

# THE LYDIARD TRAINING SYSTEM for MIDDLE and LONG DISTANCE RUNNERS

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The Brooks/American Track & Field  
Arthur Lydiard Lecture Tour (1999)

Presented by:  
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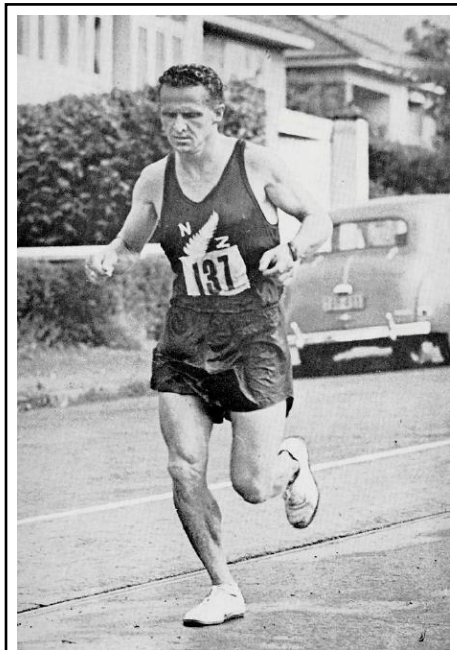
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## ***1. Arthur Lydiard – A Brief Biography***

*Arthur Leslie Lydiard was born on July 16, 1917, in Eden Park, New Zealand. In school, he ran and boxed, but was most interested in rugby football. Because of the Great Depression of the 1930s, Lydiard dropped out of school at 16 to work in a shoe factory [1].*

*He figured he was pretty fit until Jack Dolan, president of the Lynndale Athletic Club in Auckland and an old man compared to Lydiard, took him on a five-mile training jog that left him completely exhausted. He wondered what he would feel like at 47, if at 23 he was so fatigued by such a short run, and was forced to rethink his concept of fitness. Lydiard began training according to the methods of the time, but they were of little help; at the club library, for instance, he found a book by F.W. Webster, *The Science of Athletics*, but soon decided that the schedules it offered were too easy for him, so he began experimenting to see how fit he could get.*

*Lydiard started running seven days a week, up to 12 miles a day, which was considered exceptional at the time. In 1945, at age 28, he began racing again, but while he was fitter and faster, he had trouble winning due to a lack of basic speed. Because his mileage was considerably higher than those who beat him, he became annoyed and began to experiment with his daily distances and efforts, alternating short and easy days with long and hard runs.*



Garth Gilmour Collection  
Lydiard competing for New Zealand in the 1950 Empire Games Marathon, where he finished a "disappointing" 13th.

*Others joined Lydiard in training and thrashed along with him, though he still used himself as the principal guinea pig. Running up to 250 miles a week, he tested himself to extremes of heat and endurance, and discovered that when he balanced distance training with short, high-intensity workouts and speed-work, not only did his track performances improve, but his marathon times came down as well. Lydiard had no coaching experience or formal education in physiology, nor had he been to college, but where other coaches and runners had failed to unravel the fundamentals of conditioning, to Arthur Lydiard, his own training experiments spoke volumes. His practical knowledge would become the basis of the system he would later use to develop numerous Olympic medalists and international-class competitors worldwide.*

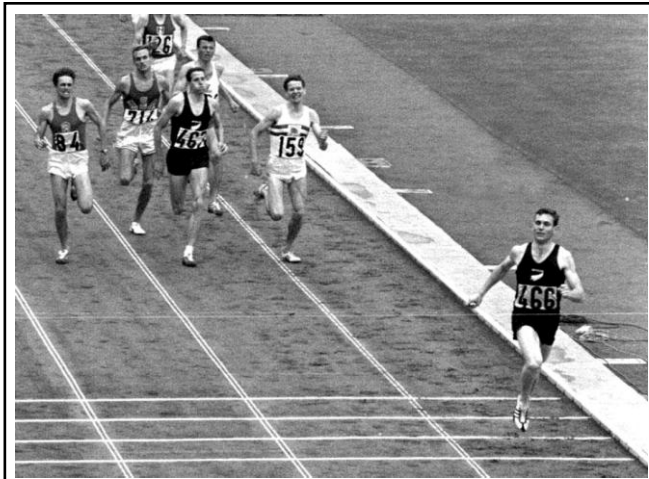
*After two years of training with Lydiard on his lonely runs, Lawrie King beat a provincial champion in a 2 mile race by 80 meters. King's win established Lydiard as a coach, a qualification he neither sought nor particularly wanted. King went on to become New Zealand cross country champion, six-mile record holder, and 1954 Empire Games representative.*

*In 1951, 17-year-old Murray Halberg came on the scene [2]. His coach, Bert Payne, consulted with Lydiard on Halberg's training. By 1953, Halberg was coached by Lydiard exclusively, and was joined by Barry Magee. It was with this group that Lydiard first tried out his formula for building stamina and coordinating training with races.*

*Lydiard completed his training regime in the mid-1950s. By then he knew how and when to mix the components – long marathon-type mileages, hill work, leg-speed and sprint training, sharpening and freshening – and how to plan it so his runners would peak at the right time.*

*In 1955, Lydiard stopped racing in order to devote himself to work, and until 1957, he held two jobs, one of which was delivering milk in the middle of the night. He quit that job to coach a marathoner, Ray Puckett, who won the national championship that year, with Lydiard second at the age of 40, but it was in 1960 at*

*the Rome Olympic Games that Lydiard's runners broke through to achieve worldwide notoriety: Peter Snell outsprinted Roger Moens for the 800 meter gold medal, then less than an hour later, Murray Halberg broke away alone two laps from the finish to win the 5,000 meters, and finally, Barry Magee captured the bronze medal in the marathon behind Abebe Bikila of Ethiopia and Rhadi Ben Abdesselam of Morocco.*



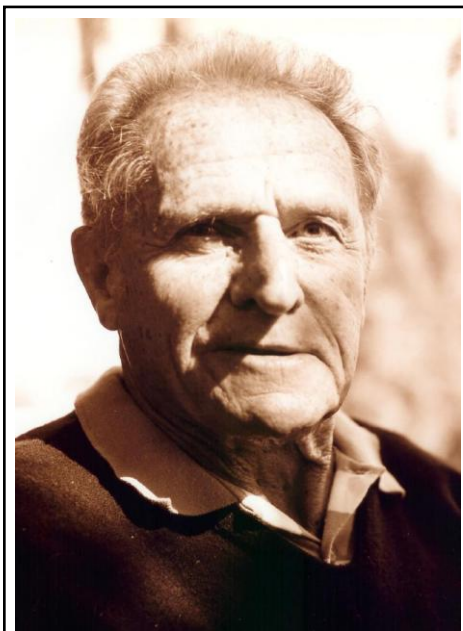
Garth Gilmour Collection

Peter Snell wins the 1,500 meter run at the 1964 Tokyo Olympic Games, the third gold medal of his career. His teammate John Davies (#467) won the bronze.

*At the 1964 Olympics, Snell repeated in the 800 and took the 1,500 meters as well, while John Davies, also Lydiard-trained, captured the 1,500 bronze medal [3]. With such successes as final proof, Lydiard was the man who knew all the answers. He knew his methods worked, though he didn't know why, since he had only basic knowledge of human physiology.*

*The world wanted to know more about the training methods of this group of Auckland teammates. Fortunately, Lydiard was not at all closed-mouthed; indeed, he went to great lengths to publish and discuss his ideas, and began working with coaches instead of athletes in the early 1960s. In 1966, he accepted an invitation arranged by Bud Winter (ex-San Jose State coach) to work in Mexico, where he*

*stayed about 8 months. Out of his efforts came Alfredo Penaloza (third at Boston in 1969), Pablo Garrido (2:12:52 marathon PR), and Juan Martinez (fourth in the 1968 Olympic 5,000 & 10,000 meters).*



Bud Coates

Shown here during his 1999 U.S. lecture tour, Lydiard remained in worldwide demand into his late 80s, and was engaged in another speaking tour of the U.S. when he passed away from a heart attack in Houston on December 11, 2004.

*Lydiard next took a coaching position with the Finnish Track & Field Association and stayed in Finland for 19 months, to mixed reviews. The Finns, with their mistaken concepts of the 1950s, had become interval junkies; they were stubborn and generally reluctant to accept his suggestions, but his lessons were not wasted on the coaches of Pekka Vasala and Lasse Viren, who listened carefully and blended Lydiard's concepts with those of Percy Cerruty, Paavo Nurmi, and Milhaly Igloi. The results of his visit finally came into focus when Olavi Suomalainen won the 1972 Boston Marathon, then at the 1972 Munich Olympic Games, Lasse Viren got up after falling in the 10,000 meters and went on to win the gold medal in world record time. Viren also won the 5,000 (with a final mile of 4:01), Pekka Vasala won gold in the 1,500, and Tapio Kantanen took the bronze in the steeplechase. When Lydiard arrived, it had been seven years since any Finnish distance records had been broken. Four years after he left, the Finns again owned world records, Olympic gold medals, and several international championships.*

*Arthur Lydiard continued to make his methods available to any interested party until his passing in 2004. The Lydiard system has been applied to rugby, cycling, canoeing, squash, and even gridiron football. By discussing his concepts with experts in*

*physiology and sports medicine, Lydiard was able to explain the scientific basis for his success.*

## 2. Introduction to the Lydiard System

The Lydiard training system is based on a balanced combination of aerobic and anaerobic fitness, with elements to enhance all aspects of your running – conditioning, strength, and speed. The end result is stamina, or the ability to maintain speed over the whole distance.

Exercise is termed aerobic, or “steady-state,” when its intensity stays within the ability to breathe in, transport, and use oxygen to metabolize energy sources (fats and carbohydrates); everyone is limited in the maximal rate at which they can do this, or the volume of oxygen they can use per minute. Endurance exercise performance is determined overwhelmingly by the “maximum steady-state,” or the level where you are working nearly to the limit of your ability use oxygen on a prolonged basis, and with the right kind of training, this can be raised substantially. The farther you go beyond this threshold, the more heavily a second metabolic process, called anaerobic glycolysis, is called on to meet energy demands without oxygen. While its rate of response is much faster than aerobic metabolism (nearly instantaneous, in fact), its capacity to produce energy is far more limited, and depending on the extent to which it is taxed (i.e., how far and how long you exceed anaerobic threshold), you incur “oxygen debt,” which is accompanied by the build-up of lactic acid and other metabolic waste products, in turn leading to neuromuscular breakdown, or failure; simply put, muscles fatigue and cannot work. Oxygen debt has the unfortunate feature of rising exponentially with a linear increase in speed.

In other words, the faster you run, the greater your need for oxygen becomes in order to continue running. From Morehouse and Miller’s *Physiology of Exercise* as an example:

SPEED INCREASE	OXYGEN UPTAKE INCREASE
From 305 to 354 meters/minute (16%)	From 5.08 to 8.75 liters/minute (72%)
From 499 to 506 meters/minute (1.5%)	From 28.46 to 33.96 liters/minute (19%)

By the quantity of energy produced, aerobic exercise is 19 times more efficient than anaerobic exercise [4]. The more intense the exercise becomes, the faster and less economically muscle glycogen is used, and the faster lactic acid accumulates.

### *Aerobic Conditioning*

This training phase stresses exercising aerobically to increase your steady-state as high as possible given your particular situation. For best results, you should exercise between 70-100% of your maximum aerobic effort, therefore, this is not “Long Slow Distance” – it is running at a good effort and finishing each run feeling pleasantly tired. You will incur the same benefits from running at a slower pace, but it will take longer than at a good aerobic pace.

