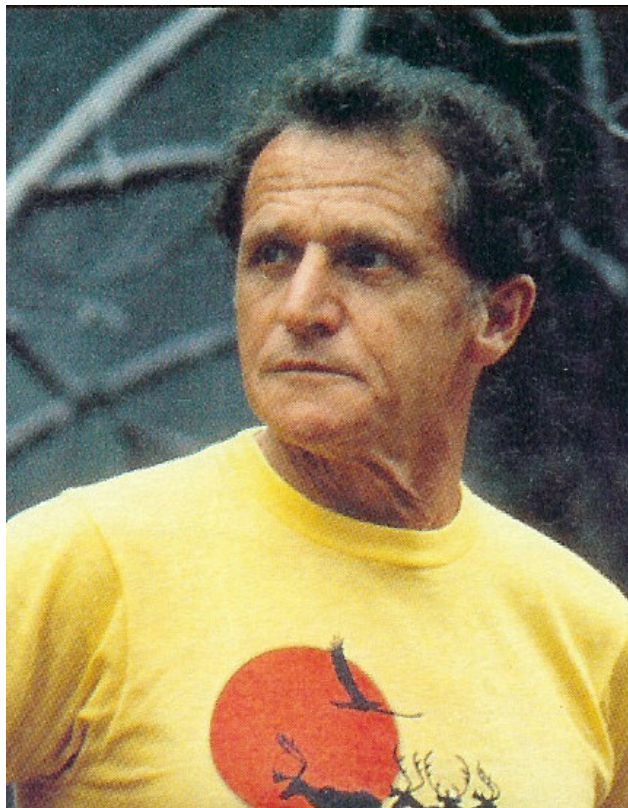


Arthur Lydiard's Athletic Training



**Training Summary
for Middle Distance and Distance Running
based on the Lydiard Principles**

Edited and footnotes added by Nobby Hashizume

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ARTHUR LYDIARD – A BRIEF BIOGRAPHY

Arthur Lydiard was born by Eden Park, New Zealand, in 1917. In school, he ran and boxed, but was most interested in rugby football. Because of the Great Depression of the 1920's, Lydiard dropped out of school at 16 to work in a shoe factory①.

Lydiard 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. Lydiard was completely exhausted and was forced to rethink his concept of fitness. He wondered what he would feel like at 47, if at 27 he was exhausted by a five-mile run.



Lydiard competing for New Zealand in 1950 Empire Games (Commonwealth Games) in the marathon; he finished "disappointing" 13th; photo courtesy of Garth Gilmour Collection.

Lydiard began training according to the methods of the time, but this only confused him further. At the club library he found a book by F.W. Webster called "*The Science of Athletics*." But Lydiard soon decided that the schedules offered by Webster were being too easy on him, so he began experimenting to find out how fit he could get. Lydiard was not a particularly fast runner in his day, nor had he any formal education in coaching or physiology. He had never been to college.

He began running seven days a week, up to 12 miles a day, which at the time was considered exceptional. In 1945, at age 28, he began racing again. But while he was fitter and faster, he had trouble winning because he was hitting his peaks at the wrong times. Because his mileage was considerably higher than those who beat him, he became annoyed and experimented with daily distances and efforts, with some days short and easy and other days hard or long.

Others joined Lydiard in training and thrashed along with him, though Lydiard still used himself as his principal guinea pig. He tested himself in extremes of heat and endurance – running up to 250 miles a week – and discovered that when he balanced distance and speed work, not only did his marathon times improved, but his track performances improved also. Where other coaches and runners had been incapable of unraveling the fundamentals of conditioning, to Lydiard, his training experiments spoke volumes. This was to become the keystone of the system he would use later to develop Halberg, Snell, and the rest.

After two years of training Lydiard on his lonely runs, Lawrie King beat a provincial championship field 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 be New Zealand cross-country champion, six-mile record holder, and 1954 Empire Games representative.

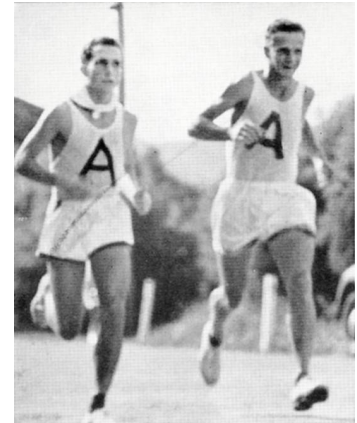
In 1951, Murray Halberg, then 17 years old, came on the scene②. His coach, Bert Payne, consulted with Lydiard on Halberg's training. By 1953, Halberg who was now with Lydiard

entirely, was joined by Barry Magee. It was with these men that Lydiard first tried out his recipe for building stamina and coordinating training with races.

