail to meet our (evolving) standards for helping us find temporal problems to solve. The rub is that we do not know exactly what it is that we ought to seek."

Chapter 4, Refining Deciding Well, fourth paragraph

Changed "descriptions" to "models" in all (2 occurrences).

Chapter 4, Refining Deciding Well, fourth paragraph, footnote

Changed "descriptions" to "models" in the fifth sentence.

Changed "any one" to "a single" in all (2 occurrences).

Chapter 4, Refining Deciding Well, fifth paragraph

Changed "stories" to "models" in the second sentence.

Changed "descriptions" to "models" in all (5 occurrences).

Chapter 4, Refining Deciding Well, last paragraph

Changed "descriptions" to "models" in all (2 occurrences).

Chapter 4, Conclusion, title

Changed "Conclusion" to "Useful Reminders."

Chapter 4, Useful Reminders, second paragraph

Changed "descriptions" to "models" in the third sentence (2 occurrences).

Chapter 5, A Sovereign Story of Boundless Pragmatism, title

Changed "Boundless Pragmatism" to "Deciding Well."

Appendix C

Added a new appendix titled "Competing Well":

Competing Well

"Supreme excellence consists in breaking the enemy's resistance without fighting." — *Sun Zi*[1]

If all of us were perfectly wise, we would all agree on which beliefs best help us pursue the invariant end of deciding well. Because none of us is perfectly wise, we not only disagree about these beliefs, but also about beliefs of all kinds. To settle these disagreements ever more wisely, we need a recursive process that concerns how to settle disagreements ever more wisely. We may call this recursive process *competing well* and the timeless end of this process *Winning*.

We pursue the timeless end of competing well by pursuing the timeless end of deciding well. We also pursue the timeless end of deciding well by pursuing the timeless end of competing well. Hence, the timeless end of competing well is an invariant factor of deciding well. Pursuing the timeless end of competing well (Winning) intertwines with pursuing the timeless ends of living well (the Good), believing well (the Truth), contemplating well (Beauty), governing ourselves well (Justice), deciding well (Wisdom), and revering life well (Wholeness). The better we decide, the more tightly these pursuits intertwine.

From the temporal view of deciding well, what we currently believe is always good, hence winning others over to what we currently believe is always good. In contrast, from the invariant view of deciding well, what we currently believe is not always what we need to believe in order to decide well, hence winning others over to what we currently believe is only good if what we currently believe is what we need to believe in order to decide well. Pursuing the timeless end of competing well calls not only for winning only those battles in which we are on the right side, but also for winning over people who do not share these beliefs in the way that is most conducive to pursuing the invariant end of deciding well. Supreme excellence consists not only in being on the right side, but also in breaking the enemy's resistance without fighting. The surest means of achieving this goal is for all people to *knowingly* pursue the invariant end of deciding well.

[1] Sunzi, *The Art of War*, trans. by Lionel Giles (London: Luzac, 1910), part III, paragraph 2, available online at Project Gutenberg, <http://www.gutenberg.org/catalog> (30 September 2010).

Changes in Version 2010.11.11

Preface, first paragraph

Changed "essay" to "book" and "thirty" to "thirty-two" in the first sentence.

Preface, fourth paragraph

Changed "values" to "timeless ends" in the second to last sentence.

Changed "timeless ends" to "ends" in the last sentence.

Removed the block quote format.

Preface, fifth paragraph

"I wrote this essay to help people find better problems to solve, particularly those that concern how to prepare for unexpected problems. In the first section, I explain why it is important to distinguish between temporal and timeless ends. I go on to develop a timeless concept of deciding well that is independent of our beliefs and circumstances. In the balance of the essay, I apply this universal, unvarying concept of deciding well to the endless pursuits of living well, believing well, and governing ourselves well."

was deleted.

Preface, new eighth paragraph, last sentence

"It involves not only logic but also symmetry across conceptual frameworks."

was changed to:

"It involves not only logic but also coherence. The source of this coherence is the symmetry of pursuing the timeless end of deciding well."

Preface, new tenth paragraph

Changed "logical frameworks" to "timeless logical frameworks" in the last sentence.

Preface, second to last paragraph

Changed "timeless, modern" to "invariant, modern American" in the last sentence.