The essential part of the conditioning period is three long runs a week, and many aspects of your physiology improve as a result: oxygen uptake, transportation, and utilization will increase, while under-developed parts of your circulatory system are enhanced as neglected capillary beds are expanded, and new ones are created. Your lungs become more efficient, with increased pulmonary capillary bed activity, which improves the tone of your blood, allowing you to get more oxygen out of each breath. Blood circulation throughout your body and within the working muscles improves, while waste products are eliminated more easily. Additionally, your heart (which is just another muscle) becomes bigger, and is able to pump more blood faster with each contraction.

### [Anaerobic Capacity Training](#)

Once cardiovascular and muscular development have proceeded as far as possible through aerobic exercise, it is time to develop your ability to exercise anaerobically, to increase your ability to withstand oxygen debt. The limit of oxygen debt a trained person can incur is 15-18 liters, so if you have a steady-state of 3 liters a minute and you run at a pace that requires 4 liters of oxygen a minute, you will last for



about 15 minutes – one liter of debt per minute. If you increase your pace and require 5 liters of oxygen per minute, your debt increases to two liters a minute, and you will be exhausted in about 7½ minutes [5]. It's common sense: sprint as fast as possible, and the distance covered before having to stop will not be very far, since the exercise is governed by anaerobic capacity, which is limited. If the pace is slowed down, however, the distance will be much greater, since it is determined by your capacity to perform work aerobically, which is virtually unlimited; the slower the pace, the further it is possible to go. When your maximum steady-state is low, you will run anaerobically at a relatively slow speed, but as fitness improves, the speed that was anaerobic before is now high aerobic, therefore, you want to get your maximum steady-state at the highest possible level before you tackle anaerobic training.

Similar to aerobic training, you should do three hard workouts a week during the anaerobic phase, each separated by at least 40 hours to allow adequate recovery. The idea is to stress your system, recover completely, then stress it again. It is not all that important what the distances or speeds are, just run repetitions and intervals until you are tired and have had enough for the day. No coach can tell exactly how many repetitions you can do or what your recovery intervals should be on any particular day, so trust your instincts and responses, using any schedule only as a guide.

It is not necessary to do anaerobic workouts on a track, in fact, you may enjoy them more on a softer surface, such as a forest trail or grassy field. Just pick a tree or a marker to run to and jog back after each repetition. Do this until you have done enough, making yourself “tired with speed” [6]. The one requirement to keep in mind is that each repetition should be at least 30 seconds, since it takes this long to lower your blood pH level significantly.

Even though anaerobic development is limited, this type of training is essential to race well. In summary, its objective is to create big oxygen debts through interval or repetition training and lower your blood pH level, so that your metabolism is stimulated to build buffers against fatigue. Once this is accomplished, anaerobic training is mostly complete; to continue it is to invite sickness and injury, and sacrifice the very thing you have worked so hard to achieve, i.e., aerobic fitness, which determines your performance level.

### *Sharpening*

Once aerobic and anaerobic development are complete, you need to keep your ability to tolerate oxygen debt high without dragging your condition down. This is where ‘[sharpening](#)’ comes in – doing short sharp sprints of 50-100 meters with an equal distance of ‘floating’ in between, which allows you to tire your muscles without lowering blood pH. Once a week is most effective for maintaining maximum anaerobic development. In conjunction with races or time trials during the week, you can continue to improve your race times for quite a while.

### **3. Marathon Conditioning**

So the increase of anaerobic capacity is an important training objective, but it should only be done in relation to aerobic development. In other words, you must run as many miles or kilometers as possible at economic (aerobic) speeds to lift your steady-state oxygen uptake to the highest possible level as the foundation upon which to base anaerobic capacity training and sprint training [7].

To gain the best results for the time spent in training, you must run under your maximum steady-state, at the best aerobic speed for the given duration. Even very slow running will effectively increase general cardiac capacity, however, by running at speeds too far below the maximal steady-state, it will take longer to gain the same results as if the rates of speed were faster, but still aerobic.

In other words, one can run too fast or too slow, and it is important to control the running efforts as well as possible if optimum results are to be achieved in the time spent exercising, so to carry out this ‘near best aerobic’ training practically, it is necessary to time your runs over measured courses, and progressively increase the running efforts as fitness improves [8].

To train at speeds above the maximum steady-state calls more heavily on anaerobic energy systems, causing lactic acid buildup and lowering blood pH, resulting in neuromuscular breakdown in the working muscles. This means the volume of exercise will be limited according to the oxygen debt incurred. Since the objective of this marathon conditioning phase is to do a large volume of training, it must be aerobic, or below the maximum steady-state; we are really endeavoring to raise the pressure exerted by the heart on the vascular systems generally to a level that develops the smaller arterioles, capillary beds, and veins. The byproducts of aerobic exercise are the carbon dioxide we breathe out, and the water and salt we perspire.

With consistent training, aerobic development can proceed over a period of years. This is why marathon runners often perform better in their thirties rather than their earlier years, provided they continue with systematic, long aerobic running. I always tell runners that “miles make the champions,” and that initially this grind of running all the mileage possible between the competitive seasons is of prime importance. The more miles you run aerobically in training, the greater the endurance you will develop, so there is really no limit to the mileage a coach should place upon his athletes, provided that the supplementary miles run in addition to the required faster aerobic running are easy efforts at the lower aerobic speeds. In other words, it is wise to run once a day at faster aerobic speeds and supplement this by jogging as many miles as you find time and energy for, even if only a fifteen minute jaunt each day.

The fast aerobic running should be approached by deciding how much time you have daily for your training, then balancing your conditioning schedule upon this. Measure out several different courses over different types of terrain that allow for reasonable traction [9] – one course for each weekday, if possible, for psychological reasons (to help avoid monotony).

Initially, you should concentrate on building endurance and volume rather than controlling pace. Get yourself fit enough that you can run long distances continuously on out-and-back or circuit courses. If it takes significantly longer to return, or for subsequent laps, then you went too fast in the early going, and had to slow down during the second half of the run. You will quickly learn to adjust the effort and stay within your present fitness level. As your oxygen uptake improves, training becomes progressively easier, and it becomes possible to increase the duration of each run.

Prior to starting a program designed to have you running against the watch for mileage, a schedule such as this should be the ultimate aim, less for younger athletes:

Monday:	1 hour
Tuesday:	1½ hours
Wednesday:	1 hour
Thursday:	1½-2 hours
Friday:	1 hour
Saturday:	2 hours or more
Sunday:	1-1½ hours
<b>TOTAL:</b>	<b>9-10 hours</b>

This running should be done very easily and the miles covered are of no real account; the time spent training is the important part. Do not go straight into such a schedule, but work up to it according to your fitness and ability to train [10].

Once you can run for two hours without any problems, then start to time yourself as follows: run over your measured courses for one week, without any influencing factors such as a watch or another runner. Try to run evenly in effort and as strongly as your condition allows. Start your watch at the beginning of each run, so as to be able to take the overall time at the conclusion, which gives an estimate of your capability and condition at this stage of your training. The time taken from the first week's training should give you a fair indication of your capacity to train, and a basis on which to train further.

As you run the same course the following week, use these times to run at a comparable pace by checking your time as you pass each mile marker. For example, if you took one hour to run a ten mile course the trial week, then the next week you should set out to run six minutes per mile, allowing for hills and hollows. After a week or so, you will find that the previous times used for pace control are becoming too slow for you as your oxygen uptake improves, so it will be necessary to increase the average speed for distance by lowering the average mile time down to 5:55 per mile or thereabouts. In this way, it is possible to keep running at your best aerobic effort rather than too fast or too slow, and gain the best results for the time spent in training [11].

Through trial and error, I discovered years ago that the best results from this training period were obtained by running about 100 miles weekly at nearly my best aerobic efforts, and then supplementing this with as many miles as I could possibly manage at an easier effort. I also found that alternating the length of the runs by doing, say, 12 miles one day and 18 the next, rather than 15 miles each day, gave better results. This was due to gaining muscular capillarization through the longer runs (two or more hours), which results in greater utilization of oxygen.

Your total weekly mileage will be governed by climatic conditions and available time for training, however, it is important to realize the distance will not stop you in training as much as speed. If you keep the running efforts within your capabilities, then you will quickly be able to manage a large mileage. It is better to run a long way slowly rather than to curtail the mileage possible by running too fast [12].

When I say your aim should be to run a weekly schedule such as the following, I mean it only as a guide that you should adjust to suit your own daily program, fitness, and age.

Monday:	10 miles (15 km) at $\frac{1}{2}$ effort over undulating terrain	}	<i><math>\frac{3}{4}</math> effort should be challenging, but you should feel in control</i>
Tuesday:	15 miles (25 km) at $\frac{1}{4}$ effort on a reasonably flat course		
Wednesday:	12 miles (20 km) at $\frac{1}{2}$ effort over hilly terrain	}	<i><math>\frac{1}{4}</math> effort is easy</i>
Thursday:	18 miles (30 km) at $\frac{1}{4}$ effort on a reasonably flat course		
Friday:	10 miles (15 km) at $\frac{3}{4}$ effort on a flat course	}	<i><math>\frac{1}{2}</math> effort is somewhere in between</i>
Saturday:	22 miles (35 km) at $\frac{1}{4}$ effort on a reasonably flat course		
Sunday:	15 miles (25 km) at $\frac{1}{4}$ effort over any type terrain		
<b>TOTAL</b>	<b>103 miles (166 km)</b>		

It is just a matter of running what you feel capable of, the more the better. It is also wise to jog easily every morning for at least 15 minutes or longer.

Running action should be relaxed, with the arms following through in a low and loose action, the thumbs brushing the side seams of the training shorts. The hips should be held comfortably forward, i.e., in a neutral position, and the head should be carried so that you are looking forward about thirty yards or more. Try to bring the knees up to a comfortable height, rather than develop a shuffling action [13].

#### 4. Hill Resistance Training and Leg-Speed Training

When the marathon conditioning period of training is completed, or no further time can be spared, it is necessary to begin developing speed and the capacity to exercise anaerobically. This is accomplished by bringing resistance to the leg muscles, which develops the white (fast twitch) muscle fibers that are mainly responsible for giving better speed.

I have found that a form of isotonic exercise is most effective for this purpose, and it allows speed to be developed quickly as well [14]. By springing uphill, with a series of short and sharp bounding steps, you can use your body's weight as resistance for your leg muscles, and you will also stretch the muscles and tendons to the extreme experienced during competitions, which helps eliminate the possibility of pulled muscles and strained tendons later on.

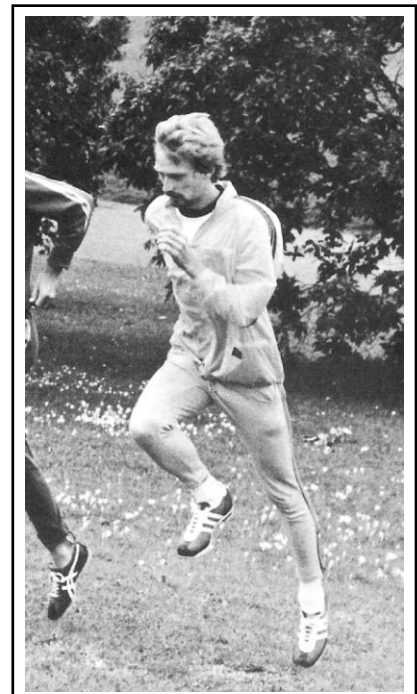
Ankle flexibility is of great concern to runners, since strong and flexible ankles increase stride length. Good running technique is also important, and by learning to run with the hips neutral, you are able to bring the knees up higher, which in turn allows the feet to follow through higher, thereby shortening the lever and allowing for a faster leg action.

