

Climbing the Depths of Gravity

R. BENISH⁽¹⁾

⁽¹⁾ Eugene, Oregon, USA, rjbenish@teleport.com

Abstract. —

The current state of fundamental theoretical and experimental physics can be related to early human migration, ancient history and certain seemingly unrelated aspects of modern culture. This idea arose in a recent discussion whose overarching theme was *Nature*, which included as a sub-topic, *surviving* nature, especially surviving the dangers of mountain climbing. Why do we pit ourselves against Nature? Where does the spirit of bold or dangerous exploration come from? R. Buckminster Fuller hypothesized that this spirit evolved with a pronounced intensity—which may also be seen as a pronounced aggressiveness—especially in Western culture. Fuller contrasted this spirit with that of Eastern culture and traced the difference back to humanity’s “first psychological screening,” which differentiated between those who would sail into the wind from those who would sail with the wind. I argue that this spirit is also expressed in the way we do science, in general, and physics, in particular.

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The concept of climbing would be meaningless without gravity. We climb a flight of stairs and scarcely think of it as an act of fighting against a fundamental force of Nature. Natural forces continually impinge on our bodies and challenge our minds. Yet we routinely prevail over them; we do not succumb. When sailing into the wind or climbing Earth’s mountain peaks, this instinct, this life force—or whatever it is—is taken to an extreme, as though we need to assert that we ourselves are forces of Nature to be reckoned with. Just as this kind of assertiveness varies among individuals within a given culture, it varies from one culture to another. Rather than emphasize opposition, some societies manifest a greater inclination to harmonize with or yield to the forces of Nature. The origin of this dichotomy can be traced back to our early history. Its significance bears not just on our fascination with extreme sports, but also on our intellectual pursuits, on the way we view the world at large and on the way we understand—or fail to understand—gravity and the other forces that shape our lives. Scientists sometimes exhibit a sense of pride that is reminiscent of a victor, as though they have conquered a territory or scaled a peak. We will see that in at least one case, i.e., the study of gravity, this attitude is, if not immature, then certainly premature.

Let's begin by considering a major root of this aggressive spirit. According to R. Buckminster Fuller, the visionary architect, inventor and naval engineer, humanity underwent its first large scale "psychological screening" [1] as early migrants set off in roughly opposite directions from Indo-China long before the birth of Christ. Occurring earlier in time, the northeasterly spearhead sailed among the islands and shores of Eastern Asia, leaving many settlers along the way, but ultimately continuing north to Alaska and back south into the Americas. This migration was relatively "easy" because the direction was mostly downwind.

By contrast, the northwesterly spearhead sailed mostly into the wind, across the Indian Ocean and beyond. This required considerably more daring and ingenuity. Eventually, the westward surge brought advanced sailing technology to the Mediterranean region and from there, across the Atlantic to the Americas. The frontier conquering spirit soon thereafter made its way across North America and back to the Pacific. Fuller argued that many of the technological / industrial developments that made this land crossing so rapid had their origins in sailing. Fast-forwarding to the present, he noted that, "The American industrial civilization has been likened to a salmon which insists upon climbing waterfalls in order to propagate. Now ages old, no logic could justify sudden cessation of that force-eating northwesterly trend" (ref. [1] p. 131). But since the globe had now been covered, "horizontal" exploration became old news. The "force-eating" spirit remains, but has entered another dimension: it pushes now ever more vertically *upward*. It is not an accident, Fuller suggested, that the aerospace industry is largely based on North America's west coast.

Flying through the air or space in heavy metal containers is the culmination of a long chain of trials and errors, motivated by the desire to move farther, faster, bigger and higher in the face of all obstacles. Western culture, as the spearhead of this development, is often characterized by a determined opposition to, taming of or conquering of Nature. Figuring out how to move against the prevailing forces and a strong emphasis on individual initiative are the ways of Western man.

Eastern culture, by contrast, leans more toward surrendering to natural forces, going with the flow, conforming to society's expectations and a more contemplative outlook on the world. Examples abound, perhaps most poignantly in arts that were influenced by Zen Buddhism, where negative space is at least as important as the positive, forceful elements that it contains. The minimalist haiku, Japanese rock gardens and ink painting all pay deep respect to silence, unfilled intervals and receptivity. While acknowledging that both world views were noble in their own ways, Fuller pointed out the extreme "diametric attitudes toward life and death themselves—of ready commitment of self to death by the eastbound Asiatics, and stubborn refusal of it by the Westerners" (ref. [1] p. 130). Perfect examples are the "honorable" Japanese act of *hara kiri* and the fact that the world's highest summit, though residing in Asia, was first reached by an English expedition.