Chapter 3, *Three Approaches to Constraints*, fourth paragraph

"Now imagine giving the greatest scientific minds of today the task of computing π to one googol (10^{100}) decimal places. Based on how they respond to this challenge, these people will likely fall into one of two basic groups. The first group will report how computing π to one googol decimal places might be done using currently existing or imagined tools. The second group will report that it is currently impossible to imagine what tools will first make computing π to one googol decimal places possible."

was changed to:

"Now imagine giving the greatest scientific minds of today the task of computing π to one googol (10^{100}) decimal places. Based on how they respond to this challenge, these people will likely fall into one of two basic groups. The first group will report how computing π to one googol decimal places might be done using currently existing or imagined computing tools. Because this approach relies on currently existing or imagined tools to pursue our chosen

ends, we may call it *the temporal approach to overcoming constraints*. The second group will report that it is currently impossible to imagine what computing tools will first make computing π to one googol decimal places possible. Because this approach relies on endless competition to produce the tools we need to pursue our chosen ends, we may call it *the timeless approach to overcoming constraints*."

Chapter 3, *Three Approaches to Constraints*, last paragraph, last sentence

"Over time, pursuing this virtuous circle will yield general purpose computing tools capable of computing π to far beyond one trillion decimal places."

was changed to:

"Over time, pursuing this virtuous circle will yield computing tools capable of computing π to far beyond one trillion decimal places. We may call this *the invariant approach to overcoming constraints*."

Chapter 3, *Public Order*, first three paragraphs

Changed "based on currently existing or imagined knowledge" to "based on using currently existing or imagined tools" in the second sentence.

"These three responses to constraints we currently face in computing π suggest three distinct ways of thinking about policymaking. The first way suggests that policymakers ought to promote solutions to problems based on currently existing or imagined knowledge. From this view, excellence in means concerns *efficiency at solving given problems*. We may call this the *engineering approach to policymaking*."

"The second way suggests that policymakers ought to leave the problem of overcoming constraints to people to work out for themselves by means of the recombination of existing knowledge, the random creation of new knowledge, and unbounded competition in the marketplace of knowledge. From this view, excellence in means concerns *fitness for the environment*. We may call this the *biological approach to policymaking*.

"The third way suggests that policymakers ought to promote the invariant process of deciding well. From this view, excellence in means concerns *willingness and ability to pursue the invariant end of deciding well*. We may call this the *invariant approach to policymaking*."

were changed to:

"These three approaches to overcoming constraints suggest three distinct approaches to policymaking. The temporal approach to overcoming constraints suggests that policymakers ought to promote solutions to problems that use currently existing or imagined tools. From this view, excellence in means concerns *efficiency at solving given problems*. We may call this the *engineering approach to policymaking*."

"The timeless approach to overcoming constraints suggests that policymakers ought to promote modern social science and leave the problem of overcoming constraints to the marketplace of ideas. From this view, excellence in means concerns *fitness for an ever changing environment created by people acting like social animals*. We may call this the *biological approach to policymaking*.

"The invariant approach to overcoming constraints suggests that policymakers ought to promote the invariant process of deciding well and leave the problem of overcoming constraints to the marketplace of ideas. From this view, excellence in means concerns *fitness for an ever changing environment created by people deciding ever more wisely*. We may call this the *invariant approach to policymaking*."

Chapter 4, Refining Everyday Thinking, tenth paragraph, second footnote

"[4] Note that this holistic definition of science reconciles W. V. O. Quine's belief that the philosophy of science is philosophy enough with Morton White's apparently contradictory belief that philosophy ought to include the whole of human experience. See White, Morton, *A Philosophy of Culture: The Scope of Holistic Pragmatism* (Princeton, NJ: Princeton University Press, 2002)."

was deleted.

Chapter 4, Refining Everyday Thinking, eleventh paragraph, last sentence

Added the following sentence:

"So conceived, the whole of science contains its own metascience.[6]"

"[6] Arguably, this process consists of four levels of frames. There are basic frames that we use to choose solutions to temporal problems. These frames are analogous to the scientific frames of modern science. There are also invariant frames that we use to choose temporal problems, timeless problems, and the means for choosing timeless problems. These frames are analogous to the metaphysical frames of modern science. However, these frames are subject to empirical testing. Hence, we may reasonably call them *metascientific frames*. Philosophers may find in this boundless approach to believing well parallels to W. V. O. Quine's naturalistic epistemology. A major difference is that the former embraces the whole of experience and the latter only embraces those aspects of experience that directly concern believing well. From the invariant view of deciding well, the incompleteness of Quine's epistemology gave rise to both Jaegwon Kim's criticism of Quine's epistemology for not having a normative element and Morton White's argument with Quine over the scope of holistic pragmatism. The philosophy of science is philosophy enough if and only if science includes the interwoven pursuits of all invariant factors of deciding well."

Chapter 5, Liberalism, first paragraph

Changed "timeless" to "invariant" in the last sentence (3 occurrences).

Chapter 5, Liberalism, second paragraph

Changed "Timeless" to "Invariant" in the first sentence.

Changed "modern" to "American" in the first sentence.