So it is important to develop leg power, flexibility, and a good economical running style. With good speed development, you can run more economically at a given pace, which is of great importance to both the marathon runner and the track runner as well. Hill training develops all these abilities in the same training session, saving valuable time [15].

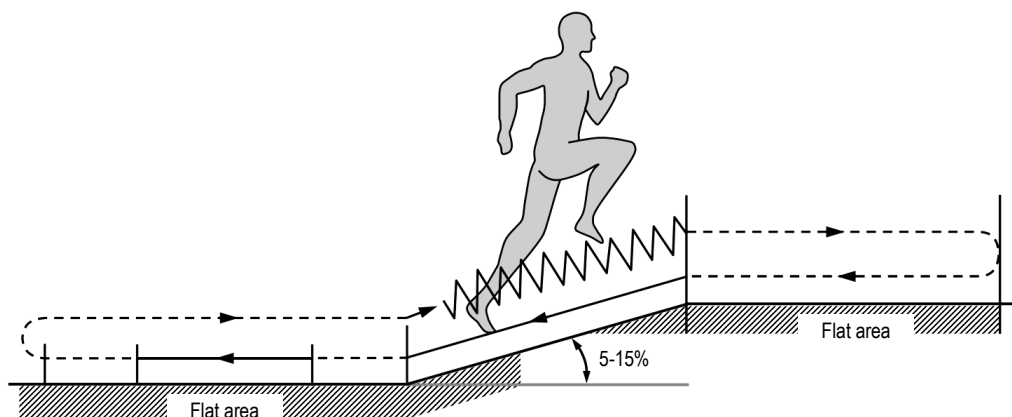
The training I suggest here is not easy and can be quite testing; you need to be well-conditioned to properly complete a one hour hill workout, and should understand what the workout is intended to achieve, so as to apply it according to your fitness and capacity to train with respect to development and age [16].

Find a hill with a rise of near one in three or a little steeper, on a paved surface, on grass, or a forest trail that gives enough traction to allow you to spring uphill without slipping. It should be about 200 to 300 meters or longer, with a flattish area at the base of approximately 200 to 400 meters where you can sprint, and an area at the top where it is possible to jog.

If a circuit can be found with a steeper hill and a similar flattish area at the top as mentioned, but with a more gradual downhill leading to the flat at the bottom, this is better for the downhill running and seems less tiresome psychologically [17]. Approach the workout this way: warm-up for at least 15 minutes, discard unnecessary clothes at the base of the hill to allow maximum freedom of movement, then start springing up the hill with a bouncing action and slower forward progression [18]. Use the body's weight for resistance, and the slower the forward momentum is, the more resistance will be felt. The center of gravity must be lifted up and down to gain resistance, not just lifting the knees. Keep the upper body relaxed, with the arms relaxed at the sides, hold the head up, and do not look down at the ground, which tends to throw the hips back. Keep your knees coming up high, with the hips held comfortably forward. Do all that you can or feel capable of doing.



*Auckland Star*  
Finland's Pekka Vasala, the 1972 Olympic 1,500 meter champion, is shown here hill training in New Zealand.





Should the exercise be too tiring to go all the way up the hill, try jogging some yards, according to your needs and ability, before doing more. At the hill top, jog easily for near three minutes before running downhill with a fast relaxed striding action, which develops fine leg-speed and also stretches leg muscles for better stride length [19]. The downhill section should be such that it allows you to stride down fast without fear of losing control and falling; if it is too steep for this, then it is better to take it easily as you come down. At the base of the hill, some windsprints (sprint repetitions) should be done to gradually accustom your body to exercise anaerobically, varying the distances from 50 to 400 meters with each circuit. If the circuit is short, do the windsprints no more often than every 15 minutes [20].

It is not advisable to suddenly go into a great volume of intense anaerobic training, as many people do, so keep the intensity and volume at reasonable levels to begin with. Doing windsprints only on the short stretch at the bottom of the hill and only every 15 minutes helps reduce the possibility of overdoing. Use whatever distance you like, but 50, 100, 200, and 400 meters give best results [21].

Repeat the circuit until you have been out for an hour, or according to ability to exercise this way, then cool down at least 15 minutes. This training should be done three days weekly, with the alternate days for leg-speed training, plus one long run of 1½ to 2 hours at an easy effort [22].

### *Leg Speed Training*

Find an area about 120 to 150 meters long and nearly flat, but with a gradual decline. Warm-up for at least 15 minutes, then run over the course ten times as described shortly, with a three minute rest interval. Do not rush through this training; it is important to have a full recovery. After the tenth repetition, cool down for at least 15 minutes.

With each repetition, think of moving the legs as fast as possible and without any concern as to stride length. Keep as relaxed as possible in the upper body. The same action can be obtained by going downstairs one at a time as fast as possible. You will find that the legs do not seem to move fast enough, so run with a normal stride, thinking of only one thing: **move the legs fast**. This way, it is possible to overcome viscosity in the leg muscles and develop fine speed.

Your legs will get tired from this training, but if it is maintained for at least two weeks, it becomes progressively easier and begins to have an effect, although best results are obtained in four to six weeks. A weekly schedule during this period could look like this:

Monday, Wednesday, Friday: hill training  
Tuesday, Thursday, Saturday: leg-speed  
Sunday: long run

It is wise to train twice a day, everyday in this period, just as during the prior aerobic conditioning period and the track training/racing which follows, even if only for 15 minutes each morning [23].

## **5. Track Training**

About ten weeks are usually sufficient for the necessary track training leading up to the first important competition [24], and this period can be divided into three sections as described below, allowing development and coordination of abilities, then tapering for optimum performance on the desired date.

### *Anaerobic Capacity/Speed Development*

The first three to four weeks should be used for the further development of anaerobic exercise capacity and speed. When developing the former, it is important to realize what you are trying to do and what physiological development you are trying to achieve, namely, the ability to incur a large (about 15-liter) oxygen debt by exercising anaerobically. Running up big oxygen debts in training stimulates the body's metabolism to create buffers against fatigue from lactic acidosis.

Once this is understood, it becomes apparent that the workout structure is of no consequence, as long as you make yourself tired with the volume of anaerobic exercise, and finish the workout quite fatigued and knowing you could not do much more nor any better. It doesn't matter if you use repetitions or interval training, over different distances with different intervals, in fact, you don't even need to time them [25].

As a practical guide, however, the work intervals should total about 10-15 minutes, or 5,000 meters; i.e.,  $12 \times 400$  meters,  $8 \times 600$  meters,  $5 \times 1,000$  meters,  $3 \times 1,600$  meters, etc., with an equal distance of recovery jogging in between. If one athlete needs more or longer repetitions than another to gain the same physiological response, then he will just need to train for a longer period.

So in many ways, it is important to evaluate your training every day, interpreting its effects, and not follow any schedule blindly. As a guideline, I advise athletes to run their hard anaerobic training during this period three days weekly on alternate days, which experience has shown is just about enough to develop the capability to incur a 15-liter oxygen debt [26]. If you continue with this type of training in great volume and intensity for much longer, the effects of lower blood pH will begin to adversely affect your body's metabolism and pull your condition down. The younger the athlete, the less anaerobic training should be used, whereas the ratio of anaerobic to aerobic training increases as the athletes get older and fitter [27]. Never do hard anaerobic training on consecutive days, as it is wise to allow your blood pH to return to normal after the exhausting workouts.

On alternate days, you need to concentrate on developing speed to near its maximum by carrying out sprint training workouts that begin with suppling and loosening exercises, then proceed to sprint starts and sprint races, and leg speed training. A typical workout could be:

1. warm-up by running easily for about 15 minutes
2. calisthenics for 10-15 minutes
3. run easily for 5 more minutes
4. 70-100 meter sprints, concentrating on the following elements (jog 3 minutes between each):
  - a. developing stride length by exaggerating the strides and pushing off hard with the back leg;
  - b. running tall, bringing your knees high and getting up high on your toes;
  - c. moving the legs as fast as possible to develop quick leg turn-over;
  - d. a final set of runs combines all of these things [28].

Each exercise (a-d) of part 4 can be done two or three times. In addition, some sprint starts can be used and a sprint race or two competed in for training. Any form of American sprint training is usually good as long as it covers these points. All middle and long distance runners should do some sprints races and train to develop their leg speed, as this increases their economy of action and reserves energy for the latter stage of competition [29]. Be careful not to rush through sprint training (as opposed repetition training), giving yourself sufficient recovery after each run [30]. On the seventh day, it is best to go for a long, easy run, with the distance or time in keeping with your age and development. In the case of a mature and fit athlete, it could be for 2 hours or more, at an easy effort.

### *Co-ordination and Sharpening*

After these first four weeks of track training, another four-and-a-half week period begins, with the aim of coordinating all the training you've done so far; speed, stamina, and anaerobic capacity are more or less developed, but it is necessary to get you running smoothly throughout your competitions without any apparent weak spots showing. Even though you may have fine stamina and speed, it does not necessarily mean that you can race well and to your best potential. If you give your body certain exercises to do often enough, it will adjust and manage them efficiently. The same can be said if you have the basic condition and run often over certain distances in a controlled way, you start to improve in performances, so at this stage of training, there are these aspects to consider.

It is necessary to continue some anaerobic training at this time, but you need to drop the volume and increase the intensity. In other words, if you have been doing twenty repetitions of 400 meters, it takes a long time and you get very tired with the training, whereas, if you run five laps around the track by sprinting fifty meters in every 100 meters, floating the other 50 meters (in all 20 sprints  $\times$  50m = 1000m), you will also be very tired, though in this case it will only take a mature runner about 7-8 minutes to complete the exercise. This is called '[sharpening](#),' since it puts a knife-edge on anaerobic capacity, and in this way we can get into racing shape without starting to pull the good condition down. At this stage it is usually best to use this training once every week, say, on Monday.

On Tuesday, a time trial could be run over or near to the distance being trained for. When training for the 5,000 and 10,000 meters, use 5,000 meters with the occasional 10,000 meters, while 800 and 1,500 meters (mile) runners should use under-distance time trials such as 600 meters for 800 meters, and 1,200 meters for the 1,500 or mile; the higher speed incurs larger oxygen debts (and may require longer recovery.) From these time trials, you can observe weaknesses in your running by recording your lap times to see where you may have slowed down, then using the appropriate exercises to strengthen any weaknesses that become apparent; this is mainly where the training is coordinated. For instance, if you could run the early part easily but were tired in the latter stages, it would be advisable to do some over-distance races or time trials the following week. On the other hand, if you found the pace a little difficult throughout the run even though you were running strongly near the end and not overly tired, then under-distance races or trials would be indicated for the next few days [31]. All athletes are different in their training response, so you have to be a little experimental to determine exactly how to co-ordinate the training, but the trials (and development races) will provide the necessary information quite well.

On Wednesday, sprint training should be done and a club (team) level sprint race or two competed in. This applies to long distance runners too. A middle distance race could be used as well.

On Thursday, you could do any training you consider necessary using the information gained from the time trials, however, it is also a good idea to work at pace judgment, two to four times over 400 meters at your intended race pace. You can also do more sharpeners if you think you require them.

On Friday, leg speed can be done over 120 meters, say four to six times after warming up and doing some stretching exercises.

Saturday can be a development race, with the best competition available; since you are training hard and are tired to a degree, it is not possible to give your best effort [32]. These races should be over- and under- distances, according to your needs and considering your response to the time trial.

On Sunday, the usual long run should be taken at a leisurely pace.

