

# Preface

*'Tis the good reader that makes the good book; in every book he finds passages which seem confidences or asides hidden from all else and unmistakably meant for his ear; the profit of books is according to the sensibility of the reader; the profoundest thought or passion sleeps as in a mine, until it is discovered by an equal mind and heart.*

R. W. Emerson

I was always very curious about how one gets around to preparing a book and so perhaps as a reader you are as well. Mark Twain takes me into his confidence with the words: "...there ain't nothing more to write about, and I am rotten glad of it, because if I'd'a' knowed what trouble it was to make a book I wouldn't'a' tackled it, and ain't a-going to no more." In contemporary practice portraying a prelude many not have *argumentum ad hominem* much in vogue. But in the entire gamut of my reading experience, I never laid hands on any treatise without going through the very pursuit of the author first. On the same ground, it remains almost a compelling choice for me to insinuate what inspires me. I plead to exempt me from the *egalitarian fallacy* of trying to make all persons alike.

Every true research is but autobiographical and so is the following monograph. At a personal level, trying the best to be very meticulous and carping on almost every aspect that crops up in my way even results in imperfect performance, and thus further suffering a setback of dilemma on decision. Riding on the lacuna of my habit of witnessing ill decision and the stigma of a perfectionist, I was prompted to compose my first scientific writing [1] while I was a second-year undergraduate student in 1991, of a 4-year Mechanical Engineering degree program at the National Institute of Technology Durgapur, India, formerly recognized as Regional Engineering College Durgapur. After many years of latency, in January 2007, I submitted my doctoral thesis [2] haunted by my way of dogma and dilemma and by June 2007 I defended. In 2009, my doctoral thesis was selected only in the group of top five by the Prigogine prize selection committee for the best doctoral thesis in thermodynamics and hence my work could not see the delightful sun of scrutiny by a wide range of readers. Today, I continue to regard that my scientific approach has not been well circulated, especially among physicists. Until in January 2012, when I got a call from Adrian Bejan to publish a book chapter [3], I did not get a pat on my back. By now I got older and somewhat more immuned and case hardened about

what other people would think of my preparation and presentation. Granted by Heaven, maybe I can afford to toy myself with the fascinating idea of writing a book. Jonathan Swift has rightly pointed out that, “if a Writer would know how to behave himself with relation to Posterity; let him consider in old Books, what he finds, that he is glad to know; and what Omissions he most laments.”

The essay by Sadi Carnot [4], about a quarter of a century earlier than the terminology adopted by Thomson [5], is a milestone example of how the proponent of a new theory has no choice but to misuse the language of old theory [6]. Thus, without a constant misuse of language there cannot be any discovery, any progress [7]. Tuesdell [8, 9] addressed the celebrated failure of thermodynamics in the nineteenth century, accursed by misunderstanding, irrelevance, and retreat. In the spreaded span of the late twentieth century to the beginning of the twenty-first century, through the constructal theory (fourth law of thermodynamics) [10–12] proposed by Bejan, a consistent brilliant progress has been made in the unified description of nature as well as artificial (engineered) systems. Leib and Yngvason, [13] for the first time in the history of thermodynamics, made it scholarly possible to realize the concept of entropy purely on a macroscopic basis, in contrast with the system theoretic approach of thermodynamics by Haddad et al. [14]. In company with these recent developments, the present treatise is a systematic development and application of a new theory of motive force (power), long due after Carnot [15, 16]. The former faint ideas of the author, which go by the label “heuristic” [17] and “method of synthetic constraint” [18], are formally forged into a generalized formulation recognized as a natural tendency and hence perhaps may be regarded as a law of nature.

The crisis of totalitarian victory is, from the perspective of history, an awkward predicament characterized by intellectual sloth, lack of imagination, and wishful thinking [19]. It is well known that no science develops systematically from one single starting point according to a definite preconceived plan, but its development depends on practical considerations and proceeds more or less simultaneously along different lines, corresponding to the many ways of looking at the problems, and to the times and views of the investigator. Thus, science cannot attain its objective by direct means, but only gradually along numerous and devious paths, and therefore a wide scope is provided for the individuality of the worker [20].

Admittedly, if we do not succeed in solving a mathematical or physical problem, it is often because we have failed to recognize the more general standpoint from which the problem before us appears as a single link in a chain of related problems. This way to find generalized methods is certainly the most practical and the surest one, for he who seeks the method without having a definite problem in mind seeks in vain [21]. For reasons, in this present endeavor, it is preferable to choose some topical problems that are of common interest both to physicists and to the engineering community. This effort is inspired by the seminal call of Bejan through a letter [22] that appeared in the Journal of American Association of Physics Teachers (AAPT).

Nowadays, it has become a fashionable trend [23–25] to publish volumes of empirical material without any thesis or antithesis, such as figures, photographs,

computer generated images, and essays on the observation that both natural and engineered systems exhibit a category of symmetry [26, 27]. In contrast, this monograph is a submission against such strategies that may eventually open up the vision of contemporary as well as the next generation of researchers. This, at any rate in my opinion, lack or even absence of figures accompanying the analysis or description, actually stimulates the abstract thinking process, which is eventually the key to the problem solving aspect.

