Irreducible Complexity Reduced: An Integrated Approach to the Complexity Space

Eric Anderson

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ABSTRACT

William Dembski's and Michael Behe's recent article, Irreducible Complexity Revisited, *provides an important update on the irreducible complexity argument since the publication some 8 years ago of Behe's book,* Darwin's Black Box. *Their article, however, exhibits some confusion, or at least a lack of explicit clarification, regarding the interplay among specified complexity, cumulative complexity and irreducible complexity. In the present article, I analyze the relationship of these concepts and show that the argument from irreducible complexity cannot be divorced from the broader argument of specified complexity. While this has been previously acknowledged in a broad sense, I make explicit irreducible complexity's dependence on specified complexity, including specified complexity as applied to cumulative complexity, and further demonstrate why this dependence causes the irreducible complexity argument to break down in the evolutionist's mind. Indeed, this dependence is directly responsible for evolutionists' ability to acknowledge the existence of irreducibly complex biological features while still rejecting the irreducible complexity argument. Finally, the present article demonstrates how the arguments from complexity can be better understood within the context of an integrated approach to the complexity space. With a better understanding of the complexity space, the concepts of irreducible complexity and specified complexity can be fortified and focused in order to bring the full weight of these arguments to bear on evolutionary claims.*

In his recent essay, *Irreducible Complexity Revisited*,[2] William Dembski provides an update on the irreducible complexity argument, and a brief response to criticisms raised, since the publication some 8 years ago of Michael Behe's book, *Darwin's Black Box*. Dembski (and Behe, who is acknowledged as a co-author of the essay) presents a number of arguments previously advanced, as well as a probability equation for assessing the likelihood of a Darwinian pathway creating an irreducibly complex system.

An update on irreducible complexity is timely, given the responses to Behe's book raised by Darwinists and the continuing assertion – popular within evolutionary circles – that Behe's arguments have somehow been refuted. Dembski shows that this common refrain

[1] Revised and referenced September 18, 2004.

[2] William A. Dembski, "Irreducible Complexity Revisited," retrieved from www.designinference.com at www.designinference.com/documents/2004.01.Irred_Compl_Revisited.pdf (last accessed September 18, 2004).

is inaccurate at best, and that the intervening period since the publication of *Darwin's Black Box* has only underscored the acute lack of any meaningful explanation for the existence of irreducibly complex systems on the basis of Darwinian principles.

Irreducible Complexity Revisited contains a summary of many of the arguments that Dembski and Behe have made over the years, and for those wishing to understand the current status of the debate thus stands as a very useful companion to *Darwin's Black Box*. In particular, Dembski addresses the recent "scaffolding" and "co-option" hypotheses (although it is unclear to me that these ideas qualify as scientific hypotheses, given that they are lacking in all meaningful detail).

For anyone interested in the debate regarding irreducible complexity, I would therefore recommend *Irreducible Complexity Revisited* as a good overall summary of the status of the debate, and would also recommend it as a valuable essay in its own right.

But my purpose here is not to applaud Dembski's and Behe's efforts, though I do; nor is it to concur with the general thrust of the essay, though I do. Rather, I hope to provide a few thoughts and clarifications on the topic of irreducible complexity, in its updated form as summarized and articulated in *Irreducible Complexity Revisited*.

I qualify my enthusiasm for *Irreducible Complexity Revisited* because I find it problematic in three areas. First, on my initial reading of the opening section of the essay (devoted to a definition of irreducible complexity) I was struck by how much ground Dembski cedes to traditional evolutionary ideas. This may have been done to attract a broader readership than otherwise would have been available. It is also possible that Dembski purposely ceded ground to evolutionary theory in order to focus on the specific thrust of the irreducible complexity argument. Whatever the reason, a reader might very well gain the impression that a Darwinian mechanism has capabilities far and above what in fact has ever been demonstrated.

Second, there appears to be some confusion, or at least a lack of explicit clarification, regarding the interplay among specified complexity, cumulative complexity and irreducible complexity. Finally, I am concerned that the general line of argumentation followed in *Irreducible Complexity Revisited* may unintentionally weaken the authors' ultimate thesis.

My purpose, therefore, in writing the present article is to discuss these areas of needed improvement, to offer clarifications on the definition of irreducible complexity, to outline an integrated approach to the overall complexity space, and to provide an assessment of the contribution of the irreducible complexity argument to the broader debate regarding the origin and diversity of life on the Earth.

Specifically, I will argue that: (1) irreducible complexity can be identified only with reference to the context in which the system in question operates and the function in fact carried out by that system, regardless of the existence of or lack of similar systems elsewhere, (2) cumulative complexity, so long as the probabilistic hurdles attain, lies just

as squarely within the realm of specified complexity as does irreducible complexity, and is thus inaccessible to a Darwinian mechanism, (3) the argument from irreducible complexity depends on a conclusion regarding the lack of a cumulative pathway, based on application of the probability equation to a cumulative pathway, (4) this fact, coupled with evolutionary critics' failure to focus the argument from specified complexity on putative cumulative pathways leads evolutionists to reject the argument from irreducible complexity, and (5) by taking an integrated approach to the complexity space, the concepts of specified complexity and irreducible complexity can be fortified and focused to bring the full weight of these arguments to bear on evolutionary claims.

Irreducible Complexity Defined

In the first section of *Irreducible Complexity Revisited*, Dembski seeks to provide a relatively comprehensive working definition of irreducible complexity. He does this initially by giving counterexamples of things that he considers less than irreducibly complex.

The Stool

Dembski first proffers a stool as an object that is not irreducibly complex. The point of Dembski's stool is to provide an example of a situation where a "simpler system achieves the basic function." He defines the basic function of the stool as providing "a seat by means of a raised platform." Having thus defined the stool, he notes that it is in fact possible for something much simpler, such as a solid block, to achieve this basic function, and quickly concludes that "the three-legged stool is not irreducibly complex."

But Dembski has sold the stool short. Dembski earlier defines "basic function" as consisting of three things: primary function, minimum function, and mode of function. If we apply these three tests to the stool, and also examine a bit more closely the specifications needed for the stool to perform these functions, we find that the stool is not necessarily just a "seat by means of a raised platform."

For example, it is very possible that the stool's function is not just a seat, but a seat made with a certain amount of material. This is particularly important in the biological context, where materials might come at a premium. Thus, for example, we might define our stool not simply as a seat, but a seat made with no more than 1 cubic foot of material.

The weight of the stool could also be an important functional requirement – it certainly would not be easy to haul a heavy block of wood back and forth between the kitchen and the pantry. Yet the weight also needs to be coordinated with strength requirements in the proper ratio. Further, if the stool is used at a bar, it will need to be of a particular height. The stool may come with a backrest or without, depending on the intended function. Not the least of its characteristics is the need to be carefully sanded and finished, to prevent receipt of unpleasant slivers in sensitive areas when sitting down. Finally, in many instances, an integral part of the stool's function is to blend with the décor in the room in

which it will be used. Yet other characteristics of the stool might be required to adequately and comprehensively define its basic function.

Thus, rather than simply defining the stool as a raised seat, if we were defining a stool at my bar at home we would have to define it as "a seat, made with a particular type and amount of wood, with a weight not greater than x, with the legs and cross supports at such-and-such positions and angles, carefully sanded and smoothed, with a backrest of such-and-such a height at such-and-such an angle to the seat, finished with a natural wood stain to match the décor, and so on."

Once we come up with an adequate definition, or in other words, an adequate set of specifications of the stool's basic function, is there another simpler system that exhibits this basic function? Certainly the block of wood does not qualify. Indeed, it is difficult to think of anything else (except for another stool) that would. And if not, and if loss of any of these components of our stool would compromise the function, then the stool, adequately defined and specified, may be irreducibly complex.

Dembski's block of wood qualifies as a stool only because his definition of "stool" is so broad and loose as to encompass a huge range of possibilities. In other words, the stool has not been adequately or comprehensively defined.

The Bacterial Flagellum

Similarly, if we define a bacterial flagellum simply as a whip-like filament protruding from a bacterium, then it is tempting to look around in nature, see things that look superficially similar, and think that we have a solution to its origin. Even if we can't find something with the exact same function, if we have something that looks kind of close, then the bacterial flagellum must not be irreducibly complex, the thinking goes. This is the practical, if not explicit, approach (and mistake) made by those with fertile evolutionary imaginations, like Kenneth Miller.[3]

Their mistake is that they see a whip-like filament here (bacterial flagellum) another whip-like filament there (type III secretory system), and assume that the distance between the two must be modest – a minor co-option here, a slight mutation there, and we're done. The rhetorical approach in public discourse is then to state that either (i) there are no irreducibly complex systems, or (ii) if such systems exist, then evolution has no problem creating them. This failure to comprehensively define the system in question, the environment in which it operates, and the function the system in fact carries out constitutes what I call "Miller's Mistake."[4]

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[3] See, e.g., Kenneth R. Miller, "The Bacterial Flagellum Unspun," retrieved from www.millerandlevine.com/km/evol/design2/article.html (last accessed September 18, 2004).