### *Freshening Up*

Use the last week-and-a-half to freshen up by lightening your training, which builds up your reserves mentally and physically for the coming important competition, an effect known as "supercompensation." This period is important to achieve peak performance, and its duration should be decided by the athlete through trial and error methods, as individuals differ in this respect, though 10 days is usually about right on average. You should train every day, but easily. The fast training should be small in volume and the longer runs should be at very low efforts.

When the main competitions are reached, it is important to realize you have trained for them, and you should not continue to train hard, as many athletes make the mistake of doing. All that is necessary now is to keep fresh and sharp, and you cannot do so if you are doing hard repetition training, etc., therefore, a typical training week during the competitive season would go something like this:

Saturday: race  
Sunday: long easy run  
Monday: a few sharpeners  
Tuesday: sprint training or leg speed  
Wednesday: a club race  
Thursday: jog  
Friday: leg speed, etc.

Train just enough to keep your condition at a good level, saving your energies for your races, which indicate your general condition and are all the hard work you need. Go for an easy jog every morning except the day of your long run, as this helps keep blood pH level normal and aids recovery. It also maintains cardiac fitness.

Without being too specific, this is basically the way to approach training for the middle and longer distances. As long as workouts are evaluated daily to be modified as needed, and the training plan is adjusted as required, you are sure to start to gain a fine balance in your schedule and get the desired results. On the other hand, you can work hard and not succeed if the training is not approached in an intelligent way.

## **6. How to Set Up a Training Schedule**

Counting backwards from the first important race date:

1. Allow ten days to freshen up [33].
2. Allow four or five weeks for co-ordination training. Sharpeners, time trials, development races (under and over-distances), pace judgment training, fast relaxed striding. If needed, 300 and 500 meters, fast anaerobic.
3. Allow three to four weeks for anaerobic development, with two or three workouts weekly. One day long aerobic run. Other days sprint training of sorts and easy running.
4. Allow four weeks for hill resistance training, done two or three days weekly, plus one day long aerobic run. Wind sprints every 15 minutes during hill training, other days leg speed and fast relaxed runs over 100 meters, or easy aerobic running.
5. Allow at least 10 weeks for marathon conditioning:
  - a. start with only aerobic mileage (flats and hills)
  - b. then include a day easy fartlek and strong runs over ~5K and 10K – the 10K only once every two weeks, and the 5K three times every two weeks [34]
6. Continuation of racing – race week/non-race week schedule.

These schedules allow a runner to compete often and to keep improving, as long as the races are not run every week. It is usually best to race every three weeks.

## 7. A Generalized Training Schedule

The following schedules are for guidance **only**. They provide a balanced method of training for distance events, but think of them as flexible guidelines, allowing for age and general conditioning. Study your responses to the training from day to day and if you feel stale or suffer from any soreness, allow some time to recuperate [35]. Never do speed training when your muscles are sore or you are feeling tired – just jog easily, regardless of what is on the schedule for that day’s training. You can never harm yourself by jogging and it will usually help to overcome the soreness or tiredness, whereas fast training can lead to injury and make you more tired.

The instruction “for as long as possible” on the schedules refers to the period between the finish of one season and the start of the next (e.g., between cross-country and track seasons, etc.)

Training should be done on all types of surfaces, and trial runs over courses similar to the race being prepared for. Training volume should also be applied in relation to age and condition. Regular running on hills helps develop and maintain speed. Try to fit in some hill springing, uphill running, or bounding with a driving action, plus some steep hill or step running whenever you can – but don’t overdo it [36].

Again, please note that it is wise to run supplementary miles at an easy pace, as many as you can, in addition to the schedules presented here. This will help you maintain good general condition and recover from training sessions more easily. Even 15 minutes is of value.

Finally, don’t race your training, except when full efforts are called for on the schedule. Run strongly yet easily enough that something always remains in reserve [37]. As you feel improvement, gradually increase your training tempo, but never use that reserve [38].

Top form can be maintained for months, provided the conditioning base is deep enough, and two simple precautions are taken: don’t to try train hard and race at the same time, and always make allowances for recovery from races. To keep **fresh** and **sharp** is the secret.

### I. Aerobic Conditioning (at least 10 weeks and as long as possible, in 2 week cycles)

Monday:	aerobic running 45-60 minutes
Tuesday:	aerobic running 60-90 minutes
Wednesday:	hilly course 30-60 minutes
Thursday:	aerobic running 60-90 minutes
Friday:	jog 30-60 minutes
Saturday:	hilly course 30-60 minutes
Sunday:	aerobic running 90-120 minutes
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Monday:	hilly course 30-60 minutes
Tuesday:	aerobic running 60-90 minutes
Wednesday:	time trial 3,000 or 5,000 meters
Thursday:	aerobic running 60-90 minutes
Friday:	jog 30-60 minutes
Saturday:	relaxed striding 4-8 × 200 meters
Sunday:	aerobic running 120 minutes or more

### II. Hill Resistance Training (4 weeks)

Monday:	leg-speed 6-10 × 100 meters
Tuesday:	hill circuit training 30-60 minutes
Wednesday:	fast relaxed running 6-10 × 100 meters
Thursday:	hill circuit training 30-60 minutes
Friday:	leg-speed 6-10 × 100 meters
Saturday:	hill circuit training 30-60 minutes
Sunday:	aerobic running 60-120 minutes



### III. Anaerobic Capacity Training (3 weeks)

- Monday: sprint training
- Tuesday: repetitions
- Wednesday: easy fartlek 30-60 minutes (jogging and striding) or sprint training
- Thursday: repetitions
- Friday: relaxed striding (fast and easy)
- Saturday: repetitions
- Sunday: aerobic running 60-120 minutes

### IV. Co-ordination Training (4 weeks)

- Monday: wind-sprints 10-20 × 50 meters every 100 meters, or 100 meters every 200 meters (total of 2,000-4,000 meters)
- Tuesday: for middle distance – fast relaxed striding or sprint training  
for distance – time trial 3,000 or 5,000 meters  
for either – easy fartlek or aerobic running up to 60 minutes
- Wednesday: development races (sprint and middle distance) or time trial
- Thursday: fast relaxed striding, or pace judgment, or easy fartlek, or fast runs in repetition 3 × 300 meters or 2 × 500 meters
- Friday: leg speed 4-6 × 120 meters, or jog 30 minutes
- Saturday: development race (over or under race distance)
- Sunday: aerobic running 60-90 minutes

### V. Freshening up (2 weeks)

- Monday: wind-sprints 12-20 × 50 meters
  - Tuesday: easy fartlek or aerobic running 60 minutes
  - Wednesday: time trial over race distance (fast)
  - Thursday: fast relaxed striding 6 × 100 meters
  - Friday: jog 30 minutes
  - Saturday: race or time trial ½ race distance
  - Sunday: aerobic running 60-90 minutes
- 

- Monday: wind-sprints 10-16 × 50 meters
- Tuesday: time trial, 400, 600, or 1,500 meters
- Wednesday: fast relaxed striding 6 × 100 meters
- Thursday: jog 45 minutes
- Friday: jog 30 minutes
- Saturday: first important race
- Sunday: jog 60-90 minutes or more

### VI. Continuation of Racing

- Monday: easy fartlek 45-60 minutes
- Tuesday: relaxed striding 6 × 200 meters
- Wednesday: race or time trial
- Thursday: easy fartlek 60 minutes or jog 45 minutes
- Friday: jog 30 minutes
- Saturday: race or time trial
- Sunday: jog 90 minutes

## 8. Sample Training Schedule for 10,000 meters

### I. Aerobic Conditioning (at least 10 weeks and as long as possible)

Monday: aerobic running 60 minutes  
Tuesday: aerobic running 90 minutes  
Wednesday: aerobic running 60 minutes  
Thursday: aerobic running 90 minutes  
Friday: aerobic running 60 minutes  
Saturday: aerobic running 90 minutes  
Sunday: aerobic running 120-150 minutes

### II. Hill Resistance Training (4 weeks)

Monday: easy fartlek 45 minutes  
Tuesday: hill springing & bounding 60 minutes  
Wednesday: easy fartlek 45 minutes  
Thursday: hill springing & bounding 60 minutes  
Friday: relaxed striding 6 × 200 meters  
Saturday: hill springing & bounding 60 minutes  
Sunday: jogging 120 minutes

### III. Anaerobic Capacity Training (4 weeks, in 2 week cycles)

Monday: repetitions 6 × 800 meters  
Tuesday: jogging 90 minutes  
Wednesday: time trial 3,000 meters  
Thursday: easy fartlek 60 minutes  
Friday: jogging 30 minutes  
Saturday: repetitions 12-15 × 200 meters  
Sunday: jogging 120 minutes

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Monday: repetitions 6 × 600 meters  
Tuesday: jogging 90 minutes  
Wednesday: time trial 5,000 meters  
Thursday: easy fartlek 60 minutes  
Friday: jogging 30 minutes  
Saturday: repetitions 10-12 × 400 meters  
Sunday: jogging 120 minutes

### IV. Co-ordination Training (4 weeks, in 2 week cycles)

Monday: wind-sprints 10 × 100 meters every 200 meters  
Tuesday: easy fartlek up to 60 minutes  
Wednesday: time trial 1,000 meters  
Thursday: fast relaxed running 10 × 100 meters  
Friday: jog 30 minutes  
Saturday: time trial 5,000 meters  
Sunday: jogging 120 minutes

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Monday: wind-sprints 10 × 100 meters every 200 meters  
Tuesday: easy fartlek up to 60 minutes  
Wednesday: time trial 1,600 meters  
Thursday: fast relaxed running 10 × 100 meters  
Friday: jog 30 minutes  
Saturday: time trial 10,000 meters  
Sunday: jogging 120 minutes

V. Freshening up (2 weeks)

Monday: wind-sprints 20 × 50 meters every 100 meters

Tuesday: easy fartlek 30 minutes

Wednesday: time trial 3,000 meters

Thursday: fast relaxed striding 10 × 100 meters

Friday: jog 30 minutes

Saturday: time trial 5,000 meters (½ race distance)

Sunday: jogging 60 minutes

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Monday: wind-sprints 12 × 50 meters every 100 meters

