BOOKS: PHYSIOLOGY

The Race To Understand the Outlier

by Bernd Heinrich

Few passions have inflamed human minds and bodies more than spending the shortest time possible running between two points. And no better and more comprehensive a scientific treatment of the topic exists than Tim Noakes's *Lore of Running*, now in its fourth edition. This encyclopedic book, rightly called "The Bible of Running," summarizes in 1277 pages often controversial research spanning the last century and beyond.

Lore of Running
4th ed.
by Tim Noakes
Oxford University Press Southern Africa, Cape Town, 2001. 1277 pp. R400. ISBN 0-19-578016-7.

Running combines science with sport, lifestyles, history, and entertainment, through the disciplines of physiology, medicine, psychology, anthropology, and philosophy. Noakes, a physician and researcher at the University of Cape Town with numerous scientific publications on running physiology and a rower who became an ultramarathon runner, discusses the physiology relevant to human running performance, reviewing a literature of over 3600 references which are not all that could—and in some cases should—have been included. He also introduces recommended training schedules and biographies of noted runners with their philosophies, training methods, and achievements. Throughout, Noakes integrates research results with reference to underlying physiological mechanisms.

A central thesis of the book is the concept of a "Central Governor" that controls pacing, whether it be for the mile, marathon, or ultra-marathon. This concept posits that the muscles feed information of limiting factors (such as energy stores, for example) to the brain, which responds through a feedback loop to the muscles, so that the exhaustion point can be delayed to near the anticipated end of the race. According to this theory, fatigue is a sensation that is part of the brain's pacing strategy, which limits the activation of the muscles. The muscles thus act both as sensory organs that supply information to the brain and as effectors responding to brain activation. Noakes postulates a series of other models that integrate the Central Governor model with modulators such as the "glycostat," "thermostat," "mechanostat," and "cardiostat."

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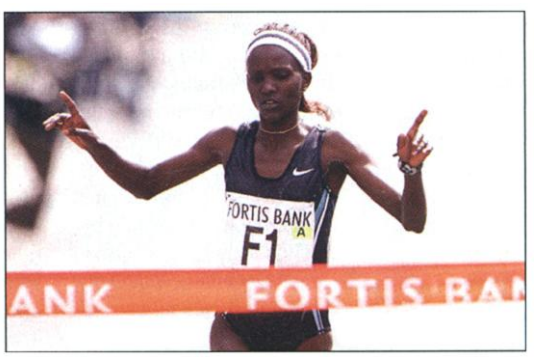
Running is a difficult topic to deal with experimentally because of the many variables and their complex interactions. The various theories formulated by Noakes do provide a framework to explore insights into unanticipated variables. It is a first attempt at a revolutionary approach to exercise physiology that will engender debate and research. But I'm not sure that his concepts quite succeed in being predictive.

The "problem" is that any treatment of human running performance almost invariably deals with individual performance rather than the overall average. Most runners and students of running are concerned with what factors will enable superior performance—specifically the outlier points. And these athletes are not interested in just the one outlier point in a hundred, but in millions or billions—ultimately, in the outlier that will produce a national or a world record. What does this one runner in millions have that others lack, and how does one get it? We will only be able to attain the performance of the outlier points when not one, but all the limiting factors and innumerable conflicting demands and interactions are understood, accounted for, and dealt with.

Ultimately, though, there is no one physiology of running because the limiting factors of a sprint, middle-distance event, and ultra-distance event are vastly different. Excellence in one event may be correlated with excellence in another, but peak excellence in one necessarily excludes peak excellence in another. Although "rules" or generalities can be deduced from individual empirically derived data points, those rules are descriptions and not laws. They cannot be uncritically applied to any one individual of specific genetic predisposition, age, or experience, never mind the idiosyncratic thoughts and motivations in the mind of the runner that may make "all" the difference.

Simplifications and sometimes lack of understanding of underlying mechanisms have resulted in running myths, and Noakes explodes a number of them. The results of any one study may be valid, and may seem to apply generally, but they nevertheless come with the caveat of "all things being equal"; with hundreds of variables, they almost never are. There is no simple explanation for the ultimate speed a runner can attain. Rather, a long chain of rate-limiting steps contribute to the overall effect, so if one link in the chain holds then it inevitably stresses the rest of the physiological steps.

Of the generalities that can be derived, some seem counterintuitive, and may not apply to the average performance yet must be addressed in achieving a performance that is far beyond average. For example, proper liquid management varies enormously under different running conditions and distances, and it might be useful to know that cold liquids are absorbed almost three times more quickly than warm ones. Similarly, fuel depletion is critical in longer running distances, and carbohydrate ingestion and absorbtion from the gut becomes an important factor. Such information might make it useful for a runner to know that glucose is absorbed more quickly than fructose, but total carbohydrate absorption is greater if glucose ingestion is combined with fructose. Too much of a good thing—especially in the amount and kind of training, drinking on the run, eating, and salt ingestion—is also possible. Those who do not heed the basics as revealed by the best research and the example of the most accomplished runners are doomed either to fail or to perform their own experiments.



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The object here is to profit from the experiments of others though. Who have been the great runners and what can we learn from their sacrifices? To what factors can we attribute their success? There are no certain answers on how to succeed, but any serious runner or one interested in the complexities of the responses and limits of the human body will want to own Noakes's book. It is not intended to be digested in a sitting or two, rather it is to be read and referred to.

Tim Noakes is of the South African running tradition, that is to say he is a devotee of the 54-mile Comrades Marathon. His is the best book on running that I am aware of. Many others have been written about running and runners, but none integrates so much science, medicine, history, and philosophy into one package.