[4] In fairness, Miller does a decent job of marshalling evidence to suggest that the bacterial flagellum might consist of smaller subsystems that could themselves have been the object of selection. However, in scoring this technical point Miller mistakenly assumes that he has dismantled the argument from irreducible complexity. While identifying similar systems elsewhere in nature or subsystems that could hypothetically

But properly defined, as done by Behe, John Postgate, Scott Minnich and others, the bacterial flagellum is not simply a whip-like filament, but a whip-like filament with an acid-powered motor, spinning at thousands of revolutions per minute, capable of changing direction, capable of propulsion necessary to overcome Brownian motion, with a stator, O-rings, bushings, drive shaft, and on and on.[5] The technical specifications to properly define the basic function of the bacterial flagellum would fill pages (and that is ignoring the tremendous amount of information required to construct the flagellum in the first place).

Thus, properly defined, the bacterial flagellum's irreducible complexity comes into focus, and it cannot be blithely dismissed (at least by the intellectually-honest observer) as just another one of those whip-like filaments protruding from bacteria and a readily explainable feature under gradual Darwinian evolution.[6]

Similarly, if properly defined, it is not clear that the stool is less than irreducibly complex. Certainly the stool has fewer parts and is less impressive than the bacterial flagellum, but if the basic function is comprehensively defined, an irreducible core may be found.

Finding the Irreducible Core

But Anderson, you ask, isn't this taking the exercise of defining an object a bit too far? Isn't a computer, a watch, a pen, goodness, even a piece of ordinary printer paper

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be co-opted is academically interesting, it does not resolve the central scientific problem. Miller therefore defeats a very narrow conception of irreducible complexity and in his haste to declare victory unfortunately misses the larger issue raised by Behe and Dembski, namely the improbability of the system arising without large quantities of information input. (As I will demonstrate in the present article, Behe and Dembski are partly responsible for this disconnect in the debate for their failure to focus directly on overall information input and instead their tendency to attack a version of an evolutionary mechanism that is limited to a narrow component-by-component progression.) With respect to the biochemical evidence, Scott Minnich and others are much more qualified than, and have detailed significant problems with Miller's type III secretory proposal from a biochemical standpoint (see, e.g., Scott A. Minnich & Stephen C. Meyer, "Genetic Analysis of Coordinate Flagellar and Type III Regulatory Circuits in Pathogenic Bacteria," *Second International Conference on Design & Nature, Rhodes Greece*, September 1, 2004, retrieved from http://www.discovery.org/scripts/viewDB/filesDB-download.php?id=148 (last accessed September 18, 2004).

[5] See, e.g., David J. DeRosier, "The Turn of the Screw: The Bacterial Flagellar Motor," retrieved from http://ecoserver.imbb.forth.gr/microbiology/s-e-papers/e-papers/flagellar_motor.pdf (last accessed September 18, 2004) and Robert M. Macnab, "The Bacterial Flagellum: Reversible Rotary Propellor and Type III Export Apparatus," retrieved from http://jb.asm.org/cgi/content/full/181/23/7149 (last accessed September 18, 2004).

[6] Debmski's and Behe's insistence on detail drives evolutionary proponents crazy. Why should we subject our theory to all that analysis and rigorous testing? We have found a system or two that are kind of similar to, well, OK, bear a vague resemblance to, the system in question, and we can *imagine* various intermediate systems – don't ask for details, please. That's good enough for us, why can't those pesky critics accept the truth of it all?

irreducibly complex under this approach?

Undoubtedly there are many objects that are not irreducibly complex, but I suspect that if properly and comprehensively defined, there are precious few designed objects in the world that do not have at least an irreducible core.[7]

Nevertheless, what if Dembski's example is right; what if the basic function is in fact just a raised seat? If I am around a campfire under the stars, might I not be just as content with a stump or a block of wood as a nice stool? Certainly. If someone started asking about the kind of wood I wanted, the smoothness of the seat, the weight-to-strength ratio, the finish, the surrounding décor, and so on, I might very well get frustrated and say, "I don't care. Just give me something to sit on."

Now what about that piece of printer paper – is it irreducibly complex? Don't try to tell my schizophrenic printer that each and every characteristic of that piece of paper is not necessary. Paper a bit smaller, paper a bit larger, paper a bit thicker, paper that is not just square – any one of a half-dozen minor deviations from the intended design, and crunch: "Paper Jam." In contrast, if I am covering the kitchen table with paper before carving pumpkins, not only would my printer paper work, but newspaper, butcher paper, etc.

In the latter case, my printer paper has not changed a bit, but the way in which it is used has – so much so that a definition of its basic function in the latter context (covering the table to keep seeds and pumpkin innards off of the table and facilitate cleanup) might make the printer paper less than irreducibly complex. At the very least, we can safely conclude that some of the characteristics of my printer paper would not be part of the irreducible core in the new context of a pumpkin carving activity.

With a nice stool around the campfire or our printer paper on the pumpkin carving table we observe that what would be an irreducible core in one context is being put to a simpler use in another context, with less demanding specifications and greater margin of error. Put another way, it is being used for a different purpose or a less stringent purpose than for what it was designed, and in all such situations it is, by definition, the case (if it is to perform that new and different purpose), that the system will have certain extraneous characteristics that formed part of its original irreducible core, but do not form part of an irreducible core in the new context. Similarly, if the bacterial flagellum were used simply to tickle other bacteria, then perhaps any number of similar-looking whip-like filaments might do the trick.

The Challenge of Defining an Irreducibly Complex System

What the above shows is that it is not so easy to dismiss a system as less than irreducibly complex. Whether a system is considered irreducibly complex depends first on having an

[7] This point is not part of the design inference per se, but is part of the background information underlying the design inference. One of the principal characteristics of objects that we know are designed, certainly those of complexity, is that they consist of integrated parts and irreducible cores, rather than a jumble of random and uncoordinated components.

adequate and comprehensive definition of its characteristics, and depends further on understanding the environment in which it is used and the function it in fact carries out.[8] Thus we come to a first critical challenge in the irreducible complexity debate: properly defining a system's basic function can be adequately accomplished only if we have properly identified the context of the system's environment and the use to which it is in fact put. The bacterial flagellum is noteworthy by its very existence, but it is the context of the environment in which it exists, the primary function that it in fact performs, and the way the numerous parts interact to make an integrated functional system, that commands our attention.

In attempting to provide a working definition of irreducible complexity, Dembski ignores many of the more challenging aspects of a system's complexity, such as aesthetics and integration of the system into the overall organism, and instead focuses on a narrow, isolated aspect of function that might be properly characterized as motive or mechanical function. This narrow scope necessarily limits the number of irreducibly complex systems and throws out a lot of baby with the bathwater. For purposes of debate, however, this approach may have some merit, as it challenges Darwinian evolution in the very area in which it is supposedly most adept: producing raw mechanical function.

Of course, the main lesson to be taken from our analysis of Dembski's stool example is not the proposition that a stool is or is not irreducibly complex. A more important lesson is that conducting a survey of other systems in nature is inadequate to permit us draw any conclusions about a system's irreducibly complexity. Rather, irreducible complexity depends on identifying the irreducible core (under Dembski's definition, the core that produces raw mechanical function), and if we are to avoid Miller's Mistake, identifying the irreducible core can be accomplished not by gazing about to see if similar systems may exist,[9] but only by carefully defining the system in question, the environment in which it operates, and the function it in fact carries out.

Irreducible Complexity v. Cumulative Complexity: The City

In *Irreducible Complexity Revisited*, Dembski also seeks to contrast irreducible complexity and cumulative complexity. Using an example he has previously used, at least as early as an October 1998 First Things essay[10], Dembski cites the example of a city, slowly growing and increasing in size and complexity, while retaining its basic function of a city. He concludes – presumably on the notion that a city is a city is a city –

[8] Even if a system does not appear to be irreducibly complex in the current environment in which it is used, it may have originated as an irreducible core in some other environment or for some other function. This fact is directly relevant to addressing Darwin's concern about vestigial organs, but that is a topic for another time.

[9] This exercise might certainly be helpful in testing one's notions about what might constitute the irreducible core.

[10] William A. Dembski, "Science and Design," *First Things #86*, October 1, 1998, retrieved from http://www.designinference.com/documents/1998.10.science_and_design.htm (last accessed September 18, 2004).

that "it follows that the Darwinian selection mechanism can readily account for cumulative complexity."

In fact, no such thing follows.

Not unlike the stool in the previous section, one of the first challenges with Dembski's city is the difficulty of defining a "city." Dembski defines the city's basic function as providing a "sense of community." On that definition, it is not clear that we even need anything that would be recognizable to the average person as a city – a single family, or a group of nomads in the desert, or a few friends on a backpacking trip in the Rockies might each do the trick nicely. What's more, if we take time to carefully look at the large city he started with and define it in a relatively comprehensive manner, then not just any old conglomeration of people and buildings will do.

Is a City an Example of Irreducible Complexity?

Based on our previous discussion of the stool, the answer to this question may depend largely on how carefully and comprehensively we define the city. If we simply define it as a place where people live and work and we look around to see if any simpler cities exist, we might be tempted to think that our city is not irreducibly complex.

