The Importance of Riemann For Our Future

by Bruce Director

March 20—In the summer of 1854, a twenty-eight year old aspiring professor stood before the mathematics faculty of Göttingen University, to deliver the lecture required to habilitate into their ranks.[1] Unlike on most such occasions, where the aspirant seeks to impress upon the assembled his ability to present the subject matter in a manner consistent with prevailing standards, Bernhard Riemann told the conclave that they, like those similarly situated for the past two thousand years, were horribly mistaken. They had missed the obvious. Their approach toward science was wrong. He situated his polemic in the domain of geometry, but his point was much broader, aimed at overthrowing a debilitating flaw in scientific method that had infected every field, and was hindering the prospects for future progress. Specifically, he insisted that scientists had accepted certain precepts and axioms as the foundations of geometry without ever inquiring into whether these foundations were even true. Consequently, he told them, all they believed could be, and most likely is, wrong. And further, that there was nothing they could do to rectify their state of self-deluded ignorance, unless they abandoned their department of mathematics altogether, and joined with him in the quest for real knowledge.

Carl Friedrich Gauss (1777-1855)

In this lecture, as well as in the wide-ranging output of his all-too-short creative life, Riemann ignited a revolution that paved the way for all progress in science since. He forced science to recognize that the generation of concepts comes before calculation, and that only a rigorous examination of the workings of the creative mind, not logic or mathematics, can provide a secure foundation for progress in Man's understanding and mastery in, and over, the universe. Progress in science depends on digging up and clearing away the false, but unquestioned underlying assumptions, that prejudice our thoughts and hinder our ability to create entirely new ideas.

However, with few exceptions, most notably Riemann's teacher, Carl Friedrich Gauss, Albert Einstein, and Lyndon LaRouche, Riemann's ideas have either been attacked or, at best, grudgingly acknowledged and ignored. Instead, science, especially since the ascendancy of Bertrand Russell's logical reductionism at the beginning of the Twentieth Century, has been shackled in a tangle of mathematical rules that chain thought to the very axioms and assumptions that must be broken. The conflict that has raged over the past 165 years concerning Riemann's method touches on all the essential struggles that mankind has faced in the intervening period, and that confront us today. Thus, LaRouche is entirely

1. Bernhard Riemann, "On the Hypotheses which Lie at the Foundation of Geometry" (1854) in English translation.

justified, and prescient, in raising, once again, the significance of Riemann's thought in this present period.

Essential Features of Riemann's Thought

To fully grasp this meaning would require a thorough and exhaustive study of Riemann's corpus, which is beyond our scope here. Nevertheless it is possible, in this short space, to acquaint the reader with the core of the issue by touching upon some of the essential features of his contributions.

The habilitation lecture is a good place to start. Riemann had come to Göttingen several years earlier, intending to study theology, being the descendant of several generations of Lutheran ministers. Shortly after arriving, he switched his attention to science, having been recruited by Gauss, who recognized in Riemann a creative spark rare among his other students. Gauss, already an old man by the time of Riemann's arrival, had himself generated a plethora of revolutions in science. But during most of his career he labored in the climate of enforced pessimism that dominated Europe in the period following the oligarchical reaction against the Leibnizian spirit of the American Revolution.

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Georg Friedrich Bernhard Riemann (1826-1866), a student of Gauss.

Absurdity of Euclidean Geometry

As a result, though Gauss was justly famous for many astounding scientific breakthroughs, such as his discovery of the orbit of Ceres, and new discoveries of the nature of gravity and electromagnetism, he kept much of his deep thinking on the fundamentals of science to himself. Very dear to his heart were his insights into the characteristic flaw of mathematics—that the true nature of the universe, and man's role in it, cannot be discovered by mathematical formulas or deductive logic.

This failing infected all science. Instead, Gauss recognized that the subject of science was the interaction of the creative powers of the human mind with the physical universe, which created new concepts and new states of existence.

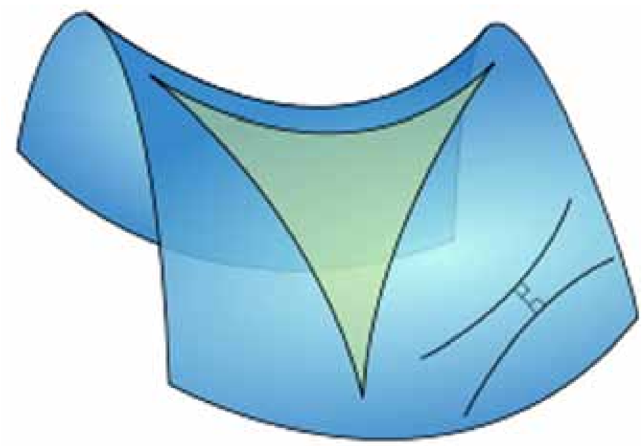
Exemplary of this are Gauss's insights into the complete absurdity of what has become known as Euclidean geometry. The acceptance of Euclidean geometry as physically real, had been the dominant thought in physics and mathematics, but also more generally. The oligarchy's favorite philosopher at the time, Immanuel Kant, had insisted that Euclidean geometry must be true because it was the only geometry the mind was capable of conceiving that was consistent with sense perception.