Changed "the modern liberal view" to "this modern" in the second sentence.

Chapter 5, Liberalism, third paragraph

Changed "Timeless" to "Invariant" in the first sentence.

Chapter 5, Liberalism, fourth paragraph

Changed "timeless" to "invariant" in the first sentence.

Chapter 5, Liberalism, fifth paragraph

Changed "timeless" to "invariant" in the first sentence.

Appendix B, *Einstein's Twin Warnings*, first paragraph

Changed "atheists" to "materialists" in first sentence.

Changed biblical quote from Revised Standard Version to New Revised Standard Version.

Deleted the last sentence:

"Atheists ought to heed Einstein's warning, "science without religion is lame.""

Appendix B, *Einstein's Twin Warnings*, second paragraph

Changed "theists" to "dualists" in the first sentence.

Changed biblical quote from Revised Standard Version to New Revised Standard Version.

Appendix B, *Einstein's Twin Warnings*, third paragraph

Changed "this belief in divine revelation" to "this belief" in the second sentence.

Changed "pronouncements of divine law are the word of the divine being" to "divine pronouncements are divine" in the third sentence.

Appendix B, *Einstein's Twin Warnings*, fourth paragraph

Merged the fourth paragraph into the third paragraph.

Appendix B, *Einstein's Twin Warnings*, last paragraph, last sentence

"Theists ought to heed Einstein's warning, "religion without science is blind.""

was changed to:

"Dualists as well as materialists ought to heed Einstein's twin warnings, "Science without religion is lame; religion without science is blind."

Appendix C, second paragraph

Deleted all parenthetical terms from the fourth sentence.

Changed "pursuits" to "endless pursuits" in the last sentence.

Appendix C, third paragraph

Changed "goal" to "temporal end" in the last sentence.

Changes in Version 2010.11.24

Preface, eighth paragraph

Deleted the second to last sentence: "It involves not only logic but also coherence."

Preface, tenth paragraph

Changed "four chapters" to "six chapters" in the last sentence.

Preface, last paragraph

Inserted the following paragraphs:

"In the chapter titled *Revering Life Well*, I describe a timeless spiritual end that both materialists and dualists can agree to pursue. In doing so, I expound on Einstein's twin claims that science without religion is lame and religion without science is blind.

"In the final chapter, *Competing Well*, I describe Douglas Hofstadter's concept of superrationality. I then explain why we ought to replace our current concept of rationality with a generalized form of Hofstadter's superrationality. I go on to use this general concept to show the limits of using John Boyd's idea of competing in time as a tool for helping us find problems to solve."

Chapter 1, Temporal versus Invariant Values, third to last paragraph, second footnote

Deleted the last sentence: "For more on revering life well, see Appendix B."

Appendices B and C

Promoted Appendices B and C to chapters 6 and 7.

Chapter 7, end

Added the following two sections:

The Scope of Reason

As we saw in the first chapter of this book, it is reasonable for us to use the concept of symmetry to help us find problems to solve in pursuing the invariant end of deciding well. The more beautiful a problem appears to us, the more likely it is a good problem to solve.

From the modern view of game theory, the invariant approach to finding problems to solve is irrational. In contrast, from the invariant view of deciding well, the modern approach to game theory is irrational. This disagreement arises from differing concepts of reason. From the modern view of game theory, reason is a matter of following the rules of logic. In contrast, from the invariant view of deciding well, reason is a matter of not only following the rules of logic, but also the rules of symmetry. We can see this difference in the problem that modern cognitive scientist Douglas Hofstadter used to introduce what he called *superrationality* to readers of his Scientific American column, *Metamagical Themas*.[2]

Hofstadter sent a registered letter out to twenty people asking them to play a one-time Prisoner's Dilemma game against each other. In each game, if both players cooperated each would receive $3; if both defected each would receive $1; and if one defected and the other cooperated, the defector would receive $5 and the cooperator would receive $0. Hofstadter told them that this was a one-time game and that, in his opinion, each player was equally bright. He asked them not to try to discuss this game with anyone, especially with other people who they thought might be other players. He also gave them several scenarios to make sure that they understood the game. He told them that if everyone cooperated, everyone would receive $57 (19 x $3). If everyone defected, everyone would receive $19 (19 x $1). If eleven people cooperate and nine people defect; then the cooperators will each get $30 (10 x $3 + 9 x $0) and the 9 defectors will each get $63 (11 x $5 + 8 x $1). He told them that defectors would always receive at least as much money as everyone else (hence would never be a "loser"), but that they should aim at getting as much money as possible rather than to be a "winner." He also told them that the ideal situation for any one player would be to be the single defector, in which case he or she would make $95 (19 x $5) and the others would each make $54 (18 x $3 + 1 x $0). Finally, he asked each player to tell him by telephone whether they wished to cooperate (C) or defect (D), and to explain why they chose as they did.[3]

