

Hans van Dijk | Ron van Megen

### THE SECRET OF RUNNING

MAXIMUM PERFORMANCE GAINS THROUGH EFFECTIVE POWER METERING AND TRAINING ANALYSIS

How much power does your human engine have? How much power do you need for running in different conditions? How can you optimize your training and racing performance? How can you use power meters to improve your results? What are the ultimate limits of human performance?

*The Secret of Running* answers all of these questions. All factors determining the performance in running (from 800 meter race to marathon) are explained step by step: training, nutrition, body weight, running form, wind, hills, temperature, running gear, power meters and much more. Written in a crystal-clear and lively style, this book is a wealth of information for every ambitious runner. This title also contains brand new insights on how the balance of the power of your human engine and the power requirement for running in different conditions determines your performance. It shows how power meters can be used to optimize your training, running economy and race result. This book is lavishly illustrated and packed with useful data. Being already a bestseller in the Netherlands and Belgium, *The Secret of Running* can be considered the ultimate textbook for all serious runners and their coaches.



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How much power does your human engine have? How much power do you need for cycling in different conditions? How can you optimize your training and racing performance? How can you use power meters to improve your results? What are the ultimate limits of human performance?

*The Secret of Cycling* answers all of these questions. All factors determining the performance in cycling are explained step by step: training, nutrition, body weight, bike weight, wheels, frame, aerobars, power meters, wind, hills, temperature, the world hour record and much more. Many graphs, tables and examples from practice make it very easy to understand for the reader. Get 20% fitter, healthier and faster! This title also contains brand new insights on how the balance of the power of your human engine and the power requirement for cycling in different conditions determines your performance. It shows how power meters can be used to optimize your training and your race result. Being already a bestseller in the Netherlands and Belgium, *The Secret of Cycling* can be considered the ultimate textbook for all serious cyclists and their coaches.

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RON VAN MEGEN  
GUIDO VROEMEN



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### THE AUTHORS



**Hans van Dijk** is a lifelong runner and scientist. After retiring from his professorship at Delft University of Technology, he has been studying the laws of running and cycling, developing new concepts and models and writing books and columns on running, cycling and other endurance sports. He has developed the running and cycling calculators, enabling the readers to analyze and calculate their own performances.



**Ron van Megen** is a lifelong runner, engineer and managing director. He is keen on quantifying his results and on using all new technologies, including power meters. He made many of the photographs in the book.



**Guido Vroemen** is a cyclist and triathlete and a sports physician. He is the team doctor and coach of the Dutch Pro-Continental Cycling Team Roompot-Oranje Peloton. He is the owner of a Sports Medical and Performance Centre and combines this with many training and coaching activities (several elite cyclists, Ironman triathletes, the Dutch Triathlon Association). His expertise is in the field of exercise physiology and also in training and racing with power meters.

**Hunter Allen**, Legendary Coach and Co-developer of TrainingPeaks' WKO+ software

"When Dr. Coggan and I wrote Training and Racing with a Power Meter, there were some very elite coaches that took this information and became experts around the world. The authors of this book are such experts. They used the laws of nature to describe and calculate the performance in running as well as in cycling. This book will help to take your cycling to the next level and the concepts written inside are foundations to creating success."

**Asker Jeukendrup**, Sports Nutrition Scientist, Professor of Exercise Science

"One of the best books about endurance performance I have ever seen, with an evidence based analytical approach to performance in cycling. The many practical examples make it easy for the reader to understand and apply this to improve their own performance. The breakthrough of power meters is analyzed critically, including the possibilities to increase cycling economy and cycling performance."

**Maria Hopman**, Professor of Integrative Physiology, Radboud University, Nijmegen

"I like the quantitative approach to the physics and physiology of cycling in this book. I feel this is important to understand and improve the performance in sports. I believe this book will help coaches and cyclists as theory and practice are combined in a highly understandable way."

The contents of this book were carefully researched. However, all information is supplied without liability.