Gauss, like LaRouche many years later, found this standpoint to be absurd, and mind-deadening. In his earliest private writings, Gauss noted that all the results of Euclidean geometry were derived by a deductive progression from an unproven, and unprovable, axiom of parallel lines. Similarly, Gauss delighted in pointing out that something as simple as the distinction between right and left, could never be decided by mathematical procedure, but required a reference to a physical effect. Although Gauss's notebooks are filled with discussions about the stupidity of accepting Euclidean geometry as true, he never dared to state this publicly. On numerous occasions, Gauss told his closest friends that he could never publish his thoughts in his lifetime, for fear of backlash.

Riemann's Habilitation Lecture

It is not hard to imagine the delight of the 78-year old Gauss, when his young protégé, Riemann, approached him for advice on what subject to present for his habilitation lecture. Riemann presented his mentor with a choice of three subjects, the last of which was on the foundations of geometry. Gauss insisted that Riemann make this his subject.

It is also not hard to imagine, and eyewitness accounts confirm it, that the normally dour Gauss was vis-


Tad Boniecki/soler7.com

Were you taught that the sum of the angles of a triangle must always be 180 degrees?

ibly delighted when Riemann opened his lecture:

> It is known that geometry assumes, both the notion of space and the first principles of constructions in space, as given in advance. She gives definitions of them which are merely nominal, while the true determinations appear in the form of axioms. The relation of these assumptions remains, consequently, in darkness; we perceive neither whether, and how far, their connection is necessary, nor *à priori,* whether it is possible.
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> From Euclid to Legendre (to name the most famous of modern reforming geometers) this darkness was cleared up neither by mathematicians nor by such philosophers as concerned themselves with it. The reason of this is doubtless that the general notion of multiply extended magnitudes (in which space-magnitudes are included) remained entirely unworked. I have in the first place, therefore, set myself the task of constructing the notion of a multiply extended magnitude out of general notions of quantity. It will follow from this that a multiply extended magnitude is capable of different measure-relations, and consequently that space is only a particular case of a triply extended magnitude. But it then follows as a necessary consequence that the propositions of geometry cannot be derived from general notions of magnitude, but that the properties which distinguish space from other conceivable triply extended magnitudes are only to be deduced from experience. Thus arises the problem, to discover the simplest matters of fact from which the measure-relations of space may be determined; a problem which from the nature of the case is not completely determinate, since there may be several systems of matters of fact which suffice to determine the measure-relations of space—the most important system for our present purpose being that which Euclid has laid down as a foundation. These matters of fact are—like all matters of fact—not necessary, but only of empirical certainty; they are hypotheses. We may therefore investigate their probability, which within the limits of observation is of course very great, and inquire about the justice of their extension beyond the limits of observation, on the side both of the infinitely great and of the infinitely small.

Riemann then went on to outline the basic means to replace the mathematical fantasy-geometry of Euclid with a real physical one. In such a case, assumptions, such as the number of dimensions, the curvature, or the discreteness or continuity of space, are no longer given by *à priori* assumptions, but only determined by real physical investigation. To do this, Riemann insisted, one must reject the dogma that Euclidean geometry must be true because it is consistent with sense perception. As Riemann noted in the above-cited excerpt from his lecture, it is only when science reaches beyond the domain of sense perception, that real physics begins.

This pursuit would eventually become the basis for Einstein's and Planck's discoveries in atomic physics, as well as Einstein's theories of special and general relativity. It is beyond our scope here to delve more deeply into the rich field of ideas contained in Riemann's short lecture, but suffice it to say that Riemann's concluding admonition, "This leads us into the domain of another science, that of physics, into which the object of today's proceedings does not allow us to enter," gave Gauss great delight, and left many of the other participants stewing.

Science Reaches Beyond Sense Perception

The approach to geometry expressed in Riemann's habilitation lecture was preceded, and followed, by its application to many areas of science including gravity, electromagnetism, light, hydrodynamics, thermodynamics, and physiology. In all cases Riemann focused on the contradiction that arose between the behavior of physical phenomena, and the prevailing mathematical concepts which were largely based on the relationships that seem obvious from the standpoint of sense perception.

Like Plato, Kepler, and Leibniz before him, Riemann understood that sense perception is only a shadow of reality, even in domains accessible to the senses, let alone in the very large and very small. This is obviously the case in investigations concerning non-perceptible phenomena such as gravity, light, electromagnetism, and heat, which cannot be perceived directly.

Riemann focused on the creation of new concepts that advance our understanding of the principles underlying these phenomena, instead of merely describing the observed effects, as when he pioneered what have become known as complex functions.

The Role of the Human Mind

Though this work has been falsely represented as purely mathematical investigation, largely because the history has been written by his enemies, Riemann's development of these ideas is based on his intention to dig deeper into the direct role of the human mind in the universe. Toward what would be the end of his life, he was led to study the interaction of the mind with the physical world by investigating the paradoxes associated with hearing.[2] In his uncompleted study, Riemann poses the contradictions between the simply mechanical concept of sound, pushing and pulling on the hearing organ, and what hearing actually does. No mechanical explanation of sound can account for the mind's ability to distinguish subtle changes in, for example, timbre and tone, that are essential to conveying ideas.

And this brings us to what is the unifying quest in Riemann's scientific work most desperately needed today: developing a deeper capacity to grasp the nature of human creativity through its role in the universe.

In 2018 a Chinese spacecraft will land on the far side of the Moon and peer into the universe from a vantage point never before accessed by Man. At that point, everything Man has thought about the nature of space will be brought into question. It will be a triumph for Riemann's thought. Its prospect reminds us why we urgently need a new appreciation of Riemann today.

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2. Bernhard Riemann, "The Mechanism of the Ear" (1866) in English translation, *Fusion*, Sept.-Oct. 1984, p. 31.