From the modern view, the better solution to this game is to defect. The reason is that regardless of what the opposing player does, the deciding player is better off by defecting. If the opposing

player defects, cooperating yields nothing and defecting yields $1. If the opposing player cooperates, cooperating yields $3 and defecting yields $5. In contrast, Hofstadter suggests that all players consider the symmetry of the game as a whole before they settle on a strategy. Considering the game as a whole, each player can see that all players face the same problem and so should seek the same solution, which is the solution that provides the best payoff to each player. Again, if everyone cooperates, each player would get $57; and if everyone defects, each player would get $19. Hence, the better solution is to cooperate.

The actual results of Hofstadter's experiment in game theory were that six people chose to cooperate and fourteen chose to defect. Both groups received less than the $57 each would have received had all chosen to cooperate. The six cooperators each received $15 (5 x $3 + 14 x $0) and the fourteen defectors each received $43 (6 x $5 + 13 x $1). This result led Hofstadter to speculate that somewhere in the universe there are societies in which people compete by considering the symmetry of the whole before choosing a strategy. These "superrational" societies would tend to do better than "rational" societies.[4]

The players' reactions to the game were as interesting as the results themselves. An expert in modern game theory saw no reason to cooperate. A biologist was so sure that no one would cooperate that he began his phone call by announcing "Okay, Hofstadter, give me the $19." A physicist reported that he wanted to cooperate, but said that he couldn't find any way of justifying it. Another player became so frustrated that he ended up flipping a coin to determine whether to cooperate or defect.[5] These reactions are typical of how people react to perceptual and cognitive dissonance. Nearly thirty years on, the conceptual problem underlying this dissonance has remained unresolved.

From the invariant view of deciding well, this dissonance is the result of using modern game theory to explain what people will do. We may use modern game theory to help us predict what social animals will do. However, we ought never to use modern game theory to help us explain what people do. To do so would be to prescribe that people ought to act like social animals rather than wise people.

Consider the reaction of the former author of the Scientific American *Mathematical Games* column, Martin Gardner, to Hofstadter's game:

"Horrible dilemma. I really don't know what to do about it. If I wanted to maximize my money, I would choose to D and expect that others would also; to maximize satisfaction, I'd choose C, and hope other people would do the same (by the Kantian imperative). I don't know, though, how one should behave *rationally*. You get into endless regresses: 'If they all do X, then I should do Y, but then they'll anticipate that and do Z, and so...' You get trapped in an endless whirlpool."[6]

Gardner recognized that the problem players face in Hofstadter's game is how best to frame the problem. From the invariant view of deciding well, we best frame this problem by making the problem of framing this problem part of the problem we are trying to solve. This creates an endless loop: How do we choose the best frame? We choose the frame that best helps us decide well. How do we choose the best frame for choosing the best frame? We choose the frame that best helps us decide well. How do we choose the best frame for choosing the best frame for

choosing the best frame? We choose the frame that best helps us decide well... Regardless of how many times we cycle through this endless loop, the answer is always that we choose the frame that best helps us decide well. From a purely logical view, this gets us nowhere. Each time we cycle through the loop, we end up back at our starting point. However, from the invariant view of deciding well, each time we cycle through this loop, we expand the scope of the problem we are seeking to solve. This is consistent with Dwight Eisenhower's maxim, "If a problem cannot be solved, enlarge it." Taking this advice to its logical limit, we end with the problem that contains all other problems. We best address this universal problem by pursuing the invariant end of deciding well. Within Hofstadter's game, we best pursue this timeless end by choosing the more beautiful temporal problem to solve, which is the temporal problem that calls for us to cooperate well. This temporal problem has us act like wise people rather than social animals.

From the invariant view of deciding well, Hofstadter discovered an anomaly in modern game theory as a tool for helping us find problems to solve, but did not put forth a viable alternative to modern game theory as a tool for helping us find problems to solve: He showed us a procedure that changes us from acting like social animals to acting like wise people. However, he did so using language that discouraged us from using this procedure.[7] He told players to aim at getting the most money. He might instead have told them to act in their own best interest. He told players that they were all equally bright. He might instead have told them that they were equally wise, hence equally good, true, and just. He emphasized the one-time nature of the game. He might instead have emphasized how current choices foreclose paths forward. In explaining what he had discovered, he distinguished between "rational" defectors and "superrational" cooperators.[8] He might instead have distinguished between "incoherent" defectors and "rational" cooperators. He might have changed the concept of excellence in thinking, which we commonly call "rationality," from a concept based on logic to one based on both logic and symmetry.