Neither the author nor the publisher will be liable for possible disadvantages or damages resulting from this book.

HANS VAN DIJK | RON VAN MEGEN | GUIDO VROEMEN

# THE SECRET

## CYCLING

MAXIMUM PERFORMANCE GAINS THROUGH EFFECTIVE  
POWER METERING AND TRAINING ANALYSIS

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# WHY DID WE WRITE THIS BOOK?

*In theory, there is no difference between theory and practice. In practice, there is!*

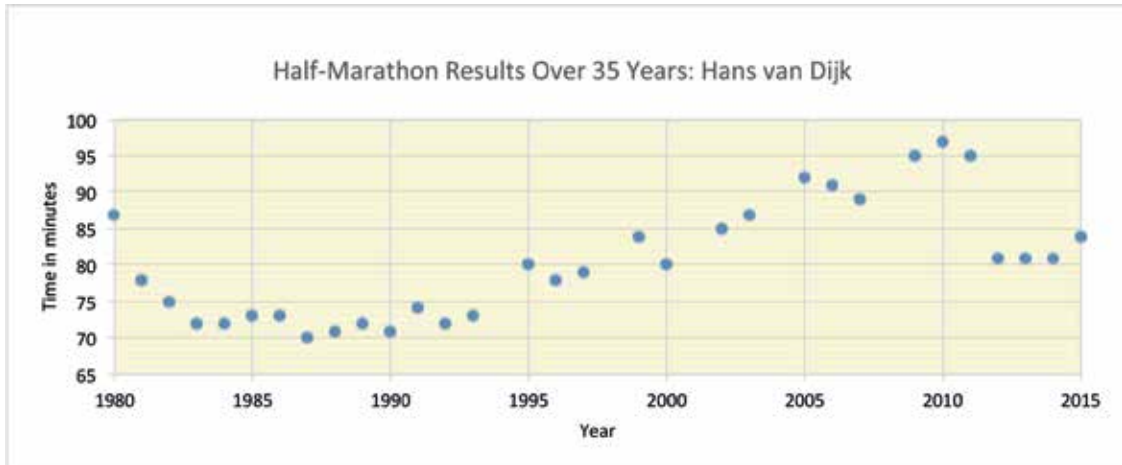
## The Success of Our Books on the Dutch Market

Our previous Dutch books<sup>1,2,3</sup> were an instant success in the running and cycling communities in the Netherlands and Belgium. Apparently many thousands of runners and cyclists share our passion to understand, quantify and optimize the power of our human engine and to calculate and predict our attainable performance in sports. More than 10,000 copies of our books have already been sold in the (relatively small) Dutch market. We get tons of enthusiastic reactions from fans, who call our quantitative approach “a revelation in sports books.” The calculators at our websites [www.thesecretofrunning.com](http://www.thesecretofrunning.com) and [www.thesecretofcycling.com](http://www.thesecretofcycling.com) are visited by many thousands of runners and cyclists, who enjoy calculating how they can optimize their performance.

## How to Get Fitter and Faster

We share a lifelong passion for running, cycling and science. The remarkable story of our books starts in 2011 when Hans retired (at the age of 57) from his position as full professor at Delft University of Technology. Hans decided to devote his time to running and studying the science of running to see if he could get fitter and faster. Hans has been a committed runner since 1980, but over the years his race times had declined slowly as shown in the figure below. Obviously, the decline in performance with age will not surprise our readers, but the fact that he got significantly faster after 2011 should! From 2013 onwards he even managed to become a multiple Dutch Masters Champion (M60)! The reasons for this amazing improvement are the topic of our books. You will gain insights into the factors that determine your performance and how you can get fitter and faster.