Lydiard completed his recipe for running in the mid-1950's. By then he knew how and when to mix the ingredients – the long marathon-type mileages, the hill work, the leg-speed work, the sprint training, the 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 his time to business. Until 1957, he worked two jobs, one of which was delivering milk in the middle of the night. Then he quit that job to start training with a marathoner, Ray Puckett. Puckett won the national championship that year with Lydiard second. Lydiard was 40 years old.

Peter Snell was the next of “Arthur’s runners” to win worldwide acclaim when he outsprinted Roger Moens for the 800-meter Olympic gold medal in 1960. In the 5,000-meter final, Murray Halberg broke away half a mile from the tape for the gold. New Zealand captured two gold medals in an hour. Barry Magee captured the marathon bronze medal behind Africans, Bikila and Rhadi only a few days later.



Lydiard (r) running New Zealand marathon championships in 1958 with Ray Puckett (l): photo courtesy of Garth Gilmour Collection.

By 1960 and the final proof in Rome, Lydiard was the man who knew all the answers, he knew his methods worked, though he didn't know the how. He had only the basic knowledge of human physiology. He just knew his system worked because he has spent

more than ten years making it work. In 1964 Olympics, Snell won golds in the 800- and 1,500-meter, and John Davies^③, also Lydiard-trained, captured the 1,500 bronze medal.



Peter Snell (#466) winning his third gold medal in 1500m at Tokyo Olympics in 1964 with his teammate John Davies (#467) finishing third for the bronze medal: photo courtesy of Garth Gilmour Collection.

The world wanted to know more about the methods by which this group of Auckland teammates trained. Fortunately, Lydiard was not at all close-mouthed. Indeed, he went to great length to publish and discuss his ideas.

In the early to mid 1960's, Lydiard began working through coaches instead of with athletes. In early 1966, Lydiard accepted an invitation arranged through Bud Winter (ex-San Jose sprinting coach) to work in Mexico.

Lydiard stayed about eight months. Out of his efforts came Alfredo Penaloza (third at Boston in 1969), Pablo Garrido (2:12'52"), and Juan Martinez (fourth in 1968 Mexico City Olympic Games at 5,000 and 10,000 meters).



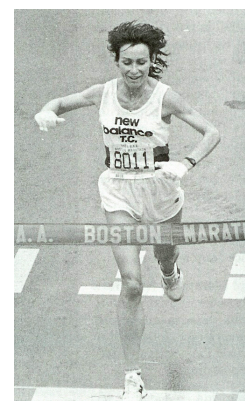
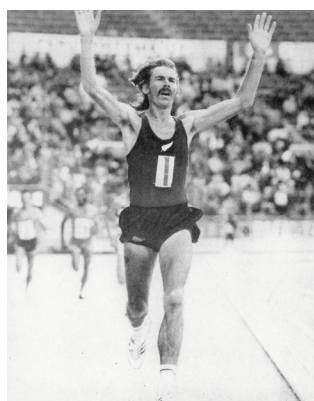
Finland's Lasse Viren winning the gold medal in 10000m in 1972 Munich Olympic Games; first Olympic gold medal for Finland in 36 years and the first of Lydiard's influence since 1964. Viren went on to win 3 more gold medals: photo courtesy of Kodansha, Japan.

Lydiard next accepted an invitation from the Finnish Track and Field Association. The Finns, with their misinterpreted concepts of the 1950's, had become interval junkies. Lydiard stayed in Finland for 19 months to mixed reviews. The Finnish were stubborn and reluctant to accept Lydiard's suggestions. However, Lydiard's lessons were not wasted on the coaches of Pekka Vasala and Lasse Viren. They listened carefully and blended Arthur's words with those of Percy Cerruty, Nurmi, and Mihaly Igloi. The results of Lydiard's visit finally came into focus when Olavi Suomalainen won the 1972 Boston Marathon. Then at Munich in 1972, Viren got up after falling in the 10,000 to stun everyone with an Olympic gold and the world record. Viren won again in the 5,000 (with a final mile of 4'01"), Pekka Vasala took the gold in the 1,500, and Tapio Kantanen took the bronze in the 3,000 steeple.

Until 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.

Lydiard has made his methods available to anyone who wants to use them and the system has been applied to rugby, cycling, canoeing, squash, gridiron football. By discussing his concepts with physiology and sports medicine experts, he can now explain the scientific reasons for his successful methods. He inspires coaches and athletes to aspire to their potential.

- 1) He built track racing spike shoes for Peter Snell which he wore and won the gold medal in 1960 Olympic Games 800m at Rome. He also built most of his runners' training shoes. He became known as the toughest critic of athletic footwear but he certainly had the knowledge and experience.
- 2) Halberg was paralyzed in his left arm from a rugby accident when he was 17. He was literally at his death bed; doctors had to open his chest to remove blood clot forming around his heart. He bounced back quickly, joined the Lydiard School and ended up winning the Olympic gold medal.
- 3) John Davies went on to coach many of next generations of "Flying Kiwis" such as Dick Quax (silver medal in 5000m in 1976 Montreal Olympics; world record for 5000m in 1977), Lorraine Moller (bronze medal in the marathon in Barcelona Olympics in 1992; winning Boston Marathon in 1984), Anne Audain and Toni Hodgkinson (finalist in 800m in 1996 Atlanta Olympics).