The concept of excellence in thinking is one of the most important concepts in our belief systems. Changing the meaning of this key concept calls for us to restructure our entire belief system. People will tend to make these changes when they expect the benefits of making them to exceed the costs of making them. The expected benefit of making these changes increases with the size of the problem on which we base our expectations. In contrast, the expected cost of making these changes remains the same regardless of the size of the problem on which we choose to base our expectations. Hence, the larger the scope of the problem on which we base our expectations, the more likely we are to make these changes. For example, if we base our expectations on the problem that contains all other problems, we will likely make these changes; but if we base our expectations on Hofstadter's one-time game, we will likely not make them.[9]

When combined with the inexhaustibility of knowledge, the tendency to adapt an ever more expansive and coherent view of the problems we face suggests a natural dynamic in the evolution of culture:

People who take a more expansive and coherent view of the problems they face tend to make better use of knowledge of how to live well than do their competitors. This affects their competitors in two ways. First, it provides competitors with an example of how to live better in the current environment. Second, it changes the environment in a way that is relatively better for people who take a more expansive and coherent view than those who take a less expansive and

coherent view. In particular, it increases the pace of change. This shortens the time people have to adapt to change, which in turn increases the value of knowledge related to adapting to change. This knowledge includes knowledge of what people need in order to adapt well to a wide variety of possible changes. People acquire this knowledge by taking a more expansive and coherent view of the problems they face.

This natural dynamic calls for us to learn ever more about what ends we ought to pursue, which in turn calls for us to use a concept of rationality that considers not only logic but also the symmetry of pursuing the invariant end of deciding well.[10]

The Scope of Strategy

The virtuous circle between the pursuit of the invariant end of deciding well and the pace of change suggests a strategy for competing well by pursuing the invariant end of deciding well ever more quickly. We can view this strategy as the invariant counterpart to the timeless approach to competing well by pursuing the timeless end of deciding well ever more quickly. [Stub of a longer section.]

[2] *Metamagical Themas* is an anagram of *Mathematical Games*, the title of the Scientific American column Martin Gardner wrote from 1956 through 1980. Hofstadter wrote this column from January 1981 until July 1983. Many of these columns expand on themes he originally put forth in his book, *Gödel, Escher, Bach, An Eternal Golden Braid*.

[3] Hofstadter, Douglas *Metamagical Themas, Questing for the Essence of Mind and Pattern* (New York: Basic Books 1985), pp. 740–1.

[4] Ibid., p. 764.

[5] Ibid., pp. 742–3.

[6] Ibid.

[7] Ibid.

[8] Ibid., pp.739-55.

[9] This is not to say that people make such calculations before they change their belief systems. It is only to say that they tend to act as if they do.

[10] As we have seen throughout this work, learning ever more about what ends we ought to pursue conflicts with temporal views of competing well, which do not allow for learning. Learning ever more about what ends we ought to pursue also conflicts with timeless views of competing well, which allow for learning ever more about means but not about ends. We can see this limitation in timeless social science models, which concern the evolution of cooperation. We can also see this limitation in timeless biological models, which concern how species pursue the timeless end of living well. When used as tools for helping people find problems to solve, both of these types of timeless models tend to blind us to pursuing all invariant factors of deciding well. We can avoid

being blinded by the models we use to find problems to solve by using invariant models to help us find problems to solve. These models use a concept of rationality that considers symmetry as well as logic.

Chapter 5, Summary and Conclusion, entire section

Moved this section to the end of the seventh chapter.

Changes in Version 2010.11.29

Chapter 3, *A Decision-Oriented Interpretation of Quantum Mechanics*, title

Changed "***A* Decision-Oriented Interpretation**" to "***Decision-Oriented Interpretations***."

Chapter 3, *Decision-Oriented Interpretations of Quantum Mechanics*, fifth paragraph

Changed "uncertain event objects (branch points)" to "the model" in the second sentence.

Chapter 7, Summary and Conclusion, entire section

Promoted the section to become the eighth chapter, introduced by the following Hayek quote from the conclusion of *The Road to Serfdom*: "We shall not grow wiser before we learn that much that we have done was very foolish."

Chapter 7, The Scope of Reason, first paragraph

Changed "lot" to "life" in the second sentence.