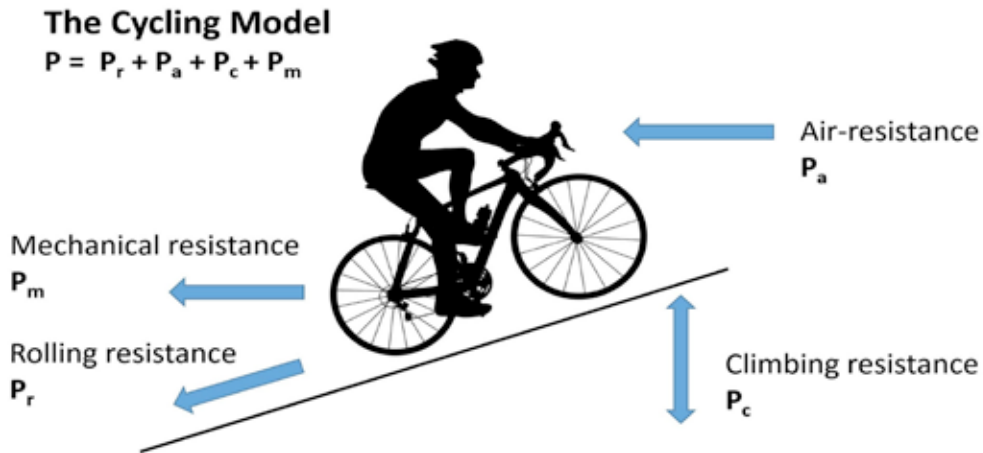


## The Quantitative Approach to Sports

As scientists, we were not satisfied with the traditional handbooks on running and cycling which are based mostly on the experiences of athletes and coaches. They do describe the factors which influence the performance, but only in a qualitative way. We were interested in hard numbers and formulas that would enable us to calculate the performance exactly. We also wanted to differentiate between scientific proof and the opinions of athletes and coaches, so we have set out to develop science-based models for all factors influencing the running and cycling performance and to test these models with hard data from measurements.

## Cycling Science: The Laws of Physics and Physiology

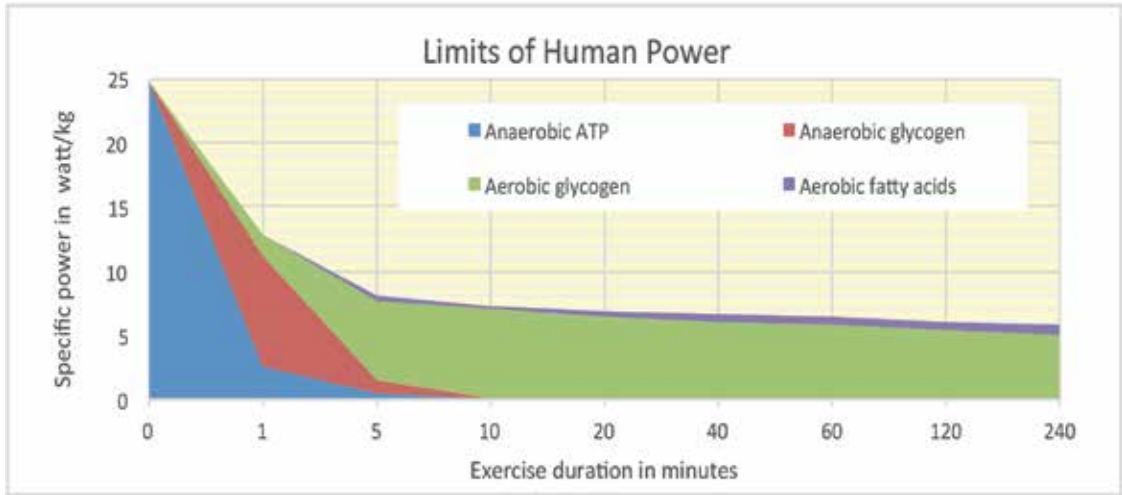
We have developed a complete cycling model based on the laws of physics and physiology. The figure below illustrates the model, which enables us to calculate the race time exactly.



The model is based on the fact that your muscles and your cardiovascular system form your human engine. Your human engine has a certain capacity, which can be described in terms of the traditional notion of oxygen uptake capacity ( $VO_2$  max), but better in terms of the amount of power ( $P$ , in watt). Obviously, the power ( $P$ ) depends as factors such as talent, training, endurance time or distance, altitude, tapering and so on.