However, if we define our particular city as a place for one million residents, within a certain square mileage, with buildings no taller than a certain height, with no-one living more than x miles from downtown, with a certain percentage of the area covered in parks and other green areas, with certain zones for residential and industrial activities, with an efficient roadway system, electrical power and water distribution, and so on, then it is not so easy to dismiss our city, at least the general plan, as less than irreducibly complex.

For Behe and Dembski, irreducible complexity is something that loses functionality when parts are removed. One could argue that if certain parts of our city are removed (such as water or power services), then function is lost. At least to that extent then, our city has an irreducible core.

Refining the Definition

With the above background, we can begin to refine the definition of irreducible complexity. Put simply, if we have a functional system with components A, B, C, D and E, and if the removal of any of these components eliminates function, then the system is irreducibly complex (there may be other components in the system, but these five would be the irreducible core).

In attempting to find our irreducible core, we must keep in mind that it is not necessary that the *same* function be preserved when a component is removed. In fact, it is more accurate to say that *the same function cannot be preserved*; otherwise we would simply be refining our definition of the irreducible core. For example, if we discover that A, B, C and D perform the same function as A, B, C, D and E, then the latter was not really an

irreducible core, but the former might be, if it turns out upon further examination that components A-D are necessary to preserve the relevant function. Thus, if the removal of a component does not hinder current function, then we have not yet found the irreducible core. (This is part of the difficulty of getting our arms around the definition of a city.)

How does Irreducible Complexity Differ from Cumulative Complexity?

In order for our system A-E to be cumulatively complex, it is necessary to show a continuous pathway from a simple system to our more complex system. For example, if each of systems A, A-B, A-C and A-D exhibit functionality in their own right, then A-E may be cumulatively complex.

However, if only systems A, A-B and A-D exhibit functionality, *and* if system A, B, D does not have functionality, then there is no continuous pathway from A to A-E. Going from A-B to A-D requires the addition of two new components, each of which are interdependent to get to A-D, and neither of which by itself brings functionality.[11]

The Essentials

Dembski's essential point with the city example appears to be that some systems can be simplified and still exhibit a high degree of functionality. However, his city example is misleading on this very point, because we have shown that if the functionality exhibited by the simpler system is the same as the functionality exhibited by the more complex system, then by definition, we are but refining our description of the irreducible core, not demonstrating a cumulative pathway to new function.

In the context of cumulative complexity, Dembski also appears to be using the city example to underscore the lengthy process involved. He is trying to lay the groundwork for making the subsequent point that irreducible complexity requires all parts to come together at once. However, this approach is misguided. As I will demonstrate later in this essay, there is no principled way to distinguish between irreducible complexity that comes together all at once and irreducible complexity that results from a slow cumulative process, and this is precisely the difficulty of convincing faithful evolutionists of the merits of the irreducible complexity argument.

Let us now step back for a moment, however, and take a look at the complexity space as described thus far.

The Complexity Space

In its simplified form, the overall complexity space may be characterized as in **Figure 1**.

[11] This strict component-by-component approach is not a logical requirement of a cumulative pathway, as I will demonstrate later. However, this is the approach taken by Behe and Dembski, and for present purposes is sufficient for examining Dembski's city example.

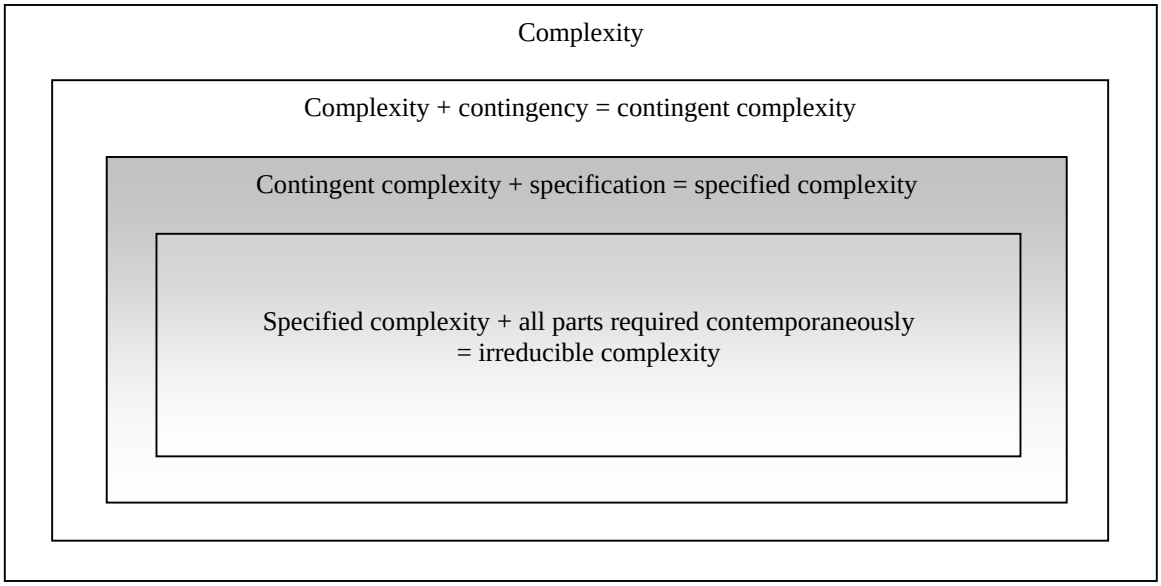

Figure 1 – The Complexity Space

Within the universe of all complexity lies a smaller space of contingent complexity, that is, complexity that may be explainable by, but is not required by, the fundamental laws of nature. If I drop a bucket of computer parts on the floor, their arrangement will be caused and explainable by the fundamental forces, but it is contingent. That is, I can drop them again or reach down and re-arrange them in near-infinite combinations without running afoul of the fundamental laws.

Within this space of contingent complexity lies a smaller space of specified complexity – the realm of intelligent design theory – represented by the shaded area. I should add here two points. First, due to practical limitations, the illustration is by no means to scale, as the space of specified complexity, to borrow a phrase from David Berlinski, "occupies an area no larger than a dime" against a "planet-sized" backdrop of contingent complexity.[12] Second, the specified complexity we are talking about for present purposes is the specified complexity outlined elsewhere by Dembski, and thus represents characteristics that are sufficiently concrete to allow us to ascertain with a high degree of certainty that the contingent complexity of the particular system in question is not the result of chance.

Finally, within the realm of specified complexity, we come to the subset of specified complexity that is relevant to our present discussion: irreducible complexity. For Dembski and Behe, irreducible complexity is specified complexity that comes about all at once. In other words, there is a contemporaneous integration of parts, rather than a sequential integration of parts.

[12] David Berlinski's well-known essay, "The Deniable Darwin," can be retrieved from a number of locations, including www.id.ucsb.edu:16080/fscf/LIBRARY/berlinski/deniable.html (last accessed on September 18, 2004).

However, if we focus on the shaded specified complexity space for a moment, we might do well to inquire what other kinds of specified complexity might exist in addition to irreducible complexity. In order to assist in answering this question, let us consider for a moment the broader realm of Dembski's city example: that of specified complexity.

Is the City an Example of Specified Complexity?

The other night I entered the on ramp to interstate 101 from downtown San Francisco. Almost immediately, I was lifted high above the streets, shops and residences below and swept onto the massive superstructure of the multi-lane complex that makes up the 101. As I sped along the 101 with hundreds of other vehicles – I mean, as I carefully and cautiously drove within the designated speed limit along the 101 – I was struck by the incredible engineering feat this interstate system represented, lanes merging in and out, on ramps springing up from the streets below, and exits placed to deliver traffic to designated locations in the surrounding cities.

Whatever views we may have of our transportation department officials, and whatever we may think of the competence of our civil engineers, the fact remains that the 101, like numerous other roadway systems around the world, is a marvelous feat of engineering. I thought of the city streets I had left behind, the cable car system, the wharf, the homes and shops and the impressive skyscrapers, each carefully designed and created to fulfill a particular function, and more importantly for purposes of our present discussion, each representing a contingent selection of specifications within an almost infinite array of possibilities under natural law.

The 101, the Embarcadero Center rising against the skyline of the setting sun behind me, Candlestick Park to my left, the shops and residences below, indeed the city as a whole, are each examples of specified complexity. Are they any less so because they took years, sometimes decades, to build, as opposed to arising overnight?

Specified, Irreducible, Cumulative?

The fact that a cumulatively complex system did not arise in one fell swoop in no way at all suggests that a series of slight changes plus natural selection has any capability at all of producing the system. Without information content and information processing to drive the construction, it is unclear how Darwinian evolutionary theory can account for any kind of functional complexity, whether irreducible or cumulative.

Dembski's a city is a city is a city reminds me of the classic exchanges about the mammalian eye. Evolutionists say, here is a light sensitive cell, here is a simple eye, here is a simple lens-type eye, and here is a complex camera-type eye. The basic function is to perceive light – an eye is an eye is an eye. It is just an example of increasing complexity, right? We haven't changed the basic function, all we have done is accumulate a little more complexity along the way. Richard Dawkins' now-famous musings about 5% of an eye, then 6% of an eye and so on, fall squarely within this

category of fallacious thinking.[13] If we follow Dawkins' line of thought and if we can characterize this as cumulative complexity rather than irreducible complexity, then according to Dembski, "it follows that the Darwinian selection mechanism can readily account for" the mammalian eye.