Especially during the latter two or three centuries of Western man's westward and eventually upward push, the physical tools that made it possible were backed up by theoretical principles. *Physical* conquering was facilitated by *abstract* conquering. The *forces* of Nature had to obey the *laws* of Nature. In some ways our attempt to understand the fundamental forces reflects the same aggressive spirit of westward / upward exploration. This is exemplified by how "frontier" researchers are sometimes approvingly characterized in the popular media. Commenting on recent cosmological speculations, *Discover* magazine author, Dennis Overbye wrote that "cosmologists drive the equations of physics like Grand Prix racers piloting sports cars." [2] In a recent *New York Times* eulogy for the late theorist, John A. Wheeler, it says, "Wheeler set the agenda for generations of

theoretical physicists, . . . students and colleagues [sending] them, minds blazing, to the barricades to confront Nature.” [3] Lately, however, Nature has not yielded; she is not divulging the answers that Wheeler’s protégés and other physicists have come to expect; things are not adding up. It has been nearly a century since the last major advances have occurred and some physicists have begun to express their reservations about the prevailing trends of research. [4] Maybe the barricades remain in place because physicists are racing and blazing in the wrong direction, with a state of mind that is not conducive to perceiving Nature’s next big clue, with a state of mind that inhibits looking where they have not yet looked.

Could it be that progress in fundamental physics has been thwarted because we are fixated on too narrow an approach, as though we were afraid to look down? What would happen if, instead of incessantly climbing (fighting against gravity) in this one direction we tried surrendering to it (falling) instead? I don’t mean falling to collide with the Earth and die. I mean to observe the falling of a ball, for example, into a larger massive body whose diameter has been cut away *so there is no collision*. Imagine floating in outer space and dropping a ball into a hole through the center of a much larger massive sphere. What happens? Curiously, this simple question remains unanswered. Nobody has ever done the experiment.

In 1984 I wrote to Wheeler to suggest that we fill this gap in our empirical knowledge. Besides his reputation, another reason for writing to him is that in one of his books he had written about what is *supposed* to happen in the circumstance described above. [5] What’s supposed to happen is that the ball oscillates back and forth from one end of the hole to the other. I wrote to urge that we test this prediction. Wheeler wrote back saying: “The best place to see a spherical distribution of mass with a hole in it is a star cluster. Spectroscopic observations show that individual stars oscillate right through it in the stated manner.” [6] Putting this response in the best possible light, Wheeler was mistaken. More realistically, I suppose, he lied; Wheeler knew he was only guessing; he cited no references. A quick search in the UC Berkeley Astronomy Library at that time yielded evidence of the paucity of our knowledge of the motions of stars in their clusters. I subsequently embarked on a more thorough search which continues to this day, looking for astronomical data bearing on this question.

In 1996, after the Hubble Space Telescope had been in operation for a few years, I wrote to Kyle Cudworth, an astronomer who had made the motions of stars in clusters his specialty. Even the world’s most powerful telescope cannot yield the kind of data that Wheeler had claimed we have already gathered. Cudworth replied: “I am quite sure that Hubble observations have not directly shown stellar oscillations through the centers of star clusters. . . . The interpretations of the data make assumptions [that] make general statements that may sound as if everything is known, but that’s very different from the kind of clear observational demonstration you (and I) would want.” [7] Twelve years after disposing of my inquiry with his guess, Wheeler was still wrong. Now, in 2009, the situation is not much different. If anything, the meager data on star motions in clusters is beginning to reveal an anomalous pattern which suggests that the standard prediction may indeed be incorrect. [8, 9]

The situation is especially curious because the gap in empirical knowledge is so big. What we know about gravity is based almost entirely on observations from the horizon upward. Can we claim an understanding of gravity if we don’t know the result of yielding to it; of letting an object fall as far and as long as it can possibly fall by taking away any surface upon which it could “land”? No, we cannot. We can guess all we like, but without empirical evidence, the most important part of the *science* of gravitation remains

conspicuously missing. Maybe the object will not oscillate as predicted. We cannot be sure until we've tried it.

I've made many attempts in writing—letters and papers—to generate interest in doing the “interior falling” experiment. Physicists are unimpressed because they think they already know what would happen. They thus give their theories, their abstractions, the status that good scientists are supposed to give only to the real world, to empirical data. They are so bold, so confident in their mathematical scheme, that they feel no need to surrender to gravity, to admit their ignorance of it, to look inside to see if the actual *force* of gravity conforms to their invented *law* of gravity.

What if an understanding of gravity and how it relates to the other forces of Nature becomes essential for humanity's survival? Then the situation could come to resemble that of the desperate mountaineers whose lives turned on the simplest decision: “When there is only one way to survive in the mountains, you must check every possibility to the very end in order to find the one that works.” [10] Of course, this is just one instance of the general credo of all good scientists and detectives, to leave no stone unturned. “Check every possibility to the very end.” But in the case contemplated here, what's at stake is not just the fate of one small party of climbers. As our continued technological advance makes Fuller's appellative, *Spaceship Earth* [11] all the more appropriate, it becomes increasingly likely that the fate of all humanity will someday depend on a much deeper understanding of natural forces than we presently possess.

Blazing and racing to confront the barricades of Nature—the attitude reflected by this characterization—may have become an obsolete, suicidal approach for trying to obtain this knowledge. Surely much has been learned from it. Western society's fruits are plentiful and mostly beneficial. But this (moving faster farther heavier higher) heritage has unwittingly fostered a kind of blindness and insensitivity that undoubtedly affects more than our scanty understanding of gravity. What else might we be missing because of it? As Asiatic and Native American cultures are increasingly succumbing to Western influence, it is not yet too late to encourage some of their earlier characteristics. In particular, I think we need to humble ourselves, to temper our relentless outwardness and to not just theorize about, but to actually look under Nature's unturned stones.

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