In the equilibrium condition, the power of your human engine ( $P$ ) is used to surmount the rolling resistance ( $P_r$ ), the air resistance ( $P_a$ ), the climbing resistance ( $P_c$ ) and the mechanical resistance ( $P_m$ ). Consequently, we can calculate your cycling speed and race time when the conditions of the race (such as distance, pavement, wind, temperature, hills, and altitude) are known.

We believe that our cycling model is a major step forward as it is based on the laws of physics and physiology. This applies particularly to our model of the human power. Based on the biochemistry of the four energy systems of the human muscles, we managed to calculate the ultimate limits of human power as a function of time, as illustrated in the figure below.



Our calculations show that these ultimate limits of human power match perfectly well with the current world-class performances in cycling and in other sports, including running.

## The Theory of Nearly Everything: How to Calculate and Optimize Your Race Time

We have never met a cyclist that did not want to get faster. Moreover, most cyclists are keen to learn the impact of all factors that may affect their performance. Consequently, in this book we have systematically analyzed the impact of nearly everything on your cycling performance. In 66 chapters, you will find the answers to questions like:

- » How big is the power of your human engine?
- » How fast can you race with your human engine (both at the flat and uphill)?
- » How much slower do you get with age?
- » How much faster can you get by shedding body fat?
- » How much faster can you get from training?
- » How can you optimize your training?
- » How much time can you gain from a perfect bike position?
- » How much time can you gain from an aero bike?
- » How much time can you gain from a lightweight bike?
- » How much time can you gain from better bearings and gearing?

- » How much time can you gain from high-performance tubes?
- » How much time do you lose on account of the wind?
- » How much slower do you go uphill and how much faster downhill?
- » How can you use power meters?
- » How can you optimize your pedaling efficiency?
- » What is the ultimate limit of the world hour record?
- » What is the ultimate limit of the clean climbing time to the Alpe d'Huez?
- » How big is the impact of the air pressure on your race time?
- » How big is the impact of the temperature?
- » How big is the impact of altitude and training at altitude?
- » How much time can you gain from riding together or in a pack?
- » How big is the impact of nutrition and carbo-loading?

## Who Are the Authors?

Hans van Dijk is a lifelong runner and scientist. Since retiring from a full professorship at Delft University of Technology, he has devoted his time to studying the laws of sports, developing new concepts and models and writing books and columns on running, cycling and other endurance sports. Hans has also developed the running and cycling calculators, enabling the readers to analyze and calculate their own performances. As an added bonus, his research has led to a spectacular improvement in his race times at the age of 60!

Ron van Megen is a lifelong runner, engineer and managing director. He has been a friend and running mate of Hans for over 30 years. He enjoys quantifying his running results and using new running technologies, including power meters. Just like Hans, he is also keen on improving his race times, and was happy to see them go down by 20% at the age of 55! He has organized the production of the book and provided many of the photographs.

Guido Vroemen is a cyclist, triathlete and sports physician. He is the team physician and trainer and coach of the Dutch Pro-Continental Cycling Team Roompot-Nederlandse Loterij. He is the owner of a sports medical and performance centre and combines this with many coaching activities (e.g., elite cyclists, ironman triathletes, the Dutch Triathlon Association). His expertise is in the field of exercise physiology and in training and racing with power meters.



*Hans van Dijk (right), Ron van Megen (left) and Guido Vroemen (middle), authors of this book.*

## Website and Calculators

The website [www.theseecretofcycling.com](http://www.theseecretofcycling.com) contains many columns, papers, media reports, Q&As and our calculators, which the readers can use to calculate and predict their own race times, depending on many variables. The authors welcome reactions from readers and cyclists around the world, and hope that the readers will enjoy the calculators and give us their feedback!

**Hans van Dijk, Ron van Megen and Guido Vroemen**

**Leusden, the Netherlands, September 2016**