Now I know that Dembski does not view the mammalian eye as anything other than irreducibly complex. Nevertheless, the above demonstrates that it is incorrect to conclude that complexity that arises slowly over time does not need massive amounts of information input and is thus readily accessible to Darwinian evolution, whereas complexity that that arises all at once is irreducible and thus inaccessible to Darwinian evolution. It simply doesn't follow.

Let us return to Dembski's city. First, as indicated above, it is not clear that the city is less than irreducibly complex, but I am willing to grant that proposition for the moment as there is a much more significant issue lurking here. The problem is that Dembski, in his haste to move on with the discussion of irreducible complexity, has failed to discuss the key issue: specified complexity.

If Dembski thinks that a city, at least much of what constitutes a city, is not an example of specified complexity, then he and I disagree. Fair enough. However, if he acknowledges specified complexity, but further states, simply by virtue of the fact that it is cumulative rather than irreducible, that a Darwinian mechanism can "readily account" for it, then he disagrees with himself. As argued by Dembski himself on other occasions, evolutionary theory has no plausible explanation for any system that exhibits specified complexity. I argue that it makes no difference whether this specified complexity is cumulative, arising slowly over time, or whether it is irreducible, arising in one fell swoop.

Let us therefore take another look at the specified complexity space, as slightly refined in **Figure 2**. In this figure, we see that the specified complexity space can be broken down into two subcategories: specified complexity in which the parts arise contemporaneously, and specified complexity in which the parts do not arise contemporaneously, but over a period of time – in other words cumulative complexity.

[13] Dawkins certainly deserves a good deal of blame for popularizing this brand of thinking. However, he was only following Darwin's example: "How a nerve becomes sensitive to light, hardly concerns us more than how life itself originated . . . the simplest organ which can be called an eye consists of an optic nerve, surrounded by pigment cells and covered by a translucent skin . . . when we bear in mind how small the number of all living forms must be in comparison with those which have become extinct, the difficulty ceases to be very great in believing that natural selection may have converted the simplest apparatus of an optic nerve, coated with pigment and invested by transparent membrane into an optical instrument as perfect as is possessed by any member of the Articulate Class." Charles Darwin, *On the Origin of Species*, 6th ed. (reprinted New York, New York: New American Library, 1958), pp. 172-173. Darwin might be forgiven for his credulity, due to a lack of knowledge about the inner workings of biomolecular machines a century and a half ago, but it is more difficult in our age to justify Dawkin's failure to address genetic and biochemical particulars in his contemporary version of the evolutionary just-so story.

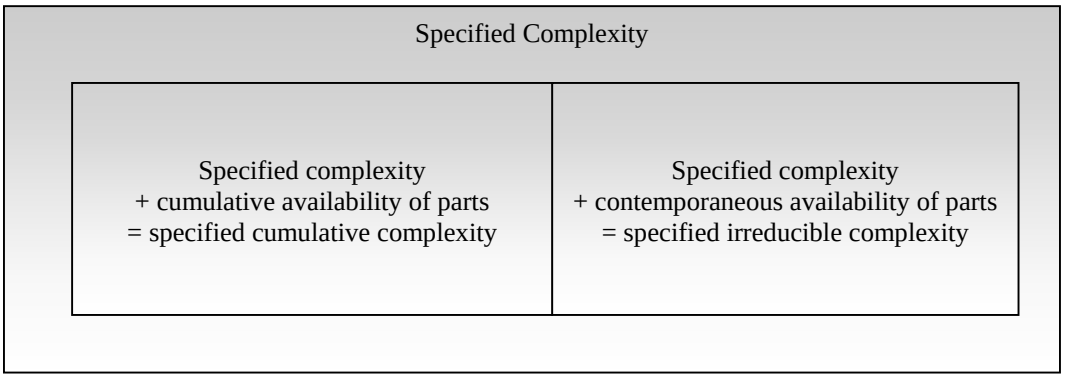

Figure 2 – The Specified Complexity Space

If the city is an example of specified complexity, then it should be inaccessible to theories based on chance and necessity, such as the Darwinian mechanism, regardless of whether the city is the result of cumulative complexity or irreducible complexity. If we make the very reasonable assumption that Dembski is not contradicting himself on this point, then what appears to be happening is that he is jumping from a comparison within the specified complexity space (the irreducible complexity he is defining) to a comparison outside of the specified complexity space. This is set forth in **Figure 3**, which zooms out one level to the broader space of contingent complexity and compares the specified and non-specified regions side by side.

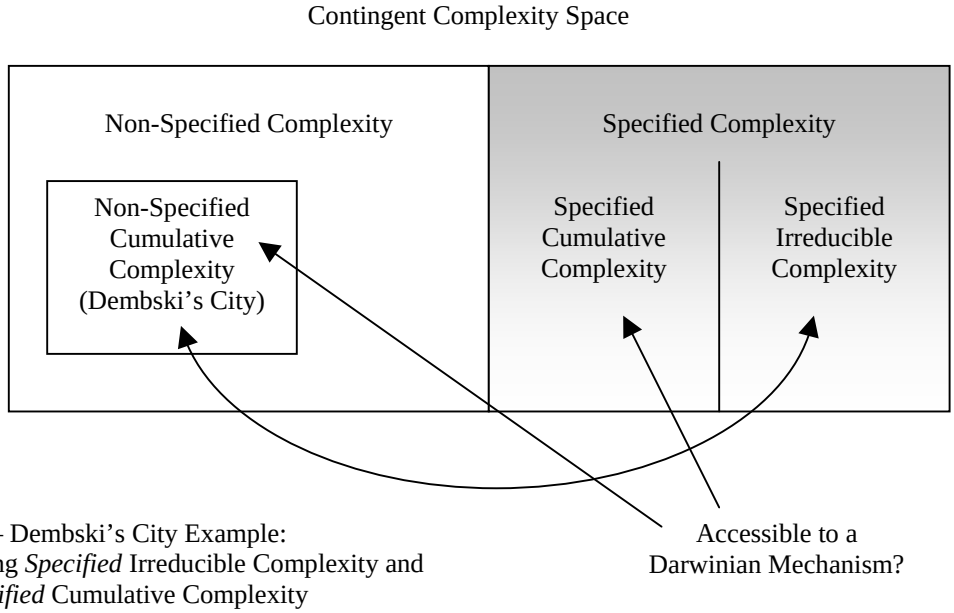

Figure 3 – Dembski's City Example:
Contrasting *Specified* Irreducible Complexity and
Non-Specified Cumulative Complexity

By not carefully distinguishing between specified cumulative complexity and non-specified cumulative complexity, Dembski gives the inaccurate impression that any kind of cumulative complexity is accessible to a Darwinian mechanism. This approach places the onus on being able to distinguish an irreducibly complex system from a cumulatively

complex system. This is a daunting task indeed, and may not even be possible in the context of historical biology. This opens the irreducible complexity argument to significant attack, and as I will show later, is a large part of the difficulty in convincing individuals like Miller and Allen Orr of the strength of the irreducible complexity argument.

As Dembski himself has argued on previous occasions, the key to ruling out chance and necessity lies in the ability to accurately identify specified complexity. Thus, the stake must be firmly placed in the ground at the specified complexity boundary, not the irreducible complexity boundary.

Finally, even if Dembski were clear that he is talking about non-specified cumulative complexity in his example of the city, it is not at all evident that a Darwinian mechanism can "readily account" for such complexity. One could certainly mount reasonable arguments that other theories, based on pure chance or self-organizational properties, for example, might just as readily account for non-specified cumulative complexity as the putative process of variation plus natural selection.

To summarize the complexity space thus far, *cumulative complexity*, so long as the system in question ultimately contains the criteria for eliminating chance and necessity, *lies just as squarely within the realm of specified complexity as does irreducible complexity*. It is here that *Irreducible Complexity Revisited* exhibits a basic disconnect. A brief review of Dembski's probability equation will further underscore why.

Improbabilities upon Improbabilities

The portion of *Irreducible Complexity Revisited* that I found most insightful was Dembski's probability equation contained in the last section of the essay.[14] Dembski outlines seven probability variables that must be addressed "to bring about irreducibly complex biochemical machines." Given that we are dealing with biochemical systems, Dembski grants that the parts will ultimately be arranged in the proper configuration as a result of chemistry, and we are thus left with six probability variables:

1- Availability of parts generally
2- Synchronization (availability at the right time – what I will call "contemporaneous availability")
3- Localization (availability in the right place – what I will call "spatial availability")
4- Lack of interfering cross reactions
5- Interface compatibility
6- Order of assembly

[14] No doubt he will receive some criticism on the way the particular probability variables are described, but the overall approach appears sound, and from a pragmatic standpoint is very useful in focusing attention on what is actually required to create an irreducibly complex system.

Dembski walks us through each of these variables and argues that a Darwinian mechanism will face such daunting odds that it can be dismissed as a serious contender for explaining the existence of irreducibly complex systems.