Changes in Version 2010.12.31

Preface, second to last paragraph

"In the final chapter, *Competing Well*, I describe Douglas Hofstadter's modern game theory anomaly, in which he uses a concept of excellence in thinking that supersedes modern rationality to produce superior outcomes in symmetrical games. I then expand this concept of excellence in thinking to the limits of imagination. The result is an invariant concept of rationality, which is based not only on logic but also on the symmetry of the pursuing the invariant end of deciding well. I go on to use this invariant concept to expose the limitations of using John Boyd's idea of competing in time as a tool for helping us find problems to solve."

were changed to:

"In the final chapter, *Competing Well*, I explain why we ought to replace our current concept of rationality with a generalized form of Douglas Hofstadter's concept of superrationality. I go on to refine John Boyd's grand strategy for competing in time."

Chapter 1, Useful Frames, first paragraph, footnote, last two sentences

"The term 'normative' emphasizes that we owe it to ourselves (ought) to pursue what is truly good for us. As we shall see, the term 'timeless' emphasizes the process of pursuing what is truly good for us."

were changed to:

"The term 'normative' emphasizes that we owe it to ourselves (ought) to pursue such ends. In contrast, the term 'timeless' emphasizes that the process of pursuing such ends is not bounded in time."

Chapter 1, The EOQ/RTS Example, last paragraph, footnote

Changed "Appendix A" to "the appendix" in the first sentence.

Chapter 3, *Zero Public Entropy*, second paragraph, footnote

Changed "Appendix A" to "the appendix" in the last sentence.

Chapter 4, Refining Everyday Thinking, eleventh paragraph, last footnote

Changed "four" to "two" in the first sentence.

Chapter 6, *Einstein's Twin Warnings*, last paragraph, third sentence

Inserted the following sentence:

"His house has room for good Samaritans."

Chapter 7, title

Changed "Sun Zi" to "Sunzi" in the attribution portion of the quotation.

Chapter 7, The Scope of Strategy, first paragraph

"The virtuous circle between the pursuit of the invariant end of deciding well and the pace of change suggests a strategy for competing well by pursuing the invariant end of deciding well ever more quickly. We can view this strategy as the invariant counterpart to the timeless

approach to competing well by pursuing the timeless end of deciding well ever more quickly. [Stub of a longer section.]"

was changed to:

"The most important development in strategic thinking in the second half of the twentieth century was the idea of competing well by deciding well ever more quickly. The person most responsible for this idea was a United States Air Force (USAF) fighter pilot named John Boyd.

"***Prelude to Boyd's Idea of Competing in Time***
The development of Boyd's ideas about competing well by deciding well ever more quickly began with a combat tour as an F-86 Sabre pilot in waning months of the kinetic phase of the Korean War. After returning from Korea, he was assigned to Nellis Air Force Base for further instruction. His skills were such that he stayed on as an instructor at the Fighter Weapons School. In the final months of his six years at Nellis, he wrote a manual on aerial combat, which became the handbook for close-in aerial combat tactics in the United States, and after it was declassified, around the world.[11]

"In 1961, the USAF offered Boyd a chance to return to college to earn a graduate degree to supplement his undergraduate degree in business and economics from the University of Iowa. He instead decided to earn an undergraduate degree in industrial engineering from George Tech University. While trying to explain what he did as a fighter pilot to a fellow student, Boyd used thermodynamic terms to describe close-in aerial combat. His extended metaphor worked so well that he decided to reduce close-in aerial combat to energy relations. He later worked with mathematician Tom Christie to refine what became known as Energy-Maneuverability (E-M) theory.[12]

"E-M theory revolutionized not only the way people think about close-in aerial combat, but also the way people design fighter aircraft. Using E-M theory, Boyd predicted that the then current American fighter planes were inferior to their Soviet counterparts in most close-in aerial combat situations. The acceptance of E-M theory lead the USAF to assign him to the F-X program. Boyd believed that the plane the USAF wanted, which was a massive, multirole, single-seat, swing-wing fighter, would do very poorly against Soviet fighters. In its place, he recommended a fixed-wing, lightweight fighter optimized for aerial combat. Facing the threat of being forced to purchase the Navy's swing-wing F-14 Tomcat rather than their swing-wing FX design, the USAF decided to change their F-X design to a smaller, fixed-wing air superiority fighter. This design became the F-15 Eagle.[13]

"Boyd believed that the F-15 Eagle was both too large and too expensive. With the help of Pierre Sprey, Everest Riccioni, and other members of what Riccioni called "the fighter mafia," Boyd was able to convince enough people within the military industrial complex to proceed with developing two lightweight fighter prototypes, the YF-16 and YF-17. "The fighter mafia" and their allies were later able to force the USAF to buy the YF-16. During the development process, the USAF changed the YF-16 from an inexpensive air-superiority fighter into a moderately expensive multirole fighter, the F-16 Fighting Falcon. The Navy

eventually purchased a larger and more expensive multirole fighter based on the YF-17 design, the F-18 Hornet.[14]

"***Temporal OODA Loop Analysis***
In 1975, Boyd officially retired from the USAF as a full colonel. He planned to refine his ideas about aerial combat and develop his ideas about how and why people learn. His friend and fellow defense reformer Pierre Sprey encouraged him to develop his ideas on maneuver warfare. Given his talents as a synthesizer of ideas, Boyd saw how each of these three issues fit into the larger problem of how best to pursue the timeless end of competing well by deciding well ever more quickly.