Tuesday: easy fartlek 30 minutes

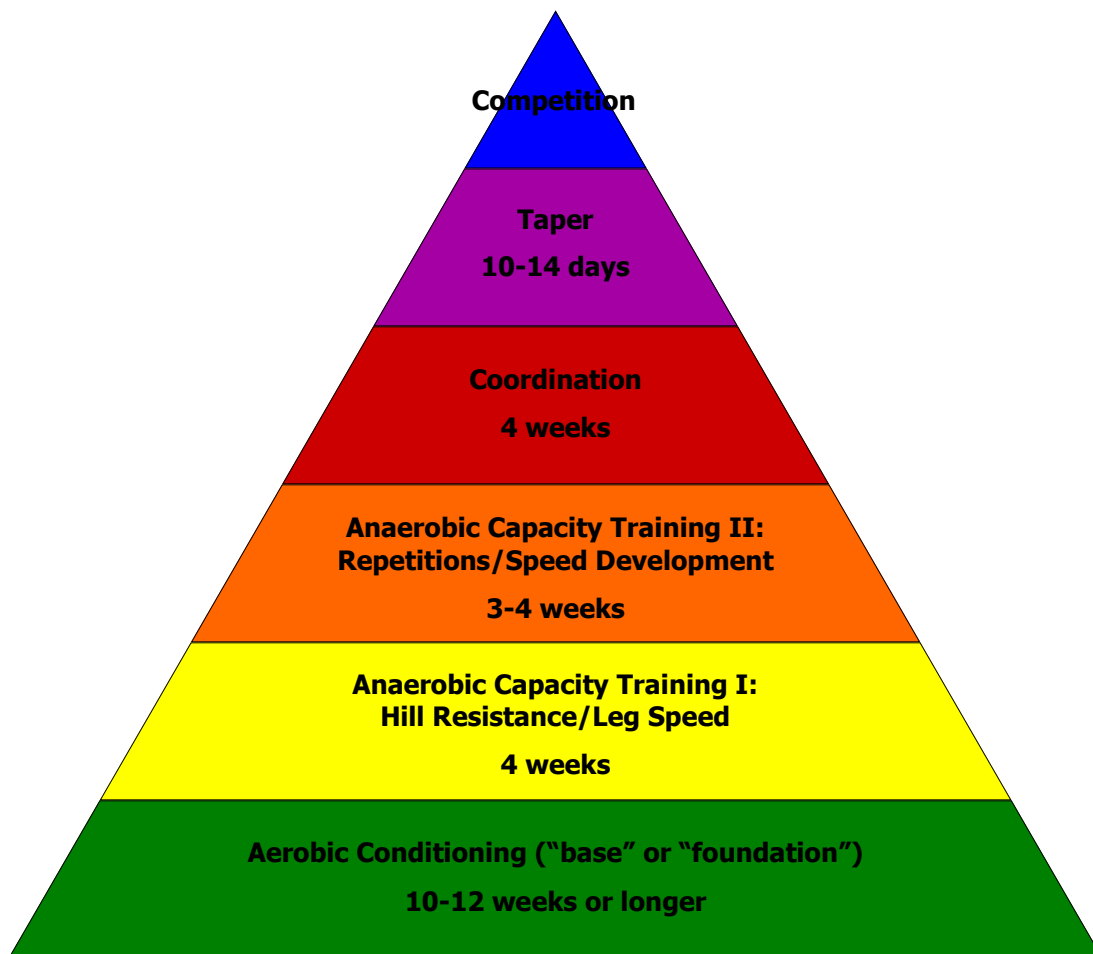
Wednesday: time trial 1,600 meters

Thursday: jog 30 minutes

Friday: jog 30 minutes

Saturday: first important race

Sunday: jog 60-90 minutes or more



## 9. Race Week/Non-Race Week Training Schedules

The following schedules allow a runner to compete often and to keep improving, as long as races are not run every week; it is usually best to race every three weeks. Two schedules are shown here, one for road racers and one for cross country racers, but basically the idea is the same.

### Cross country (non-race week)

Monday: repetitions  $3 \times 1,500$  meters or  $6 \times 800$  meters  
Tuesday: aerobic running 60-90 minutes  
Wednesday: time trial 3,000 or 5,000 meters  
Thursday: aerobic running 60-90 minutes  
Friday: fast relaxed striding  $10 \times 100$  meters  
Saturday: time trial 3,000 or 5,000 meters  
Sunday: aerobic running 60-90 minutes

### Cross country (race week)

Monday: wind-sprints  $6-10 \times 100$  meters  
Tuesday: easy fartlek 30-60 minutes  
Wednesday: time trial 1,500 to 2,000 meters  
Thursday: fast relaxed striding  $6 \times 100$  meters  
Friday: jog 30 minutes  
Saturday: race  
Sunday: aerobic running 90 minutes or more

### Road (non-race week)

Monday: repetitions  $3 \times 1,600$  meters or  $6 \times 800$  meters  
Tuesday: aerobic running 90 minutes  
Wednesday: time trial 3 miles  
Thursday: aerobic running 90 minutes  
Friday: fast relaxed striding  $6-10 \times 100$  meters  
Saturday: time trial 3 miles  
Sunday: aerobic running 90 minutes or more

### Road (race week)

Monday: wind-sprints  $10-16 \times 100$  meters  
Tuesday: easy fartlek 30-60 minutes  
Wednesday: time trial 1 mile  
Thursday: fast relaxed striding  $4-6 \times 100$  meters  
Friday: jog 30 minutes  
Saturday: race  
Sunday: aerobic running 90 minutes or more

## 10. Marathon Tips

To run a marathon, you must develop fine general cardiorespiratory condition, which basically means the improved intake and transportation of oxygen. These factors improve quickly, but adaptations in the muscles take longer [39], so development of muscular endurance can only be brought about over time with continuous exercise of the muscle groups for long periods.

Particularly when it lasts for two hours or more, this not only affects underdeveloped capillary beds, but also develops new ones, thus bringing about an important increase in muscular endurance, so to succeed in marathon racing or running, it is essential to go for long runs often, and the more the better. The nucleus of the marathon training schedule is three long runs a week, interchanged with other runs that, while they can be shorter, are usually over hilly terrain [40]. Because marathons are run most of the way at fast aerobic efforts, there is little need for much anaerobic training; fartlek and time trials over 5K to 10K will develop all the anaerobic capacity you will need.

(Fartlek, Swedish for “speed-play,” is training that mixes all sorts of running over golf course-type terrain. Once you are warmed up, stride out fast, sprint, sprint up hills, stride down hills, jog and generally run according to how you are feeling.)

When you begin marathon training, it is better to train on a time basis rather than set out to cover a given mileage. This allows you to feel your way and not bite off too much at the beginning. Always run to your individual fitness level and not at someone else’s, which can involve you in anaerobic running; in the conditioning period, you can never run too slowly to improve the oxygen uptake, but you can run too fast and go into oxygen debt, which will interfere with and hinder aerobic development.

Getting used to running in the heat is important, since you can suffer ill effects if not prepared for it. Hot weather training develops the skin arterioles, which allows more blood to be pumped to the skin surface for cooling. Sauna baths can help in this development.

Train well within your capabilities. Start each run at a steady effort and don’t be tempted into going too fast at the beginning.

### *Marathon Checklist*

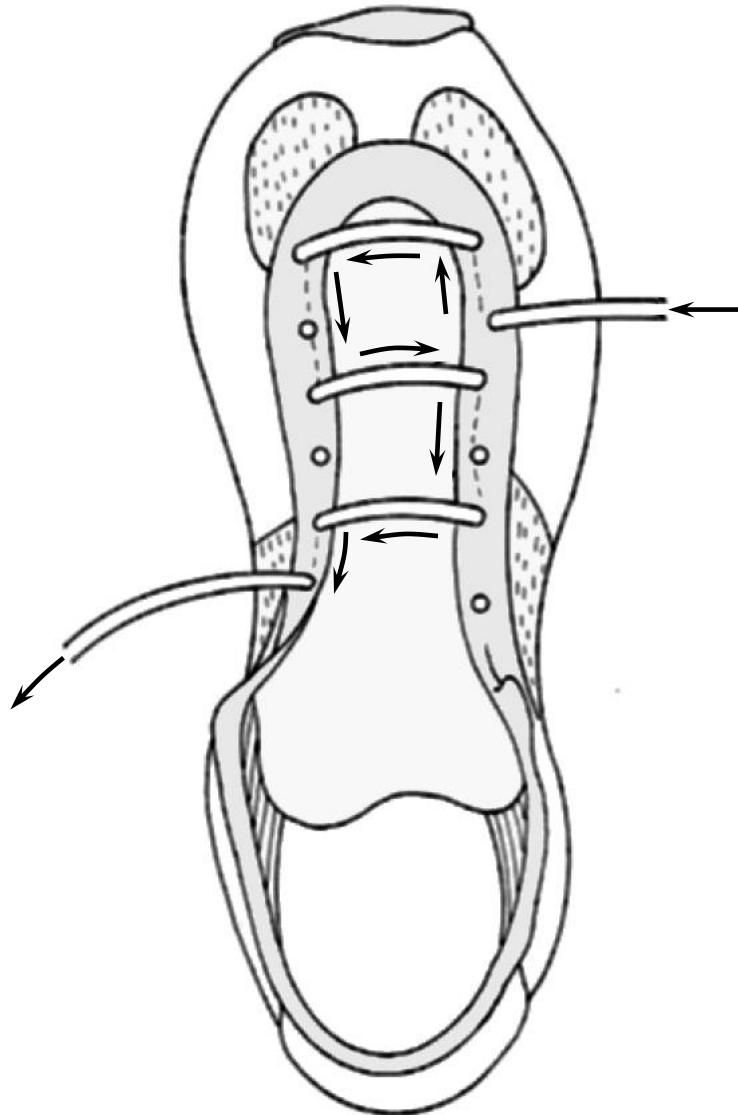
1. Keep to your normal balanced meals the days prior to the race. Protein, carbohydrate, and fat are all necessary for a balanced metabolism in the marathon race. Eat up to 8 oz. of honey supplementary to your normal meals the two days prior to the race.
2. On race day, eat a light breakfast preferably of cereals, honey and toast, with tea or coffee. Finish eating about three hours before the start.
3. Prepare carbohydrate-electrolyte drinks for a hot day. Make the mixture weaker than directed. Add some honey. A glass just prior to the start can help. Do not take salt tablets.
4. Use good-fitting clothes and shoes that do not chafe and that are suited to race day conditions. When putting your shoes on, force your heels hard into the backs of the shoes before lacing firmly, but not too tight, to stop foot movement inside the shoes that leads to blistering.
5. Use lubricant (olive oil or lanolin) under arms and crotch. Do not use antiperspirants.
6. Do not run much before the start. Save your energy. Stretch and loosen a little.
7. Start well within your capabilities and use the first 10 minutes or so to warm up, holding yourself in check. Ignore the other runners and run at an intensity that suits you; it will pay off later.



8. Do not surge in the race and waste energy.
9. Do not exaggerate your knee lift. From the start, try to relax and lift the knees no higher than necessary, to save the hip flexor muscles.
10. Drink water and carbohydrate-electrolyte drinks throughout the race on a hot day. Keep your body wet. Sponging is the best insurance against dehydration and high body temperatures.

### 11. How to Lace Your Shoes

How you lace your shoes is more important than most runners realize. [This lacing pattern](#) will not pull down on the sinews and metatarsals on the top of your foot when tightened; any other method creates pressure points across the top of the foot, which can become uncomfortable, even painful, when your foot swells. A simple matter like improper lacing can prevent the foot from functioning freely, and because it may be straining against restrictive points, the foot can be damaged.



## 12. For Joggers Only

### *Why Jog?*

Jogging, or easy aerobic running, has been evaluated in sports medicine institutes throughout the world and found to be the most effective means of exercise – next to cross country skiing – for developing general cardiac condition. Jogging eases pressure on the heart by stimulating the blood vascular (circulatory) system to gather in and transport more oxygen to the various parts of the body; during strenuous exercise, the heart can pump about 34 liters of blood each minute, but when running easily, it is still pumping several liters of blood per minute, which is sufficient to develop the smaller arteries, arterioles, capillary beds, and veins. As a result, blood can circulate back to the heart more quickly, the build-up of blood in the aorta is lessened, and pressure on the heart is eased.

A greater quantity of blood is pumped to the lungs as the arteries in the respiratory system enlarge, and this in turn improves the rate of oxygen uptake. Everyone breathes in a lot of oxygen, but much is breathed out because it cannot be absorbed. It is also agreed that better blood tone usually results from exercise, increasing the quality and quantity red blood cells. Through the increased oxygen intake per minute and improved circulation, the heart's workload eases, which is the first stage in improving cardiac capacity and eliminating the possibility of failure.