But what of cumulatively complex systems? All of the above variables are equally applicable to cumulative complexity. The only one that is even different is #2 – contemporaneous availability of parts. Irreducible complexity requires that all the parts come together at the same time, and thus presents a challenge to Darwin's "slight successive variations" over long periods of time. However, does the equation radically change simply because a system came about slowly? By removing the contemporaneous requirement, does the Darwinian mechanism suddenly jump from being unable to account for the irreducibly complex system to being able "to readily account for" the cumulatively complex system? Keep in mind that if any one of the variables is close to zero then the whole Darwinian project faces serious difficulties in being regarded as a reasonable scientific explanation for the origin of the system in question.

Furthermore, is it really the case that the contemporaneous availability of parts for irreducible complexity is any more improbable than the required sequential availability of parts for cumulative complexity? Given our system A-E, irreducible complexity requires that A-E become available all at once. Unlikely indeed, and we are impressed with the improbabilities. Yet cumulative complexity, starting with A, requires B to come along and be successfully integrated before C; then the whole process must be repeated with D, and later with E, each step of the process also satisfying the other hurdles Dembski has outlined, including localization, lack of interfering cross reactions, compatibility, and order of assembly.

Suddenly, upon closer examination, cumulative complexity does not look so easy. Indeed, a very reasonable argument can be mounted that cumulative complexity – at least of the kind we are talking about: specified cumulative complexity – is as great, and perhaps a greater, hurdle than irreducible complexity. We may be talking about smaller miracles, but we require many more miracles, and in just the right sequence. Therefore, based on Dembski's own analysis of the probability requirements, it is exceedingly unlikely that cumulative complexity could make any a contribution to Darwinian evolutionary theory.

Thus, it is troubling to find Dembski stating that a Darwinian mechanism can "readily account for" cumulative complexity. Rather, it would have been far more accurate for Dembski to say something along the following lines:

> "Assuming that we have an initial functioning system, and assuming that the necessary parts for a new system are available at the right time and at the right place, and assuming that there are no interfering reactions and that all the parts happen to interface properly, and assuming that the order of assembly of the new system somehow falls into place and that the resulting configuration confers a new beneficial function, then the

> Darwinian mechanism as a pure theoretical matter (not a realistic probability, mind you, but a pure theoretical possibility) might be able to account for cumulative complexity.
>
> Darwinists imagine that they see a potential loophole in the above probabilities, and repose their hopes in this theoretical possibility. Indeed, Darwin's entire theory is based on this theoretical possibility of 'slight successive variations' accumulating over time to produce large-scale evolutionary changes.
>
> The origination equation in the last section will show that the probability of the Darwinian mechanism accounting for the existence of cumulatively complex systems is so small as to be excluded as a serious scientific explanation. Nevertheless, we are willing to grant the theoretical possibility for purposes of our present discussion, as the remainder of this essay will also show that even this theoretical possibility of a Darwinian mechanism is not available for another type of specified complexity: irreducible complexity.
>
> In Michael Behe's 1996 book, *Darwin's Black Box*, Behe argues that a number of biological systems exhibit characteristics that cannot be accounted for on the basis of slight successive variations over time . . ."

The above approach focuses emphasis right where it should be: on specified complexity. Further, it challenges evolutionists to show how specified complexity could possibly arise, even in the cumulative context, which no evolutionist has ever done. Additionally, it keeps specified complexity clean and does not give the inaccurate impression that slow specified complexity can be readily accounted for but that sudden specified complexity is inaccessible. Finally, it sets the stage for irreducible complexity to make a contribution where it is most relevant: synchronization, or the contemporaneous availability of parts.

Would Someone Please Give Me the Time?

The great friend of the evolutionist is time. Given enough time, the thinking goes, anything is possible. Darwin was encouraged in his day by new discoveries in geology that extended the Earth's natural history from a few thousand years to millions of years. The estimates have continued to be revised, settling somewhere in the neighborhood of 4.5 billion years. This looks like an awfully large number, and whenever faced with skeptical questions about the creative powers of evolution, the evolutionist responds, "yes, but we are talking about *billions* of years," with arms spread wide and just the right vocal inflection on the word "billions." Indeed, Darwin's whole theory is based on having sufficient time to do the creative work. Darwin rejected any "great and sudden

leap" and built his entire enterprise upon "slight, successive variations," [15] which implies time – lots of time.[16]

But how much time do we really have? Darwin acknowledged, and the Neo-Darwinian Synthesis makes explicit, that we are only talking about heritable change. Let us therefore ignore for a moment that the larger mammals measure their reproductive cycles in months or even years, and let's focus instead on a hypothetical ancestor of a creature alive today with a one-second reproductive cycle. Let's further ignore the fact that simple life came on the scene relatively early in the Earth's history. Let's ignore that the Cambrian explosion was a sudden and relatively recent event, geologically speaking. Let's see just what that 4.5 billion years is made of. If we take 4.5 billion years, 365 days per year, 24 hours per day, 60 minutes per hour, 60 seconds per minute, and round up for good measure, we come up with something on the order of the following number of seconds in the Earth's history:

142,000,000,000,000,000.

Evolutionists take great comfort in all these zeroes, and fancy that they see somewhere in all these zeroes the answer to even the most challenging evolutionary puzzles. They imagine that they can glimpse on the distant horizon a loophole in Dembski's probability equation. Yet despite the apparent size of this number to our every-day experience, evolutionists fail to realize (or conveniently forget) that this number is but a pittance when compared with the awful mathematical odds that face the formation and diversity of life on the Earth – a mere rounding error, if you will, in the larger cosmic calculation.

Nevertheless, how does one deal with the Darwinists' emphasis on these billions of years and eons of time? Irreducible complexity's task is to sniff out recalcitrant Darwinists and force them out of the dark corridors and dim recesses of time and into the bright light of day. Irreducible complexity says: "Forget the zeroes; you don't have any time; time cannot be your ally; you must come up with this system all at once."

In addition to depriving the evolutionist of his greatest ally, time, irreducible complexity also seeks to deprive the Darwinist of the causal factor, by showing that "slight successive variations" will not do the trick.

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[15] "As natural selection acts solely by accumulating slight, successive, favourable variations, it can produce no great or sudden modifications; it can act only by short and slow steps." Darwin, *Origin of Species*, p. 444.

[16] For example, Darwin reposed his faith in lengthy periods of time in his discussion of the hypothesized evolutionary formation of the eye: "In living bodies, variation will cause the slight alterations . . . and natural selection will pick out with unerring skill each improvement. Let this process go on for millions of years; and during each year on millions of individuals of many kinds; and may we not believe that a living optical instrument might thus be formed as superior to one of glass, as the works of the Creator are to those of man?" Ibid., p. 174.

Darwin's Tiny Changes or Goldschmidt's Hopeful Monster?

Darwinism is beset by gaping chasms of logical inconsistency. Noteworthy among them is that tiny little changes, what Darwin called the "slightest differences of structure or constitution,"[17] are the building blocks of evolution. Yet at the same time, natural selection, by definition, is only capable of selecting those attributes or changes that provide an actual survivability advantage, or in Neo-Darwinian terms, a reproductive advantage. Furthermore, these advantages must be significant enough not only to be noticed and selected by the invisible hand of natural selection, but significant enough to overcome the myriad vagaries and hazards of nature.

Darwinism thus posits changes that are so small that they are almost imperceptible (and much more importantly for the theory's rhetorical stance, are small enough to be believable to the individual who doesn't ask too many questions), and yet, the only changes that can be selected are those which are so important that they provide an organism a key competitive advantage over its less fortunate siblings.

Natural selection is therefore in the unenviable position of having to select those changes that provide a competitive advantage, when in fact most of the changes, as evident in the real world and as acknowledged by Darwin, are insignificant. Darwin's faith, however, was unwavering, and he proposed a solution to this conundrum by painting natural selection as a near-benevolent force, much wiser and more omnipotent than our limited faculties and "immeasurably superior to man's feeble efforts."[18] Natural selection, Darwin proposed, was "daily and hourly scrutinising, throughout the world, the slightest variations; rejecting those that are bad, preserving and adding up all that are good . . ."[19]

Despite Darwin's literary skills, however, this description of natural selection is but a metaphor, and the fact remains that natural selection is logically limited to selecting changes that are significant enough to actually provide a survivability advantage. In reality, natural selection, by its very definition, is not an omnipotent force responsible for

[17] "Nature, if I may be allowed to personify the natural preservation or survival of the fittest, cares nothing for appearances, except in so far as they are useful to any being. She can act on every internal organ, on every shade of constitutional difference, on the whole machinery of life. . . . Under nature, the slightest differences of structure or constitution may well turn the nicely-balanced scale in the struggle for life, and so be preserved." Darwin, *Origin of Species*, p. 91.

[18] "Owing to this struggle, variations, however slight and from whatever cause proceeding, if they be in any degree profitable to the individuals of a species, in their infinitely complex relations to other organic beings and to their physical conditions of life, will tend to the preservation of such individuals, and will generally be inherited by the offspring. . . . Natural Selection, we shall hereafter see, is a power incessantly ready for action, and is as immeasurably superior to man's feeble efforts, as the works of Nature are to those of Art." Ibid., p. 75.

[19] "It may metaphorically be said that natural selection is daily and hourly scrutinising, throughout the world, the slightest variations; rejecting those that are bad, preserving and adding up all that are good; silently and insensibly working, *whenever and wherever opportunity offers* . . ."[emphasis in original]. Ibid., p. 91.

nature, but is a blind and bumbling observer, "unsure of where it has been, unaware of where it is going,"[20] groping in the dark and always playing catch-up to the important competitively-significant changes that somehow just happen to appear in nature.