"Boyd intuitively grasped that deciding well was a self-referential, self-similar process based on a decision cycle. Unlike the decision cycle put forth is this work, which concerns the essential sequence of finding a problem to solve, solving the problem, and learning from the experience; his essential sequence concerns observing the world, orienting oneself in the world, deciding on a course of action, and acting. He called this observe-orient-decide-act decision cycle an *OODA loop*.

"We can use Boyd's OODA loop model to solve temporal problems.[15] One such problem is the problem of predicting the performance of fighter planes in close-in aerial combat. Although we can use E-M theory to do this, there are cases in which E-M theory fails to predict well. The case that most concerned Boyd was the discrepancy between the actual and theoretical results of combat between F-86 pilots and MiG-16 pilots during the kinetic phase of the Korean War. According to E-M theory, F-86 pilots should not have been as successful against MiG-16 pilots as they were. The stock answer for this theoretical anomaly was that F-86 pilots were better trained and had more experience than MiG-15 pilots. While this was true in combat against most North Korean and Chinese pilots, it was not true against most Soviet pilots. Boyd used his OODA loop model to look deeper. He concluded that F-86 pilots were able to overcome the relative deficiencies in their airplanes that E-M theory exposed with g-suits, a bubble canopy for better visibility, and a hydraulic control system that was both more responsive and less physically taxing. These factors allowed F-86 pilots to observe, orient, decide, and act more quickly than their opponents. Unlike American P-38 pilots fighting against Japanese pilots in slower, but more maneuverable fighter planes a decade earlier, F-86 pilots fighting MiG-15 pilots were not limited to a single tactic. This made them appear more unpredictable and threatening to their opponents. It also made it possible to "get inside the decision cycles" of their opponents, where they could remain relatively safe until their opponents made an exploitable mistake.[16]

"***Timeless OODA Loops***
Boyd also used his OODA loop model to solve problems in which learning was important. This called for (1) defining a timeless end of competing well; (2) adding a learning function to the "temporal" OODA loop model; and (3) defining our relations with each other. Boyd (1) defined his concept of the timeless end of competing well to be surviving on our own terms; (2) expanded the orientation element in the OODA loop to include a learning function that includes not only our past experiences and new information (from our recent experiences), but also our genetic heritage, cultural traditions, and tools for analyzing and

synthesizing; and (3) argued that we form groups on all scales in order better to survive on our own terms.

"Boyd recognized that pursuing the timeless end of competing well (Winning) created different types of problems at different problem scales. He listed these types of problems in slide #141 of his *Patterns of Conflict* briefing:

Pattern

- **National goal**

Improve our fitness, as an organic whole, to shape and cope with an ever-changing environment.

- **Grand strategy**

Shape pursuit of national goal so that we not only amplify our spirit and strength (while undermining and isolating our adversaries) but also influence the uncommitted or potential adversaries so that they are drawn toward our philosophy and are empathetic toward our success.

- **Strategic aim**

Diminish adversary's capacity while improving our capacity to adapt as an organic whole, so that our adversary cannot cope—while we can cope—with events/efforts as they unfold.

- **Strategy**

Penetrate adversary's moral-mental-physical being to dissolve his moral fiber, disorient his mental images, disrupt his operations, and overload his system, as well as subvert, shatter, seize, or otherwise subdue those moral-mental-physical bastions, connections, or activities that he depends upon, in order to destroy internal harmony, produce paralysis, and collapse adversary's will to resist.

- **Grand tactics**

Operate inside adversary's observation-orientation-decision-action loops, or get inside his mind-time-space, to create tangles of threatening and/or non-threatening events/efforts as well as repeatedly generate mismatches between those events/efforts adversary observes, or imagines, and those he must react to, to survive;

thereby

Enmesh adversary in an amorphous, menacing, and unpredictable world of uncertainty, doubt, mistrust, confusion, disorder, fear, panic, chaos … and/or fold adversary back inside himself;

thereby

Maneuver adversary beyond his moral-mental-physical capacity to adapt or endure so that he can neither divine our intentions nor focus his efforts to cope with the unfolding strategic design or related decisive strokes as they penetrate, splinter, isolate or envelop, and overwhelm him.

