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*To my daughters, Audra Marie and Sarah Tupper,  
who keep me youthful and zealous about the future,  
and my loving wife, Nancy Jo,  
whose presence is a blessing from God.*

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# Foreword

Ten steps easy...ten steps hard...twenty steps easy...twenty steps hard...one hundred steps easy...one hundred steps hard—this has been one of my most effective training mantras, and it was taught to me by Jack Daniels.

If the best measure of good training techniques is staying power, then Jack Daniels has set the gold standard. I continue to employ his simple training techniques twenty-four years after meeting Jack in 1980 at Nike's first research lab in Exeter, New Hampshire.

"Jack Daniels?" I questioned, thinking that his name was a set-up for a punch line. I learned differently soon enough. A gentleman and a scholar, Jack Daniels is the epitome of an exercise physiologist, athletic researcher, and coach, who does it the right way—with scientific data, organization, simple explanations, and heart. Jack deserves all the accolades and praise that he receives from his colleagues in the field of exercise physiology and from those in the running community.

All serious athletes endure periods of subpar performance or injury, and believe me, these periods can be filled with nothing less than self-doubt and panic. How wonderful it has been to know Jack and to have the opportunity to listen to a voice of calm and reason during such times. More often than not, Jack would lay out a sound strategic and proactive plan to overcome the hurdles and obstacles I was facing. Waking up from arthroscopic surgery 17 days before the Olympic Marathon Trials in 1984, I was an emotional wreck. Although I reached out to a number of professionals to help speed my physical recovery, it was Jack Daniels who eased my nerves and provided me with creative and practical techniques to maintain my fitness level—both physical and emotional. Were it not for the bicycle that Jack mounted on his treadmill for me to pedal with my hands, I would not only have gone berserk, but I would probably have snuck out for a run the day after surgery, thereby ruining my slim chance of healing properly before the upcoming Trials.

I'm thrilled that Jack has decided to share his insights and knowledge in this book. I can only hope that others benefit from his expertise as much as I have during my career. You're in for a comprehensive and easily understood lesson in running, coaching, and exercise physiology.

And when I'm passed on the roads by someone mumbling "ten steps easy...ten steps hard," I'll know that the circle has been completed. Enjoy!

Thank you, Jack!

—Joan Benoit Samuelson

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# Preface

My main purpose for writing a book on running was to try to simplify the terminology and workouts so that the same types of training could be used for all categories of runners, from relative beginners to the elite. My motivation, during the 15 years I spent working on the first edition of *Daniels' Running Formula*, was the seeming lack of general training advice that could be used with beginners as well as more accomplished runners.

When I decided to become a runner, after spending my high school and college years as a swimmer, I found that most of the advice I heard and read about came from a coach telling other coaches how his star runner trained. The programs of these stars didn't really seem applicable to runners who were just getting started, or to serious runners who were not yet at a high performance level. More often than not, though, the practice was to train everyone the same way, often too hard, and hope that some would survive (the prevailing attitude being that anyone who couldn't keep up might as well give up on the sport).

I was not an elite runner, nor were the runners I was coaching when I first began my college coaching career, so I decided that I would study the science of exercise and training and see what could be applied to training runners. This took me to Sweden, where I was lucky enough to have some top physiologists as teachers (P.O. Åstrand and E.H. Christensen, to name two who influenced me greatly). After that I decided to pursue my PhD in Exercise Physiology at Wisconsin, where Bruno Balke served as my major professor. In addition to being an outstanding physiologist, Balke had been a good athlete in his native Germany, and he was also a specialist on exercise and altitude. Together we did several years of altitude research, leading up to the 1968 Mexico City Olympics, and this put us in contact with the top distance runners of that era. Interestingly the 26 runners who were the subjects of my dissertation all returned for follow-up testing 25 years later; this was one of the most encouraging research studies I have ever been involved in, and it made me feel that I had been on the right track in training my elite runners.

These elite-runner subjects from the 1960s and '70s were followed by more elite runners during the 1980s and '90s. If you are willing to listen, you can learn a great deal from successful runners, and something they all seemed to agree on is that a major key to success is to avoid injury and to immediately take care of the injuries that occur despite all precautions. In a sense, the runners we send to the Olympics are not necessarily our top runners, but they are very good runners who have avoided injury at

critical times. With this in mind, I have designed programs that optimize the benefits of different types of training and avoid placing too much stress on the runners.

Many of the elite runners I worked with did not start out to be runners. Often they took up running when they were cut from another sport or while they were doing some running as conditioning for another sport; by chance, they found that they had a special ability for running and stuck with it. Many said they wish they had received more information about how to train and how to compete.

One important thing I've learned as a coach of distance runners is that no one has all the answers about how best to train and that no single system suits every runner equally well. Therefore, I decided I would take what some great scientists and great runners had passed along, toss in what I learned as a college coach, and try to put it all down in a way that would be easily understood. I wanted to make it simple enough that a runner could learn some basic principles about training and even write his or her own training plan based on those same training principles. Clearly, even the training programs I suggest, although good for many runners, will not be ideal for every runner; therefore I provide some leeway in my recommendations.

After finishing the first edition of *Daniels' Running Formula*, I promised myself that I wouldn't spend another 15 years preparing a second edition. I have been well pleased with the first edition of my book, and comments I've received from runners and coaches from many parts of the world indicate that many readers have found it to be useful. Still, coaching is a never-ending search for better ways to succeed and for better ways to convey what may be useful information about our sport. As a result of my continued evaluation of my work and in response to input from coaches and runners who have let me know what they want to know more about, comes this second edition of *Daniels' Running Formula*.