The purview of this current script is to purport a commonality of a diverse view of observations. At the present state of human knowledge and affairs, such a unified exact description of everything on a general footing, both at the macroscopic as well as microscopic [28] levels, will only be poor, vague, and scanty. A theory that is too general is frequently too weak. There is a way out, which I frequently describe to my disciples as an approach from the “periphery to the center.” We must not look at the intricacies of the objects and events at the outset; we will keep a habit of looking into simplicities out of complexities and thus concentrate on the outer aspects of the subject during introspection. We will go on adding details in succession until we are undone with a realistic solution to the problem at our disposal. Thus, we will be able to compare apples to oranges. Dwelling on this qualitative aspect, everything appears to be a ramification of a single principle and a unique perspective, which is the object of the present treatise.

This memoir is the faithful disposition of a discourse that I witnessed and withstood with pain and pleasure as a rational as well as an emotional being. Education is the manifestation of perfection already present in man. This study is a passage to that destiny of freedom: from bondage to spiritual faith, from spiritual faith to great courage, from courage to liberty, from liberty to abundance, from abundance to selfishness, from selfishness to complacency, from complacency to apathy, from apathy to dependency, from dependency to back to bondage again. Where and how [29] do I break the chain? The teleological perspective [30, 31] of the present work that tacitly follows in disguise is however not a theme of this treatise. The highest motto underlying the curtain of thorough scientific investigation is but a true aspiration for self-knowledge and self-realization [32], or at least the awakening and sharpening of human faculties already attributed to us. For any conceivable physical principle, there must be a corresponding counterpart of mental (psychological) principle, which in turn is a replica of a metaphysical (spiritual) principle. Our complete realization will actually mean an assimilation of a principle distinctly at these three different levels of human perception. One will then at least be able to rejoice in an added confidence in thought, speech, and action [33]. These exercises were part and parcel of the character of the founders of modern science [34, 35]. An earnest study habit [36] will enable the reader to attain a greater vision to see, which is attributed only at the elevated consciousness [37]. For example, the clairvoyant investigations [38] into the structure of matter carried out by theosophists Besant and Leadbeater was confirmed [39, 40] by the physicist Philips through experimentation and scientific reasoning. As a matter of passing mention, a reader can check the progress on his way to attainment: while in deep thought (meditation), in a single chance you are able to look up a topic

from a book without consulting the index first. Accordingly, I have adopted the following principles in my research, with *noblesse oblige*.

Research requires curiosity, diligence, devotion, and aimful thinking [41, 42]. The Latin *mundo corde* describes it better. One can learn so much out of anything, if one can truly start with a blissful ignorance [43]. A perished thought is surely a germinating one. Many a sleepless thoughtful night can give birth to a resourceful dawn. Also, a researcher has first much to do with the overcoming of one's own inferiority complex [44, 45]. As such, one should publish a piece of work when it is even imperfect and incomplete than perfect and complete never. To start with, topics may be chosen with reference to some works of authorities on the subject field. Refinement, generalization, and/or dismissal of their findings could be found as a means of gaining confidence in the research progress.

There are at least two distinct ways in which a subject field can be developed. One is the "horizontal" expansion into the more remote fields intersected by the subject. Another is the "vertical" expansion, that is, a deepening of our present understanding (inception, conception, and the perception) that defines the province. A large number of contemporary workers continue to regard the field of classical thermodynamics as matured and saturated; that is precisely why such old and prevalent topics are picked up. There remains not only a merit in questioning the established point of view, but also the fact that a true research frontier is, quite often, a territory overlooked by the crowd [46]. For such reasons the classical and fundamental research is sought, so that we learn to answer the question "why" and not "how" alone [47]. In every inch of the work, a good balance between the case-specific subjective findings and the general objective reality [48] of a scientific query of general nature [49] is being established.

Regarding the research publication guideline, a piece of advice by Moran was followed [50]: (a) If the work is in the realm of theory, then what truly new insights or relations are achieved, and what is their importance? (b) If the endeavor is in the realm of engineering, then what is the contribution? (c) Does the development provide at least a picture book engineering pointing the way to a significant evolution in some aspect of engineering practice? Also, the present research constantly haunted a physical principle devoid of many computer produced tables and graphs [25]. It was the untiring motivation of the current investigation that the purpose of the computing is insight but not numbers [51].

In my stride I am blissfully aware of the very presence of my masters who preached me to inculcate discipline, method, scholarship, taste, and style up to an adorable personality, for my own survival and succor. For such reasons, it is perhaps not untimely and unprovoked to support the view [52]: "It is recorded that Sancho Panza, when he saw his famous master charge into the windmills, muttered in his beard something about relative motion and Newton's Third law. Sancho was right: the windmills hit the master just as hard as he hit them."

Some peers may rate my presentation as rushed, unwise, and inordinately pretentious and abstract. Perhaps it is. But it is too late now to escape the influence of my masters who taught me that prudence is a rich old maid courted by incapacity. Should they pay heed to the warnings of William Blake?

“When all their Crimes, their Punishments, their Accusation  
of Sin,  
All Jealous Revenges, Murders, hiding of Cruelty  
in Deceit  
Appear only at the outward Sphere of Visionary Space and  
Time  
In the shadows of Possibility, by Mutual Forgiveness for  
Evermore  
And in the Visions & in the Prophecy, that we may Foresee  
& Avoid  
The terrors of Creation, Redemption & Judgment.”

Durgapur, India

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