### *Starting Out*

As aerobic fitness improves, it is possible to progressively increase the workloads safely, running at faster speeds and for longer distances, but it is wise to run easily for several months, without regard to pace, until some level of development has been reached. Everyone has a certain ability to absorb, transport, and utilize oxygen, and when exercise calls for the highest possible aerobic level over a prolonged period, it is termed the maximal steady-state. This ability can be improved with regular aerobic exercise, but when the exercise requires more oxygen than can be taken in, it becomes an anaerobic, and the metabolism has to compensate, resulting in the appearance of lactic acid in the blood stream, which eventually causes the person to stop exercising through neuro-muscular breakdown.

To improve cardiorespiratory capacity, it is necessary to use the powerful leg and thigh muscles that do not tire quickly and keep the blood pressure generated by the heart at high levels for periods of 15 minutes or more. This should be undertaken daily or every other day at the least. The more time spent running aerobically, the more profound the adaptive response.

As regular, consistent training brings improved aerobic fitness, previously low anaerobic efforts become high aerobic exercise, which means that for an absolute workload (in this case, the running speed), the heart can perform its tasks more easily. The novice jogger should therefore exercise well within his or her fitness level and capacity to exercise – not striving too hard for at least six or more weeks, at which point the benefits of the regular exercise become evident and result in a higher oxygen uptake, making it possible to maintain a faster pace for longer periods of time.

### *Building Up*

Running continuously for longish periods of time helps to develop existing capillary beds and also creates new ones. This results in greater capacity to utilize oxygen and eliminate waste products. Greater muscular endurance comes in turn.

If you are accustomed to running for, say, 15 minutes daily, the best approach for developing stamina is to increase duration every third day to about 30 minutes. On the days in between, revert to 15 minutes for two days until the improvement in stamina is apparent. This approach to training should be continued progressively until it is possible to run for an hour or longer, i.e., an increase of the usual daily run, with the weekly schedule including two or three longer runs of 30 minutes or so for two days, then a longer run of 45-60 minutes on the third day. This way, endurance improves quickly.

When you can run freely for up to an hour or more, you should be able to participate in Fun Runs and other competitions of an aerobic nature without fear of developing a problem. If racing is contemplated, anaerobic training becomes necessary, in order to develop the capacity to withstand oxygen debt.

### *Technique*

A good running technique improves speed for a given level of oxygen consumption, and can also help to avoid some injuries. The torso should be upright, with the hips tucked directly underneath and no sway in the lower back. The upper body should be relaxed with the arms coming through loosely, low and upwards, so that the thumbs are just inside the shoulders. An upright body carriage helps to lift the knees higher, thereby increasing stride length relative to the speed attained. A relaxed style saves energy by helping to maintain balance and avoiding sway from side to side. By keeping up tall, it is possible to gain drive off the back leg and run lightly. You should not hit the ground hard with the feet as happens when someone sits back and keeps the knees bent.

Striding out over about 100 meters or more and then jogging about 300 meters before repeating can help if these principles are applied; gradually speed improves to coordinate with the endurance training. Running over hilly terrain, when you are fit enough, will strengthen the legs, adding power and flexibility, particularly in the ankles. If this is fitted into the training schedule on a regular basis, you will show a marked improvement.

### *Golden Rules*

If you have any doubts about your health, consult your doctor before starting to jog and also have regular checks to monitor the body's response to training.

Running on firm surfaces, such as roads, gives the best traction and means the leg muscles do not tire as quickly as they would on rough or soft surfaces. When training on firm surfaces, it pays to have good rubber soles and heels on running shoes to alleviate the effects of jarring. Dry grassy areas are usually best for beginners to minimize the jarring, as the slower you run, the harder you land on the ground.

Never try to run too fast during the initial training period, for it is better to run a little too slowly rather than too fast. Always try to finish in the "pleasantly tired state," knowing that you can do better. You can never run too slowly to help bring about some cardiac development, but you can run too fast, causing undue strain, sore muscles, and slower recovery. This inevitably affects the following day's training.

A sensible and balanced diet should be maintained. It pays to read all you can about the functions of vitamins, enzymes, and minerals. It is futile to train hard if your diet is not wholesome and balanced. Continued jogging over months can help lose weight, providing you run enough and at the same time watch your calorie intake.

The Golden Rules in summary:

- ▶ Whenever in doubt about yourself, see your doctor.
- ▶ Be regular with your exercising, as a little often is better than a lot occasionally.
- ▶ Jogging is an aerobic exercise, so it can be done at any time of the day or night, but not straight after meals. Give your system two or three hours to digest food before you exercise.
- ▶ Be careful of your running shoes and do not let them wear unevenly as this can lead to leg injuries.

### 13. Notes on Nutrition

The time to experiment with your diet is not before an important race, but rather when a bad reaction won't affect your training too severely. Carbohydrate, protein, and fat are all necessary in a balanced diet, but runners following the marathon conditioning program will need a higher caloric intake [41]. It is difficult to get the extra calories from bulky foods, so it is recommended to use honey, especially prior to big races, to provide the energy you need without causing intestinal distress.

You should evaluate what you are eating and what you need; some people excrete more minerals than others, and each person is unique in his or her requirements. Natural foods are the best source of nutrients because they contain not only the natural balance of vitamins and minerals, but also the enzymes needed to use them.

Always remember that, as long as you are training, your requirements are higher than normal, and deficiencies could cause a break-down in your body, so you must replace what you lose in order to continue training and competing effectively. You can get many of the minerals you need from electrolyte drinks, but be sure to check the ingredient label thoroughly.

Here are some notes on vitamins and minerals:

Calcium – your body contains about 3 lbs of calcium, more than any other mineral. Most of it is in teeth and bones, but the remaining ten percent is vital; without the proper amount in your system, your body takes what it needs from your bones to make up the deficit. Calcium allows your muscles to contract, and you can unknot muscle cramps by taking extra calcium. It also helps eliminate lead from the system.

Chromium – acts with insulin to help regulate blood sugar, which in turn helps prevent diabetes. In addition, chromium helps maintain muscle contractions and eliminate cramps.

Iron – a vital oxygen-carrying agent contained in hemoglobin. It is also reported that iron may help guard against depression. A daily dose of approximately 18 mg is recommended.

Magnesium – if you are experiencing sleepless or restless nights, perhaps you are deficient in magnesium, which acts as a natural tranquilizer to relax jumpy muscles and nerves, and counteract irritability. Also aids in the digestion of protein, fats, and carbohydrates.

Potassium – when you sweat, you lose salt and potassium. It is not necessary to replace the salt, but it is very important to replace the potassium, which helps counteract the effects of heat. A severe potassium deficiency can cause nausea, muscle weakness, cramps, irritability, and finally, total collapse. Sweat rate can vary considerably from one individual to the next, so those who perspire lightly will not need so much potassium, while “heavy sweaters” who take salt will need double doses. Food sources of potassium are bananas, oranges, tomatoes, cabbage, celery, carrots, grapefruit, apples, beans, and fish.

Zinc – almost nothing happens in the human body without zinc, which assists in the making of new cells, speeds up healing of burns and all kinds of wounds, and aids recovery from lactic acid build up.

Vitamin A – helps counteract the effects of stress and dangerous pollutants such as benzene and dieldrin. Keeps skin smooth, vision sharp, the immune system strong, and anti-stress mechanisms efficient.

Vitamin B1 (Thiamine) – assists metabolism by turning carbohydrates into glucose, which fuels the brain and the muscles. Best taken in a B-Complex form, but 5 mg daily helps most athletes. Any athlete who carbo-loads before a race should take sufficient amounts of B1, which helps convert pasta into energy.

Vitamin B2 (Riboflavin) – aids the digestion of fats. Any whole grain will do, but wild rice is best.

Vitamin B3 (Niacin) – at least 40 biochemical reactions in the body rely on Niacin, but its most important function is in maintaining the oxygen-carrying capacity of red blood cells.

Vitamin B6 (Pyridoxine) – plays a role in the synthesis of serotonin, a chemical that regulates memory. Birth control pills deplete B6 stores and may cause depression.

Vitamin B12 (Cobalamin) – assists the nervous system in relaying messages between the body and the brain. Liver is the best source, but any animal product will do. Birth control pills also deplete B12 stores.

Vitamin B15 (Pangamic acid) – increases oxygen utilization by tissues, helps maintain glycogen and creatine phosphate stores in the muscles. It also intensifies the process of aerobic oxidation during muscular activity, helps in recovery of low pH of the blood, and doubles the recovery of ADP to ATP.

Vitamin C – an all-purpose antidote. So powerful it detoxifies heroin, nicotine, alcohol, and cancer-causing pollutants. Helps counteract the effects of heat; increasing vitamin C intake a week before an event in hot weather will give you a competitive edge. 1,000 mg with a meal boosts iron absorption tenfold, which in turn maintains the blood's oxygen-carrying capacity.

Vitamin D – primarily allows calcium absorption; the only vitamin naturally produced in the body.

Vitamin E – improves glycogen storage, allowing more fuel to be available for long workouts. Improves the tone and strength of the heart muscle and protects cells from oxidation.



## 14. Training Terms

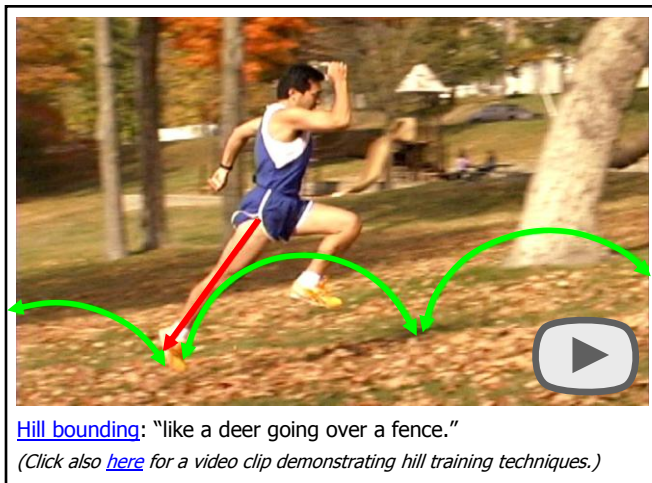
*Aerobic running* is training at a fairly strong pace (70-100% of maximal steady-state), not just jogging, and finishing in a “pleasantly tired” state. On the other hand, it does not mean racing your training.

*Fartlek*, invented by Gösta Holmér [42], is Swedish for “speed-play,” the changing of pace for varying distances during a workout. Effort is coordinated with terrain, rather than time or distance, e.g., springing or sprinting up the hills, fast relaxed striding on the downhills, sustained drives for a minute or two, or whatever you feel like doing.

*Easy fartlek running* should not tire you too much. Take easy jogging intervals whenever you feel like it.

*Strong fartlek running* is used to develop anaerobic capacity, and you should finish in a tired state.

*Hill springing* is used to strengthen the legs generally, and the ankles in particular. Find a gentle slope, and after warming up, use a bouncing action with a slow forward momentum, pushing hard off the toes, ankles flexing and so stretching the tendons and muscles. The body’s weight acts as a form of resistance that develops the fast-twitch (white) muscle fibers, which aids in speed development, since speed requires strong and flexible ankles. Do as much of this exercise as you feel your legs can take – initially just a little, and then gradually increasing the workload when you know how you will respond. Oftentimes, even just a little can help generally.



*Hill bounding* is a variation of hill exercise which uses a more gently sloping hill and long, bouncy, high knee-lifting strides, pushing hard with the back leg, forcing the arms through, and running quite fast, like a deer bounding over a fence. Again, do only what you feel you can manage. The length of the hill should be in excess of 100 meters if possible.