The intellectually-consistent approach to natural selection's logical limitations, put forth by Richard Goldschmidt, and later given a hesitant nod by Stephen Jay Gould, is to propose abrupt changes that are large enough to provide a real (as opposed to hypothetical) selective advantage – the so-called "hopeful monster."

Most modern-day evolutionists, however, shy away from the hopeful monster for one simple reason – it is not believable. It looks like reliance on fortuitous events. It looks too much like a miracle. So they posit tiny changes and long periods of time, and imagine that together these two elements will result in the significant changes that are needed for natural selection to do its magic. After all, small changes are more believable, and surely there must have been ample time, the thinking goes . . .

Unfortunately, the miracle they seek to avoid in the hopeful monster's sudden physiologically significant changes, is invoked on the other side of the equation with just enough tiny changes, in just the right sequence, at just the right time, and with just the right effect, to carry out the creative work. The argument from irreducible complexity, articulated by Behe in *Darwin's Black Box*, and later refined by Behe and Dembski, is brought to bear on this latter miracle story.

In essence, irreducible complexity seeks to force an abandonment of this incremental, bit-by-bit, process of creation with respect to certain complex biological systems, and force the evolutionist to retreat to something closer to Goldschmidt's hopeful monster.

Thus, while the concept of irreducible complexity is not necessary for the broader specified complexity argument to win the day, by robbing the Darwinist of the twin crutches of "slight successive variations" and vast periods of time, irreducible complexity forces the intellectually honest evolutionist to retreat to something more abrupt, like Goldschmidt's hopeful monster miraculously springing forth without precedent, or like the more intellectually palatable (but equally freakish) organism capable of traveling through nature, both temporally and spatially, miraculously co-opting parts for inclusion into a wonderfully integrated system.

Irreducible complexity thus takes the specified complexity argument from the mathematical to the physical, from the theoretical to the practical. Irreducible complexity challenges Darwinists who fancy they can see a logical loophole in the awful probabilities of specified complexity. Irreducible complexity seeks to shut the door on this logical loophole and force the evolutionist to address specified complexity, not on the basis of some mystical force of natural selection acting in the distant past, but on the basis of chance and necessity, in other words on the basis of the probabilities. It soon becomes clear that the probabilities are not on the side of evolutionary theory.

[20] Berlinski, *Deniable Darwin*.

Irreducible complexity further challenges evolutionary theory in the very area in which it claims to be most adept: mechanical function arising through "slight successive variations" over vast periods of time. Evolutionary theory has not successfully answered the challenge. Indeed, it has not even provided a cogent response.

Irreducible complexity is thus a powerful tool in the debate over the origin and diversity of life on the Earth, but it must be remembered that it is but a subset of specified complexity and that any kind of specified complexity, whether irreducible, cumulative or otherwise, is inexplicable by reference to chance and necessity and bespeaks the actions of an intelligent designer.

Cumulative versus Per Se Irreducible Complexity

With the foregoing background, we can make yet another refinement to the complexity space. We have already seen with our examples of the stool around the campfire or our printer paper on the pumpkin carving table that a system that was irreducibly complex in one environment may not be irreducibly complex in another environment, or, more accurately, that there will be extraneous parts that formed part of the irreducible core in the system's original context but which may not form part of the irreducible core in the new context. Furthermore, we have seen that specified complexity may exist as either irreducible complexity or cumulative complexity.

As a final refinement of our complexity space, we need to address the relationship between the existence of parts and their contemporaneous availability. If one reads Behe's book and Dembski's essay carefully, there appears to be some conflation of these two concepts. Specifically, irreducible complexity is often described as a system in which all parts are necessary for the system to perform its function. Yet it is clear from Dembski's attempt to contrast cumulative complexity with irreducible complexity, as well as his approach to the probability equation, that a critical aspect of Behe's and his conception of irreducible complexity is the need for all parts to be available contemporaneously.

However, it does not follow that if all the parts are now necessary for current function that they all had to be available at the same time. Certainly there are many examples of systems exhibiting an irreducible core in their current function that arose through an incremental process of design refinement over time. One need not agree with my position on Dembski's city example in this regard; computer programs, recent models of cars, the Space Shuttle, and numerous other systems are examples of irreducible cores that arose through lengthy processes of specified complexity input.

If there is a lack of a clear historical account, as is the case with living organisms, we are limited to identifying whether all parts are needed for a system's current function. I will term this "current irreducible complexity." Further, I propose that we distinguish between two different kinds of current irreducible complexity: (i) a system exhibits

"cumulative irreducible complexity" if all components are necessary to preserve current function *and* there is a clear cumulative pathway leading to the current function; and (ii) a system exhibits "*per se* irreducible complexity", if all components are necessary to preserve current function *and* there is no cumulative pathway to the current function. This distinction is set out graphically in a final refinement of the specified complexity space in **Figure 4**.

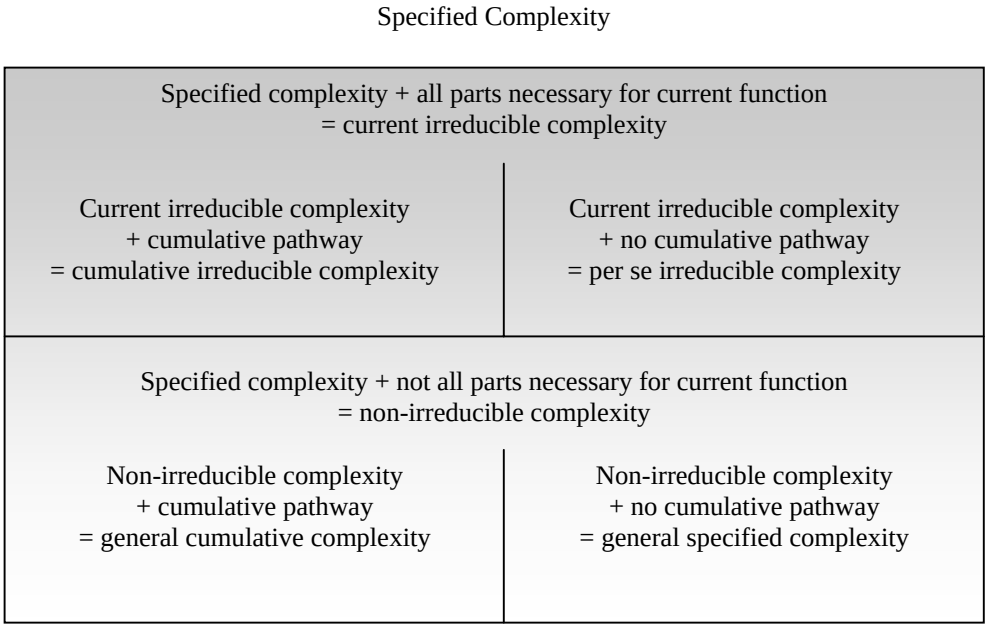

Figure 4 – Specified Complexity Refined

Behe's and Dembski's definition of irreducible complexity is focused on what I have called "per se irreducible complexity," as they seek to focus attention on the abrupt nature of irreducible complexity, as opposed to the slow process of cumulative complexity. However, without a historical account available, there is no principled way to examine a system that exhibits current irreducible complexity and determine whether it is an example of cumulative irreducible complexity or per se irreducible complexity.

Futhermore, as demonstrated in **Figure 5**, our ability to distinguish between cumulative irreducible complexity and per se irreducible complexity depends on our conclusions regarding the likelihood of a historical cumulative pathway leading to the current irreducible complexity.

The assertion that no cumulative pathway exists to current irreducible complexity is an assumption that cannot follow as a deductive matter from the evidence. The assumption of no cumulative pathway is in fact an inference, based on two things (1) the lack of affirmative evidence regarding a cumulative evolutionary pathway, and (2) Dembski's probability equation, *as applied to a cumulative approach to achieving the system*. In

other words, Behe's and Dembski's inference that no cumulative pathway to the current function exists is in fact an inference based on the improbability of a cumulative pathway arriving at the current function. This inference is itself a sub-category example of the broader "inference to the best explanation" that underlies Dembski's design argument, and may be an appropriate conclusion if appropriately fleshed out, rather than assumed.