In part I of this new edition I present some basic principles of training, discuss the physiology of running, and retain the practice of using "VDOT" as a performance-based measure of running ability and fitness, from which you can accurately determine appropriate intensities for all types of training. I have added a new approach to monitoring and logging training (time spent training at a variety of "zone" intensities); runners convert fractions of known VDOT values or monitored heart rates and durations at specific intensities into training "points." This point system can be used to monitor weekly or seasonal involvement in each type of training as well as total training stress, information that may be useful in tracking progress in training over consecutive seasons. Part I concludes with a description of how to plot out a season training plan.

In part II I describe in some detail various intensities of training, from easy runs and marathon-pace runs to threshold, interval, and repetition intensities. I explain the use of continuous (tempo) and broken (cruise-interval) runs at threshold pace, and I introduce a new table showing how to adjust the pace for tempo runs that last longer than the pace prescribed for steady 20-minute threshold runs. I conclude part II with a chapter on supplemental training, nonrunning workouts that can be used along with regular running workouts or during times when runners must curtail or abandon their running training.

Part III is a new section of my book addressed to individuals who want to use running as a means of achieving better aerobic fitness and achieving or maintaining good body composition. I identify four different levels of training and fitness by color code, starting with a level of white fitness for complete beginners and progressing through red and blue levels to an ultimate gold category, which demands some high-quality training sessions.

Part IV, as in the first edition, presents some specific training programs for a variety of race distances. New to this part of the book are chapters on training for the 800 meters and specific workouts for the cross country season.

I am confident that I have introduced enough new information in this second edition of *Daniels' Running Formula* to justify the time and effort put into the project. I recommend that readers first look through the table of contents and the brief introduction to each of the four parts of the book, and after reviewing these more general components, move to those chapters that are of particular immediate interest. When time permits, look over all the chapters because often you learn something about training for different events that you can apply to your own program. I continue to welcome comments, and in the meantime, may you run beyond your expectations.

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# Acknowledgments

The number of people who have helped me better understand distance running is far too great for me to include all their names, but some deserve special thanks because they either played a major role in my formal education, gave unselfishly of their time to help in one of my research projects, or were serious (many elite) runners who were happy to share what they had learned about training and racing. These people deserve a great deal of credit for any success I have had as a coach, and some helped me to put my thoughts into words.

Certainly, Bruno Balke, and Per-Olaf Åstrand were instrumental in sparking my interest in the science of endurance exercise, and I thank them for their encouragement. In the 1960s many of our top distance runners let me conduct numerous tests on them to study the effects of altitude. Some participated with special commitment, and to them I am particularly thankful—Jim Ryun, Tom Von Ruden, Chris McCubbins, Dave Chisholm, Conrad Nightingale, and John Mason. Carl Foster kept me on my toes with research, and Penny Werthner made coaching rewarding for me in the 1970s. In the 1980s there were many Nike winners who were extremely supportive of my ongoing research, and Joan Benoit Samuelson and Alberto Salazar were frequent visitors to the lab. Thanks to Brian Diemer, Doug Padilla, Bob Williams, and Gerry Lindgren, who provided me with some interesting insights into training and racing that have been very useful in shaping my training philosophy—I appreciate their confiding in me. Thanks to Ken Martin and Lisa Martin, who trusted me with their training and certainly substantiated some of my suspected thoughts about marathon training.

For some outstanding performances and for having confidence in me as a coach in the 1990s, I thank Jerry Lawson and the many runners at SUNY Cortland who confirmed that my ideas about training were sound. I also thank coaches Bob Sevene and Frank Gagliano, both of whom have had a positive influence on my coaching career, and the many Farm Team runners who placed their trust in me, especially Magdalena Lewy, Lori Riedy, Heather Tanner, and Peter Gilmore. For over 20 years of loyal support I want to thank Jeff Johnson, a true friend of runners. Thanks to Jimmy Gilbert for the VDOT tables, and to Graham Covington and Harry Turvey for their encouragement. Thank you all, and thank you Nancy Jo, Maro, Gerd, Carlos, and the Chasquis.

Finally, I want to offer special thanks to Julie Rhoda, whose editing expertise and understanding of the sport of running has made the task of finalizing this second edition of *Daniels' Running Formula* far easier than could have ever been anticipated.

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# Introduction: The Ingredients of Success

There are four key ingredients for success in distance running—or for any other pursuit in life, for that matter. They are, in order, inherent ability, motivation, opportunity, and direction.

## Inherent Ability

Nearly anywhere you look in sports you can see the important role that genetics (inherent ability) plays in success. When you imagine an Olympic female gymnast, a male shot-putter, an NBA center, and a jockey, you almost certainly see a petite, trim girl; a large, powerful man; an extremely tall man; and a short, lightweight man or woman. These are the necessary body types for success at the elite level in women's gymnastics, shot putting, the center position in the NBA, and horse racing. Such athletes don't achieve their anatomical structure through training; they're born with bodies that perfectly suit their sport.

Now think of a successful distance runner. What do you see? Someone who is short, tall, muscular, or very lean. There have been, and still are, outstanding runners of many body types, but physiologically they are as similar in their design as female gymnasts or NBA centers are. You can't see the physiological characteristics that make some distance runners great and others not so great, but there are inherent qualities that separate one runner from another, just as surely as body size and composition are factors in shot putting or horse racing.

Genetic ability is the first ingredient of success. You have a certain amount given to you at birth on which you can, of course, improve, but the top end of your potential is set for you, and it's up to you to do what you will with your gifts.

## Motivation

Motivation to use your God-given talent is the second ingredient of success, and this must come from within. It's easy for a basketball coach to be motivated for a seven-foot high school player, but if this seven-footer wants to be an artist rather than a basketball player, chances are he won't fulfill his full potential on the court.

I believe there are four kinds of distance runners:

1. Those who have inherent ability and the motivation to use that ability
2. Those who have the ability to do well but aren't motivated to use their ability