*Steep hills or step running* is used mainly to strengthen the upper leg muscles, though the legs benefit in general. Knee-lift is important over all distances from sprints to marathons, and the quadriceps muscles often tire, causing loss of stride length and leg-speed. Run up a

steepish hill or steps, bringing your knees up so as to make the back of the leg drive fairly hard. Don’t try to go too fast; make your legs feel the workload. Do only what you feel you can manage, giving your legs a good recovery before doing more of the exercise.

*Repetitions* are for anaerobic capacity development. Run one and jog one [43].

*Leg-speed training* is fast running over about 100 meters, concentrating on pulling your legs through quickly with the quadriceps and lower stomach muscles, rather than on driving hard off the back leg. Try to maintain a nearly normal stride length and **move the legs fast**, then jog for 300 meters before repeating. Always run the fast work with the wind or downhill.

*Pace judgment running* is used over 400 meters, usually in 4-6 repetitions, at the speed you intend to average in your racing. Take whatever interval you feel you need for recovery, as it is important to run as closely to the exact time as possible.

*Relaxed striding* helps you relax during races. Running varying distances of 100-300 meters while keeping the upper body relaxed and concentrating on good technique makes you faster without being more fit.

*Fast relaxed striding* is similar to relaxed striding, but at your best relaxed speed.

*45 meter windsprints over 100 meters* are used for sharpening and developing the ability to become accustomed to changes of pace in racing.

*100 meter windsprints every 200 meters* are similar to 45/100 windsprints, but are more effective anaerobically. Sprint the straights and float the bends.

*Speed training* is designed to increase sprinting speed, for instance, 10 × 100 meters, with a full recovery in between.

*Sprint training* consists of warming up, stretching, and the following exercises, which concentrate on form:

1. long-striding exercise – this develops stride length by exaggerating the strides and pushing off hard with the back leg. Run with a high knee-lifting, long-striding action, the arms forced through and driving hard off the back foot.
2. running tall exercise – this involves getting up and keeping high on the toes, lifting the knees high and stretching the body upwards, while lifting the torso from the pelvis;
3. high knee lift exercise – with slow forward momentum, raise the knees high and fast alternately in a running action so that the quadriceps start to feel fatigued; do what you feel you can, then jog back easily and repeat;
4. moving the legs as fast as possible to develop quick leg turn-over.

Repeat each exercise once over 70-100 meters, always with the wind (if there is any), taking the necessary recovery interval (3+ minutes) between each repetition. The running speed should not be too fast; concentrate on keeping up tall.

Then, combine all exercises and repeat 6-10 times, as fast and relaxed as possible, with a jogging interval in between each repetition.

*Time trials* are used to co-ordinate training. Run at about 7/8ths effort, maintaining even pace throughout the whole distance. Don't increase the speed by sprinting at the end.

*Hard/easy training* alternates hard days and easy days, sometimes hard weeks and easy weeks.

*Peaking* is a process by which maximum performance levels are reached for a particular event or period of time

*Jogging* is very easy running.

*Jumping rope* with a running action can be valuable when weather does not allow outdoor training. It has good value for oxygen uptake development.

*Cycling* is good for running and can be used when you are injured. It also helps develop leg-speed.

*Swimming* can be used when recovering from injuries, but is recommended only in low volumes.

## 15. Glossary

*Aerobic* – literally, “with oxygen”; exercising within the ability to absorb, transport, and use oxygen.

*Aerobic endurance* – a measure of the ability to do continuous work.

*Anaerobic endurance* – the ability to withstand lactic acid fatigue.

*Anaerobic threshold* – the level of work or exercise at which lactic acid begins to accumulate. It marks the transition from aerobic levels of exercise to anaerobic levels.

*Effort level* – relates to the percentage of maximum effort, or the use of a percent of one’s ability (power, speed, and endurance) in a particular exercise.

*Endurance* – the ability to maintain certain pace or speed over an extended time.

*Fast-twitch fibers* – muscle fibers consisting of cells that use mainly anaerobic metabolism to produce mechanical energy. They can supply a great amount of power on demand, but have limited endurance. They are called on during sprints and other such high-demand, short-duration efforts.

*Intensity* – the degree of effort exerted, or rate of energy expended in an exercise. A high-intensity effort involves near maximum effort, and a rapid build-up of fatigue. A low-intensity effort is marked by a slow accumulation of fatigue, at less than 90% effort.

*Lactic acid fatigue* – distress caused by the accumulation of lactic acid in the system to the point where neuromuscular breakdown occurs.

*Maximum oxygen uptake ( $VO_2max$ )* – the highest rate at which an individual can take in and utilize oxygen (as opposed to the rate at which air is inhaled), measured in liters per minute or milliliters per minute per kilogram of body mass.

*Over-training* – training so hard as to exhaust the body’s energy systems and create undue fatigue levels which cannot be recovered by the next workout, resulting in a decline in performance. The athlete then becomes more subject to sickness, injury, and further decline in performance.

*Oxygen debt* – the result of running anaerobically, when the amount of oxygen required exceeds what can be supplied.

*Slow-twitch fibers* – muscle fibers that use aerobic metabolism to produce mechanical energy.

*Speed* – the rate at which distance is covered; the mathematical inverse of pace, which is the amount of time required to cover a given distance (e.g., minutes per mile).

*Staleness* – a condition brought on by overtraining in which the athlete’s performance and/or workout ability decreases. Can also be accompanied by insomnia, lack of motivation, fatigue, etc.

*Stamina* – the ability to maintain a maximum effort over a given distance.

*Steady-state* – the maximum pace at which a runner can transport and utilize oxygen without incurring oxygen debt. As a result, there is no build-up of lactic acid; heart rate, cardiac output, and respiration maintain a constant level.

## 16. A Summary of the Lydiard System, by John Davies

1. Choose the event that best suits you internationally. Basic speed is the governing factor.
2. Training can be done too fast or too slow, too much or too little, at right or wrong times. Understanding the “why” of each day’s training as well as the “how” and “what” is important physiologically and mechanically. Any schedule is for guidance only; use daily responses to evaluate every workout and plan the next one.
3. All distance and middle distance athletes require
  - a. a high aerobic threshold
  - b. anaerobic development
  - c. speed, and
  - d. co-ordination of the above three

Training must be systematic. One development follows another, and the correct balance must be maintained between aerobic, anaerobic, and speed development for the chosen event, then you must peak at just the right time. It is not necessarily the best athlete who wins, but the best prepared.

4. In both middle and long distance events, a high anaerobic threshold is necessary. The aim is to develop sufficient endurance to maintain the necessary speed over the race distance to be successful, and it can only be gained through aerobic running, i.e., the accumulation of many kilometers in training; it is a mistake to use anaerobic training during the conditioning phase. Once aerobic development is finished, the basic performance level is determined.
5. While stamina can be continually developed, anaerobic capacity is a limited factor, and once anaerobic training is started, it must be continued, otherwise development is lost. Anaerobic development only takes 10 to 12 weeks to achieve maximum levels, and requires volume training, i.e., longer repetitions (30 seconds – 3 minutes), not short sharp ones (10-20 seconds). How many reps and how much recovery are enough should be decided by the athlete, in relation to his or her individual response, not by a hypothetical number of repetitions. After three weeks of heavy anaerobic overload, the athlete needs to decide whether to continue for another week or back off and start the shorter, sharper workouts that maintain anaerobic development without sacrificing good condition at the same time.
6. It is a fallacy that anaerobic training develops speed. In fact, it counteracts speed, hence the need to balance one with the other.

## 17. Bibliography and On-line Resources

*Run to the Top*, Arthur Lydiard with Garth Gilmour, 1961.

*Running the Lydiard Way*, Arthur Lydiard and Garth Gilmour (Mountain View, CA: World Publications), 1978.

*Jogging with Lydiard*, Arthur Lydiard and Garth Gilmour (New Zealand: Hodder and Stoughton), 1983.

*Running to the Top*, Arthur Lydiard and Garth Gilmour (Oxford: Meyer & Meyer Sport), 1997.

*Distance Training for Women*, Arthur Lydiard and Garth Gilmour (Oxford: Meyer & Meyer Sport), 1999.

*Running with Lydiard*, Arthur Lydiard with Garth Gilmour (Oxford: Meyer & Meyer Sport), 2000.

*Distance Training for Masters*, Arthur Lydiard with Garth Gilmour (Oxford: Meyer & Meyer Sport), 2000.

*A Clean Pair of Heels: The Murray Halberg Story*, Murray Halberg as told to Garth Gilmour (Auckland: A.H. & A.W. Reed), 1963.

*No Bugles No Drums*, Peter Snell and Garth Gilmour (New Zealand: Minerva Bookshop Limited), 1965.

*Gold Aren't Easy*, Dick Tayler and Spencer Jolly (New Zealand: John McIndoe), 1975.

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For general and biographical information, Lydiard's [Wikipedia](#) and [Te Ara](#) entries are good starting points. See also "[Arthur Lydiard, Running Man](#)" from nzedge.com. When Lydiard passed away in 2004, *The New Zealand Herald* naturally ran an [obituary](#) and [tributes](#), but his worldwide impact is evidenced by articles in [The New York Times](#), [The Age](#) (Melbourne), and the [IAAF](#).

The [Lydiard Foundation](#) is a non-profit organization created in 2006 to protect and promote Lydiard's methods for the benefit of current and future generations of athletes worldwide, at all levels. The Foundation is a partnership of Lydiard disciples Lorraine Moller and Nobuya "Nobby" Hashizume, who have recognized the importance of preserving the legacy that the charismatic New Zealander left to the world. Through coaching education courses and workshops, training camps, lecture tours, internet newsletters, and technical support services, they aim to bring Lydiard training into the 21st century along with the latest knowledge and innovations in the sport and fitness world. The Foundation's web site already boasts several multimedia presentations, including slide shows on the [Lydiard method](#), on [hill training](#), and the Lydiard [shoe lacing method](#), plus a video clip of his [hill bounding and springing](#) techniques.

For a straightforward overview of the Lydiard method, see this [article by Hashizume](#), an on-line posting of what appeared in the November 2002 issue of *Running Times Magazine*, as well as "[Training the Lydiard Way: 28 Weeks to a PR](#)" and "[The Essential Lydiard](#)", both from *Runner's World*. Then by way of contrast, Nobby engages in a [lively discussion](#) with John Molvar.

Lydiard expounds his views of all things running in two interviews, one at the [Chicago Athlete web site](#), the other from the [Washington Running Report](#). In "[Where have all the runners gone?](#)" (PDF, 9 MB), reprinted from *New Zealand Runner*, he laments the state of Kiwi running and explains why the Africans are so dominant (another overview of the Lydiard method is included), while "[The world according to Lydiard](#)," from the *New England Runner*, takes a look at things in the U.S.