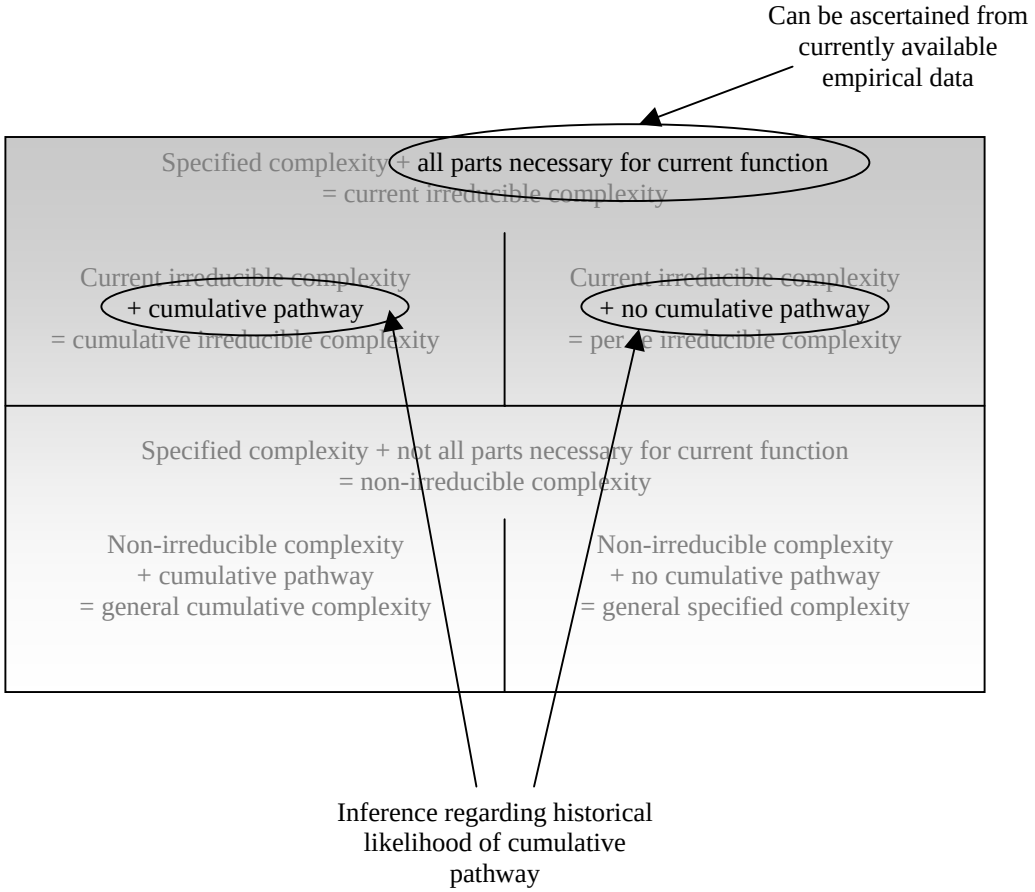

Figure 5 – Historical Inferences

What the above shows, ironically, is that not only is Dembski's probability equation fully applicable to specified cumulative complexity, and not only is the improbability of a cumulative pathway every bit as great as an abrupt irreducible origin, but that in fact *the argument from irreducible complexity depends upon a conclusion that a cumulative pathway is improbable.*[21] In order for the per se irreducible complexity argument to be

[21] This is a pragmatic, rather than a logical requirement. From a purely logical standpoint, there is no reason to favor a cumulative pathway over a sudden appearance. However, evolutionary theory is generally understood to proceed on a cumulative pathway. In addition, there are a number of natural processes that are accepted as adequate to explain certain features of the world around us, given enough time. Examples include the position and shape of the continents, formation of mountains and valleys, plateaus and canyons, etc. Acceptance of Darwin's theory only became possible in the context of acceptance of the Earth's lengthy natural history. Finally, the idea of an abrupt appearance based on natural processes (think Goldschmidt) is already rejected by most evolutionists. Thus, to the extent that the

on solid footing, Dembski and Behe must therefore fall back on the general probability argument underlying specified complexity.

We have thus come full circle in our analysis of irreducible complexity, and we see that the per se irreducible complexity proposed by Behe and Dembski depends upon the inferences that can be drawn from a probability analysis as applied concurrently to both a cumulative pathway and a non-cumulative per se origination. The probability analysis applicable to all specified complexity is thus the key to the debate, and the strength of the irreducible complexity argument ultimately depends upon the strength of the specified complexity argument, as applied to a cumulative pathway.[22]

What of the Darwinist's position? As we review Figure 5, we note that the Darwinist is in an unenviable position. The Darwinist, like Behe and Dembski, must draw a historical inference as to the existence of a cumulative pathway. Yet the faithful Darwinist must conclude that there is a cumulative pathway when everything that we do know about the system in question confirms that all parts are necessary at the same time for current function and that there is significant probabilistic hurdle of a cumulative pathway. Thus, it seems reasonable to place the onus on the Darwinist to show that a plausible cumulative pathway in fact exists.

Complexity Through the Eyes of an Evolutionist, or is the Loophole Really Closed?

Given what appears to be a decent argument on the side of irreducible complexity, why do evolutionists remain unconvinced? I believe it has much to do with the fact that without historical evidence regarding the existence or lack of a cumulative pathway to current irreducible complexity, there is no principled way to distinguish cumulative irreducible complexity from per se irreducible complexity.

As a result, individuals like Orr, who have unwavering faith in the evolutionary mechanism, remain unconvinced. They can still say, in effect, "We acknowledge that it looks irreducibly complex now; in fact we admit that all parts are now needed for its

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argument from irreducible complexity seeks to show that an abrupt pathway is not probable, it seeks to demonstrate what most evolutionists already accept. Thus as a practical matter, acceptance of irreducible complexity depends on whether it can be demonstrated that a cumulative pathway is unlikely.

[22] Although the application of specified complexity to cumulative pathways is sometimes referred to in broad terms, this is rarely fleshed out in proper detail in the irreducible complexity debate. Rather, intelligent design proponents tend to assume the lack of a cumulative pathway as an underlying subtext of the irreducible complexity argument, when it should be detailed as a separate inference to the best explanation, based on application of the specified complexity argument to cumulative pathways. In *Irreducible Complexity Revisited*, Dembski does in fact make a brief reference to specified complexity's application to cumulative pathways. It is therefore all the more disconcerting to find him stating in that same essay that a Darwinian mechanism "can readily account for" cumulative complexity. As detailed earlier, I believe this can only be explained if Dembski was conflating specified cumulative complexity and non-specified cumulative complexity.

current function, but that does not necessarily prove that no pathway existed and does not necessarily preclude a cumulative mechanism. It might make it harder for us to convince the questioning public; it might be more difficult to provide specific examples; we might be reduced to pure hypotheticals; but in the end, a cumulative mechanism is still theoretically possible."

I would note here that another practical difficulty in the irreducible complexity debate is defining what constitutes a "slight successive variation" as put forth by Darwin. Behe and Dembski tend to focus on a component-by-component pathway, but there is no particular reason why a cumulative pathway must proceed one component at a time. It could proceed in a less smooth, more abrupt fashion – two components at a time, three components at a time, a whole subsystem at a time and so forth, as proposed by co-option. All we are doing is increasing the number of parts in the availability variables of the probability equation, and thus increasing the improbabilities with respect to that particular variation.

Given, therefore, that cumulative irreducible complexity is a live possibility and given that there is no reason why more than one component cannot arrive on the scene all at once, proponents of evolutionary theory will continue to see all examples of irreducible complexity as falling into the cumulative category, rather than the per se category.

More importantly, to the extent that they do not accept the larger specified complexity argument or to the extent that they simply start with an *a priori* philosophical stance of allowing only explanations based on chance and necessity, then examples of stunning current irreducible complexity, such as the bacterial flagellum or the mammalian eye, will not be viewed as a refutation of the Darwinian mechanism, but in a wondrous twist of evolutionary logic[23] will be regarded as a confirmation of the great creative power of evolution.

Thus, without a conviction of the broader specified complexity argument, the evolutionist approaches the entire discussion from a different paradigm, and views the entire debate as taking place in the broader realm of contingent complexity, rather than in the narrow space of specified complexity. As a result, all examples of current irreducible complexity will be viewed as examples of non-specified complexity – either slowly cumulative or more abrupt. This thought process is illustrated graphically in **Figure 6**.

[23] Evolutionists assume that a cumulative pathway to irreducible complexity exists, not based on any probability analysis of the likelihood of such pathways, but because a cumulative pathway is required by evolutionary theory. It is certainly possible to indirectly attack this assumption by attempting to demonstrate the per se irreducible complexity of the system in question, as Behe and Dembski do, but I have argued that the more principled approach is to focus on specified complexity, because once the need for intelligent information input has been demonstrated, whether or not the pathway is cumulative or per se irreducible is irrelevant.