- **Tactics**

Observe-orient-decide-act more inconspicuously, more quickly, and with more irregularity as basis to keep or gain initiative as well as shape and shift main effort: to repeatedly and unexpectedly penetrate vulnerabilities and weaknesses exposed by that effort or other effort(s) that tie-up, divert, or drain-away adversary attention (and strength) elsewhere.

> "Boyd used this pattern of problems to formulate the strategy for Operation Desert Storm. Marine Corps commandant General Charles Krulak wrote of his contribution, "The Iraqi army collapsed morally and intellectually under the onslaught of American and Coalition forces. John Boyd was an architect of that victory as surely as if he'd commanded a fighter wing or a maneuver division in the desert. His thinking, his theories, his larger than life influence, were there with us in Desert Storm."[17]
>
> "***Boyd's Grand Strategy***
> Boyd called for a grand strategy based on "a grand ideal, overarching theme, or noble philosophy that represents a coherent paradigm within which individuals as well as societies can shape and adapt to unfolding circumstances—yet offers a way to expose flaws of competing or adversary systems."[18] His advice for formulating such a grand strategy was in the form of a list of desirable products, which he called ingredients:

- **Insight**

Ability to peer into and discern the inner nature or workings of things.

- **Initiative**

Internal drive to think and take action without being urged.

- **Adaptability**

Power to adjust or change in order to cope with new or unforeseen circumstances.

- **Harmony**

Power to perceive or create interaction of apparently disconnected events or entities in a connected way.[19]

> "Boyd did not provide us with a clear and concise definition of a grand strategy that rings true with pursuing the timeless ends of deciding well (Wisdom), living well (the Good), contemplating well (Beauty), believing well (the Truth), cooperating well (Justice), and revering life well (Wholeness). From his thoroughly biological view, these timeless ends are nothing more than figments of our imaginations. They are things that we invent rather than discover.[20]

"***The Grandest Possible Strategy***
To compete well, we need to consider the spatial boundaries that define the field. In the game of Reversi (Othello), the boundaries make the corner positions immune from attack. In the battle of Thermopylae, the boundaries defined by the Athenian controlled Gulf of Malia and the shoreline cliffs protected the Spartans and their allies from attack from the north and south.

"To compete well, we also need to consider the temporal boundaries that define the field. As John Boyd has shown us, people who are able to decide well more quickly can prevail by getting inside their competitors' decision cycles.

"To compete well, we must not neglect to consider the moral boundaries that define the field. In battles for hearts and minds, groups of people who adopt a grander, nobler strategy take the higher moral ground, and so tend to be more successful in attracting the uncommitted; in magnifying their own spirit and strength; and in undermining the dedication and determination of their adversaries.[21]

"The grandest possible strategy is the strategy of pursuing the timeless ends of deciding well, living well, contemplating well, believing well, cooperating well, and revering life well.[22] We may call this *the invariant strategy*.

"Adopting the invariant strategy calls for making the national goal subordinate to the grand strategy. From the theistic view of Abraham Lincoln, nations ought not to be concerned about whether God is on their side; but rather about being on the right side, for God is always right. Might may pretend to be right; but right makes might."

"[11] Corum, Robert, *The Fighter Pilot Who Changed the Art of War* (New York: Little Brown, 2002), chapter 8."

"[12] Ibid., chapters 9-10."

"[13] Ibid., chapters 11-15."

"[14] Ibid., chapters 16-18."

"[15] As we saw in the EOQ/RTS example, the inexhaustibility of knowledge effectively turns temporal problems that may involve learning into timeless problems. Hence, the only problems we ought to consider to be temporal problems are those in which we are certain that learning plays no significant role."

"[16] *Patterns of Conflict* presentation, 2005 Defense in the National Interest revision, slide #5."

"[17] Letter to the Editor, Gen. C. C. Krulak, *Inside the Pentagon*, March 23, 1997, p. 5., available online at http://radio-weblogs.com/0107127/stories/2002/12/20/theEssentialBoyd.html (18 December 2010)."

"[18] *Patterns of Conflict*, slide #144."

"[19] Ibid. Note that Boyd's use of the term 'ingredients' rather than 'products' was not a mistake. Deciding well is a process in which the output (products) of one cycle become the inputs (ingredients) of the next cycle."

"[20] Here again we can see the difference between the modern and invariant concepts of rationality. From the received view of modern science, for a model to be rational, it must be internally consistent with respect to the rules of logic. From the view of invariant science, for a model to be rational, it must not only be internally consistent with respect to the rules of logic but also be consistent with pursuing the invariant end of deciding well. From the invariant view of deciding well, the invariant factors of deciding well are things we discover rather than invent."

"[21] *Patterns of Conflict*, slide #143."