*Embedded URLs to on-line resources:*

Lydiard's Wikipedia entry – [http://en.wikipedia.org/wiki/Arthur\\_Lydiard](http://en.wikipedia.org/wiki/Arthur_Lydiard)

Entry from *Te Ara*, The Encyclopedia of New Zealand  
<http://www.teara.govt.nz/en/biographies/613/lydiard-arthur-leslie>

“Arthur Lydiard, Running Man” – <http://www.nzedge.com/heroes/lydiard-arthur.html>

Obituary and tributes from *The New Zealand Herald* –  
[http://www.nzherald.co.nz/section/4/story.cfm?c\\_id=4&objectid=9003093](http://www.nzherald.co.nz/section/4/story.cfm?c_id=4&objectid=9003093)  
[http://www.nzherald.co.nz/section/4/story.cfm?c\\_id=4&objectid=9002987](http://www.nzherald.co.nz/section/4/story.cfm?c_id=4&objectid=9002987)

Obituary from *The New York Times* –  
<http://www.nytimes.com/2004/12/13/sports/othersports/13lydiard.html>

Obituary from *The Age* (Melbourne) –  
<http://www.theage.com.au/news/Sport/Lydiard-leaves-timeless-legacy/2004/12/13/1102787015546.html>

Obituary from the IAAF web site –  
<https://web.archive.org/web/20050224142152/http://www.iaaf.org/news/Kind=131072/newsId=28022.html>

Videos and slideshows from the Lydiard Foundation – <http://www.lydiardfoundation.org/category/training/>

“Legendary Lydiard,” by Nobuya Hashizume – <http://www.runningtimes.com/rt/articles/?id=5232>

Lydiard's 1999 presentation in Des Moines, Iowa (PDF, 1.3 MB) –  
<http://rundynamics2.webs.com/lydiardiowa99.pdf>

Discussion of Lydiard method between Nobby Hashizume and John Molvar –  
<http://www.bunnhill.com/BobHodge/Special/LydiardInterpreted.htm> or  
<http://www.bunnhill.com/BobHodge/Special/LydiardResponses.htm>

“Q & A with the God of Jog,” by Mike Prizy –  
<http://web.archive.org/web/20080622132526/chicagoaa.com/features/speedplaylydiard03.html>

“An interview with Arthur Lydiard,” by Roland Rust –  
<https://web.archive.org/web/20060222145539/http://www.runwashington.com/features/trainlydiard05.html>

“Where have all the runners gone?,” by Brian Taylor (PDF, 9 MB) –  
<https://web.archive.org/web/20061108080630/http://lydiardfoundation.org/pdfs/WHATRG.pdf>

“The world according to Lydiard”–  
<https://web.archive.org/web/20070727225000/http://lydiardfoundation.org/pdfs/WATL.pdf>

“Training the Lydiard Way: 28 Weeks to a PR,”  
<http://www.runnersworld.com/race-training/training-the-lydiard-way-28-weeks-to-a-pr>

“The Essential Lydiard,” by Lorraine Moller  
<http://www.runnersworld.com/race-training/essential-lydiard>

“Run to the Top With Master Coach Arthur Lydiard,” by Garth Gilmour  
[http://www.thelegend.co.nz/legend\\_pdfs/static\\_pdfs/Lydiard\\_schedules\\_for\\_Legend.pdf](http://www.thelegend.co.nz/legend_pdfs/static_pdfs/Lydiard_schedules_for_Legend.pdf)

## 18. Endnotes, by Nobby Hashizume

1. Lydiard made shoes for most of his runners (including the racing spikes Peter Snell wore when he won the 800 meter run at the 1960 Rome Olympic Games), and became known as a strong critic of mass-produced athletic footwear.
2. Halberg's left arm was partially paralyzed in a rugby accident when he was 17. There were complications during the subsequent surgery, and Halberg nearly died when a blood clot formed around his heart, but he bounced back quickly, converted to distance running, and nine years later won the Olympic 5,000 meters.
3. John Davies coached several of the "Flying Kiwis" of the 1970s, including Dick Quax (1976 Olympic 5,000 meter silver medalist and 5,000 meter world record in 1977), Lorraine Moller (1984 Boston Marathon Champion; 1992 Olympic marathon bronze medalist; 4-time Olympian), Anne Audain, and Toni Hodgkinson (1996 Olympic 800 meter finalist).
4. This value derives from the fact that 38 ATP molecules are produced from one glucose molecule via aerobic metabolism, as compared to 2 ATPs via anaerobic glycolysis.
5. According to exercise physiologist Peter Snell, Ph.D., the absolute oxygen debt limit is more near to 4.0 liters. If 4.3 liters of oxygen per minute are required for a 70 kg runner to cover 5,000 meters in 16 minutes, then a runner with a  $VO_{2max}$  of 3.5 liters/minute would be able to run at this pace for only 5 minutes ( $4 \text{ liters} \div 0.8 \text{ liters/minute} = 5 \text{ minutes}$ ), but if he can raise his  $VO_{2max}$  to 4.05 (16%), he would incur 0.25 liters of oxygen debt per minute, and would be able to run 5,000 m in 16 minutes ( $4 \text{ liters} \div 0.25 \text{ liters/minute} = 16 \text{ minutes}$ )
6. As a guideline, Lydiard recommended the work intervals total ~5,000 meters, or that the combined time of work and recovery intervals be 30-45 minutes.
7. The basis of the Lydiard system is to balance aerobic and anaerobic development, and it was never his intention to eliminate anaerobic training; everything is important and must be combined in the proper balance. Aerobic training is simply the foundation on which more specific training (anaerobic and speed development) rests.
8. This does **not** mean that you should time every run and expect to get faster each time out; rather, you should keep the effort level about the same for each run, and as you become more fit, you will find that, as a natural consequence, you gradually become faster.
9. The better traction is, the faster you can run at the same effort, therefore, the further for a given time, providing greater pressure on the cardiovascular system, but this does not mean that Lydiard's runners always ran on the road; they used muddy courses for general conditioning, and grassy courses when their legs were sore.
10. The first step should be to get to the point where you can comfortably run for 2 hours continuously; the pace does not matter.
11. To achieve the greatest effect for the time spent training, it is important to control the running speed as well as possible so as to maintain the same effort level, or cardiovascular pressure. If you stay at the same speed while getting fitter, you are running at less and less effort. Again, this does not mean that you should push yourself in an effort to go faster every time you run.
12. Lydiard always advised it is better to start out too slowly than too fast. At this point in your development, it is more important to go far (longer) in order to develop muscular and general endurance, and if you start out too hard, you may have to finish your workout prematurely.

13. It was Lydiard's belief that, for the most part, the less upper body movement, the better. When you clench your fists and carry your arms high, you invariably tighten your shoulders, stick your elbows out (laterally), sway from side to side, and begin to waste energy. It is not a matter of how high or low you carry your arms, but how relaxed they are – relaxation is the key.
14. Speed, which has been intentionally ignored up to this point to avoid premature peaking, comes back very quickly once you start sharpening.
15. Hill training, as prescribed by Lydiard, is a form of plyometrics, using your body weight as resistance. If you cannot find a suitable hill nearby, you can perform the same types of exercises in the gym or elsewhere, but the type of hill circuit training described here includes all necessary elements in a workout.
16. To add emphasis to Lydiard's own caution, it is imperative not to rush into hill circuit training, which is quite demanding and stressful to your legs. Try just 15 minutes or so at first, see how your legs feel the next couple of days, and if they recover well, increase to 30 minutes, then to 45, and finally to an hour (not including 15 minutes of warm-up and cool-down). It helps to include some form of hilly exercise or hill course training in the latter part of the marathon conditioning phase.
17. The downhill portion of the course should be shallow enough that you can lean forward and turn your legs over as quickly as possible, without fear of falling or needing lean backward in a braking action, which incurs too much shock to the knees and heels.
18. The slower your forward momentum, the more resistance you will feel in your legs. If you ascend too fast, the resistance will be less, and the exercise may become too anaerobic.
19. Downhill exercise should not be neglected, since it not only develops leg-speed by forcing you to pull the trailing leg through faster, but is also a form of eccentric exercise, which helps toughen your legs.
20. As always, the transition to a new form of exercise should be made gradually, so windsprints should be done  $\sim\frac{3}{4}$  speed, not all-out, to avoid a prematurely heavy dose of anaerobic training.
21. Lydiard's original hill circuit was a 2-mile loop (800 meters uphill, 800 meters jog, 800 meters downhill, and 800 meters at the bottom. When Lydiard began coaching by correspondence, he realized many people did not have access to as long a hill, and if they did windsprints at the bottom, it would amount to too much anaerobic training.
22. Originally, Lydiard's runners did an hour of hill training (2-mile warm-up, 4 x 2-miles hill circuit, 2-mile cool-down) 6 days a week, plus a 22-mile run on Sunday, for a total of 94 miles. If you cannot handle too much hill training initially, then try doing some plyometrics in the gym, while maintaining aerobic condition with some long runs beside the weekend run. Otherwise, it pays to do some leg-speed training as Lydiard advises here, particularly if you can't do downhill running.
23. Just as during the marathon phase, it pays to take a morning jog to both aid in recovery and maintain aerobic condition, so you might go a bit longer (30-45 minutes) than otherwise.
24. In Lydiard's training schedule, this is referred to as the "First Important Race," but this does not mean it is the only race you will be training for. Once racing condition is reached, you can sustain competitive form for some time, assuming you built an adequate aerobic base, then did the right specialization/coordination training.



25. Lydiard believed the goal of anaerobic training is only to “make yourself tired with the volume of speed training,” thus incurring a large oxygen debt/lower blood pH, so in his view, the exact structure of the workout (how long the work phase is, how fast you run it, or how many times you repeat it) is unimportant, just so long as you achieve the desired physiological effects.
26. Again, these numbers depend on the individual, as some will need more time to recover, others less. The former will take longer to develop anaerobic capacity to the maximum.
27. Lydiard often warned that younger athletes are highly sensitive to lowering blood pH from excessive anaerobic efforts (intervals/repetitions, as well as races), and believed it was best to use early season races for their anaerobic development. Coaches and athletes at the high school and collegiate level tend to overdo anaerobic training and race too often.
28. Speed is developed by striding longer and faster; the former can be achieved by lifting the knees high and extending the push-off leg, while faster strides result from shortening the lever of your lead leg, and by lifting the knees high.
29. Lydiard used to have all his athletes, even marathon runners, participate in some sprint events to develop better speed and economy of running action.
30. Anaerobic training differs from speed training in that the goal of the former is to incur oxygen debt; repetitions are at least 30 seconds long, and are followed incomplete recovery, whereas for the latter, duration is 10-20 seconds, and recovery should be complete so that you do not tighten or tense up.
31. Careful evaluation of each day’s training in relation to your responses (e.g., lap times during time trials, etc.) is critical during this phase, since this information is used to modify subsequent workouts.
32. You cannot train hard and race hard at the same time. Too many athletes make this mistake.
33. The length of the freshening period depends on the individual, the training pattern, and the distance being raced. For instance, a marathon runner typically would require 2-4 weeks.
34. These time trials during the conditioning phase are more or less tempo runs, and can be up to 10 miles (once a week) for seasoned runners, but are more typically 5-10 km. They should not be raced.
35. If in doubt, go for an easy jog.
36. Training on hills is an excellent form of speed development training.
37. Speed development should come naturally, without being forced.
38. The most important race on the schedule is not necessarily the only one you have trained for. With an adequate aerobic conditioning period, and then appropriate training from week to week, you continue to improve for some time as you race.
39. Oxygen absorption and transportation depend on the respiratory and cardiovascular systems, whereas oxygen utilization is determined by capillarization of the working muscles, and takes longer to develop.
40. Hill running during the conditioning phase is important, since it activates muscle tone (power and flexibility), two elements not addressed by slower-paced running. It is worth noting that Lydiard’s runners originally trained in an extremely hilly area of Auckland.

41. Lydiard did not follow a strict carbohydrate-loading regime, citing the fact that you also need fat for endurance (to run through the “wall”) and protein to recover from muscle breakdown, so a balanced diet is the best way to go.
42. Holmér uttered one of Lydiard’s favorite quotes on training young athletes: “If you can get a boy in his teens and encourage him to train, but not race, until he has matured, then you have laid the foundation of an Olympic champion.”
43. Lydiard was never too concerned with the structure of anaerobic training, believing that fancy formulae for this purpose amounted to nothing more than “eye-wash.” His definition of repetition training was not to predetermine the distance, time, or number of repetitions, nor the duration of the recovery interval. On the other hand, his definition of “interval” training was to predetermine all those things, as well as how long you take to recover.