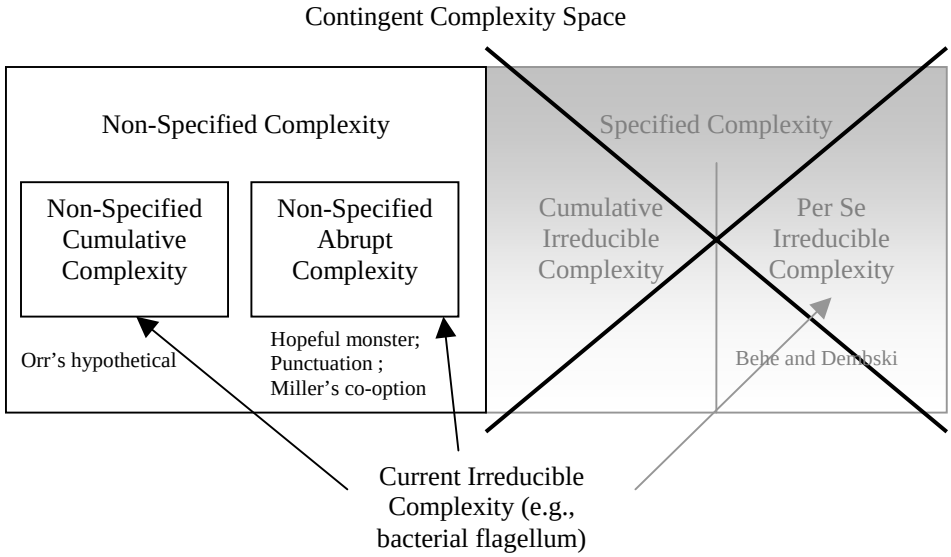

Figure 6 – The Contingent Complexity Space
Viewed by the evolutionist, without acceptance of, or with an a priori exclusion of, Specified Complexity

What the above illustrates is that in a paradigm that excludes or ignores specified complexity, the evolutionist will continue to view all examples of current irreducible complexity as nothing more than a confirmation of the broader possibilities of contingent complexity – either cumulative, in the case of Orr's hypotheticals, or more abrupt, in the case of Miller's co-option or Gould's punctuation. Furthermore, to the extent Dembski pronounces that a "Darwinian mechanism can readily account for cumulative complexity," it is then Dembski who, in the eyes of Orr and colleagues, appears to be self-contradicting.

Thus, the stake must be firmly placed in the ground at the specified complexity boundary, rather than the irreducible complexity boundary. The key to the debate is to make it clear that the debate is about specified complexity and that irreducible complexity is but one example of specified complexity.

Irreducible Complexity's Contribution

We have seen that the argument from irreducible complexity is in fact a sub-category of the argument from specified complexity and depends in large part upon the strength of the specified complexity argument as applied to cumulative pathways. The argument from irreducible complexity is thus not qualitatively different from the broader argument from specified complexity. It may, however, enjoy a slight quantitative difference. The quantity in question is time. Irreducible complexity's contribution is to challenge the Darwinian mechanism in the area in which it purports to be most adept: producing

mechanical function through a series of "slight successive variations," which implies time, lots of time.

Given enough time, Darwin thought and his disciples repeat today, anything is possible. Surely there is enough time, Darwinists assure themselves, why, millions, even billions of years; and in this they fancy they see a solution to the awful probabilities that otherwise beset the theory. Indeed, Darwin's whole theory is built upon this theoretical loophole.

For those who accept the argument from specified complexity and who realize that Darwin's loophole is an illusion (at least insofar as making any significant contribution to the evolutionary probabilities), the argument from irreducible complexity is unnecessary – almost superfluous. However, as an argumentative tool in the debate, it performs a valuable function in challenging Darwinian theory.

Darwin admitted in *The Origin of Species* that if "any complex organ existed, which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down."[24] Irreducible complexity takes up the challenge, and argues that some biological systems not only require all parts to function, but require all parts to arrive on the scene at the same time, without credible recourse to a long unbroken chain of "slight successive variations."

By arguing that the Darwinian mechanism is, in principle, incapable of producing a per se irreducibly complex system, the argument from irreducible complexity seeks to close the logical loophole that Darwinists imagine they see in the general argument from specified complexity. If Darwin is taken at his word, then upon closure of this logical loophole, his theory must be treated as having "broken down." And by further demonstrating that the probability equation, which is applicable to all specified complexity, is not met in the case of irreducible complexity, irreducible complexity provides another compelling example of the failure of evolutionary theory to explain specified complexity.

Irreducible complexity provides concrete examples of specified complexity, apart from the mathematics and the probabilities and the information theory. Irreducible complexity ignores for a moment the more difficult aspects of intelligence, consciousness and aesthetics, and demands that Darwinian evolution at least account for basic mechanistic function. Darwinism is a materialistic theory; can it explain even purely materialistic functions? Irreducible complexity argues that it cannot, and thus forces a reexamination of evolutionary theory's creative abilities and prompts a retreat from Darwin's particular version of that creation story.

[24] "If it could be demonstrated that any complex organ existed, which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down." Darwin, *Origin of Species*, p. 175. Darwin's oft-quoted challenge was logically accurate but intellectually insincere, as his very next phrase was, "But I can find no such case." He went on to suggest, "We should be extremely cautious in concluding that an organ could not have been formed by transitional gradations of some kind." Ibid. Thus, far from proposing a sincere test of his theory, Darwin sought to insulate his theory from challenge by setting up a rhetorically successful but scientifically hypocritical position that has persisted to this day: evolution should be assumed true unless there is conclusive evidence to the contrary.

If irreducible complexity can attack the basic mechanical function and if it can further successfully attack the incremental pathway to that function, then irreducible complexity successfully demonstrates that Darwinian evolution is, in principle, incapable of producing an irreducibly complex system.

It is doubtful whether the argument from irreducible complexity can completely close the logical loophole of a cumulative pathway, because absent an actual historical account, there appears to be no principled way to distinguish between per se irreducible complexity and cumulative irreducible complexity, without falling back on the broader argument from specified complexity, which faithful evolutionists reject.

Without a complete historical record, evolutionists can still follow Darwin's logical and rhetorical sleight of hand in *The Origin of Species*, which can be paraphrased in the following terms "Given that we don't have any idea how any of this actually happened, you can't prove that I am wrong."[25] Irreducible complexity presents evidence, however, that can only be refuted with ever more vague hypotheticals (Orr) that weaken the credibility of gradualists, or ever more abrupt, less believable proposals, such as Miller's hopeful co-opter. Irreducible complexity thus forces a re-examination of the creative power of the Darwinian mechanism.

Darwin issued a disingenuous challenge when he stated that the existence of a per se irreducibly complex system would cause his theory to "absolutely break down." Although Behe, Dembski and colleagues have not met the burden of conclusively proving that per se irreducibly complex systems exist, in my estimation they have certainly met the burden of proving that current irreducibly complex systems exist, and have further met the burden of going forward with the evidence to provide an inference that there is no cumulative pathway to such systems. The burden is now on the evolutionists to come up with a reasonable, concrete explanation for the existence of current irreducibly complex systems.

Conclusion

Dembski's latest essay, *Irreducible Complexity Revisited* cedes far more ground to traditional evolutionary theory than necessary, and makes a number of unstated assumptions, that might have been fleshed out in more detail. Specifically, Dembski fails to properly address the relationship between specified complexity, cumulative complexity and irreducible complexity. As a result, he offers examples that inadvertently mislead the reader into thinking that evolutionary theory has far more explanatory capability than it in fact does, and in the case of cumulative complexity, undermine his larger position.

[25] See discussion of Darwin's rhetoric under previous footnote.

Dembski's thesis would have been stronger had he (i) forcefully shown that the probability equation outlined for irreducible complexity is applicable to all specified complexity, including specified cumulative complexity, and then (ii) shown that the logical loophole evolutionists imagine they see in natural selection's theoretical ability to act over long periods of time is closed off with one particular example of specified complexity: that of per se irreducible complexity.

One of the principle challenges with the concept of irreducible complexity is defining a system's basic function within a particular environment, and thus determining the irreducible core. Suggestions that certain complex systems are not irreducibly complex often arise from a failure to comprehensively identify the system in question.

In limiting irreducible complexity to raw mechanical function, Dembski and Behe give up a tremendous amount, both in terms of the number of irreducibly complex features in the biological world, as well as the characteristics constituting an irreducible core. There does not seem to be a strong logical reason for taking this approach. However, there may be a pragmatic one. By taking this limited mechanistic approach, irreducible complexity directly challenges evolutionary theory on basic mechanical function, the area in which evolutionary theory is supposedly the most capable and the area in which natural selection is supposedly able to best operate.

The argument from irreducible complexity is a sub-category of, and depends upon, the broader argument from specified complexity. Upon acceptance and understanding of the broader argument from specified complexity, the argument from irreducible complexity challenges, on fundamental logical grounds, the ability of a gradual Darwinian scenario to produce certain complex biological structures.

Darwin's theory, which was once touted as a global theory able to explain the existence and state of nearly the whole of nature, has retreated to a relatively modest position of attempting to explain how certain organisms already on the scene might have varied, in vague and general terms, to become other organisms. As science progresses and more knowledgeable observers continue to challenge the evolutionary paradigm, the Darwinian theory of "slight successive variations" coupled with natural selection will eventually retreat to its rightful place: a novelty of nineteenth century rhetoric, offering perhaps a minor insight or two into relatively insignificant aspects of the biological world.

The irreducible complexity argument does not, and indeed cannot, offer a definitive answer regarding the origin and complexity of life on the Earth, but it is an important tool in the debate. By challenging the ability of "slight successive variations" to produce systems that exhibit irreducible complexity, and by demonstrating that a slow cumulative pathway to such complexity is unlikely, the argument from irreducible complexity lays down the gauntlet and forces evolutionists to retreat to more abrupt and organized scenarios, scenarios that require a great deal of information input, coordination and planning – in other words, design.

Irreducible complexity has answered, to the best ability of current scientific knowledge, the challenge issued by Darwin regarding the inability of “slight successive variations” to produce complex biological systems. Although Behe and Dembski may not have provided conclusive proof on this score, they have certainly met the burden of going forward with the evidence.

The burden is now on the evolutionists to provide a cogent response. □