Dick Quax (left) setting the world record for 5000m in 13:12 in 1977 in Stockholm. He later ran the fastest debut marathon in 2:11:45 while coaching at Athletics West in the USA. Lorraine Moller (right) winning the 1984 Boston marathon here competed in four consecutive Olympic marathon. Her range of competitiveness spreads from 800m to the marathon. Both were coached by John Davies; Moller later by Quax: photos courtesy of Jeff Johnson.

INTRODUCTION TO THE LYDIARD SYSTEM

The Lydiard training system is based on a balanced combination of aerobic and anaerobic running. Aerobic running means running within your capacity to use oxygen. Everyone, according to his or her physical condition, is able to use a limited amount of oxygen each minute. With the right kind of exercise, you can raise your limit.

This maximum limit is called the “Steady State”, the level at which you are working to the limit of your ability to breathe in, transport, and use oxygen. If you exceed this limit, the exercise becomes anaerobic. When this happens, your body’s metabolism changes to supply the oxygen you need to supplement the amount of oxygen you are breathing in. This re-conversion process has limits, so the body is always limited in its anaerobic capacity. When you run anaerobically, you incur what is called “oxygen debt”. Oxygen debt is accompanied by the build-up of lactic acid and other waste products, which in turn leads to neuro-muscular breakdown, or simply, tired muscles that refuse to work. Oxygen debt has the unpleasant feature of doubling, squaring, and then cubing as you continue to run anaerobically.

In other words, the faster you run, the greater your need for oxygen to continue becomes.

Lydiard often uses figures shown in Morehouse and Miller’s “The Physiology of Exercise” as an example:

<i>Yards per second</i>	<i>Liters per minute</i>
5.56 to 6.45 (an increase of 0.89 yards)	5.08 to 8.75 (an increase in oxygen requirement of 3.67 liters)
9.10 to 9.23 (an increase of 0.13 yards)	28.46 to 33.96 (an increase in oxygen requirement of 5.50 liters)

According to Morehouse and Miller, aerobic exercise is 19 times more efficient than anaerobic exercise①. The more intense the exercise becomes, the faster and less economically your body's fuel is used and the faster lactic acid accumulates②.

The Lydiard training system contains elements to enhance all aspects of your running—conditioning, strength, and speed. The end result is stamina, the ability to maintain speed over the whole distance.

Conditioning

The conditioning phase of Lydiard training stresses exercising aerobically to increase your Steady State as high as possible given your particular situation. For best results, you should exercise between 70 and 100% of your maximum aerobic effort. This, therefore, is not Long Slow Distance. This is running at a good effort and finishing each run feeling

pleasantly tired. You will certainly benefit from running slower, but it will take much longer than if you ran at a good aerobic pace.

The meat and potatoes of the conditioning period is the long runs, three a week. Many parts of your physiology improve as a result of these longer runs. The under-developed parts of your circulatory system are enhanced; neglected capillary beds are expanded and new ones are created. This increases oxygen transportation and utilization, thereby improving your Steady State. Also through aerobic training, your heart, which is just another muscle, becomes bigger and is able to pump more blood with each contraction and to pump that blood faster. 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 becomes better; waste products are eliminated more easily.

Anaerobic Training

Once you have developed cardiac efficiency through aerobic exercise, it is time to develop your ability to exercise anaerobically, to increase your ability to withstand oxygen debt. The absolute limit of oxygen debt that a person who has exercised consistently for a long time can incur is 15 to 18 liters. 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 be able to last for about 15 minutes--one liter of debt per minute. If you increase your pace and now requires 5 liters of oxygen a minute, your debt increases to two liters a minute, and you will be empty in about 7.5 minutes③. It's common sense, the slower you run, the farther you can run; the effort and speed are determined by your aerobic capacity. When your Maximum Steady State is low, you can be running anaerobically at a relatively slow speed. As your fitness improves, the speed that was anaerobic before is now high aerobic. Therefore, you want to get your Steady State, your best aerobic pace, at a high level before tackling anaerobic training.

With anaerobic training, your objective is to create a big oxygen debt and lower your blood pH level so that your metabolism is stimulated to build buffers against fatigue. This is done with interval or repetition training. Once you have built those buffers, your anaerobic training is complete; to continue this type of training is to invite injury.

Similar to the three long runs in aerobic conditioning, you should run hard (anaerobically) three times a week during the anaerobic phase. Be sure to allow yourself to recover between hard workouts, at least a day in between. 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 you exactly how many repetitions you can do, or what your recovery intervals should be, on a particular day. So trust your own instincts and use any schedule as a guide only.

It is also not necessary to run your anaerobic work on a track. In fact, you may enjoy it more if you do your workouts in an area more comfortable to you; a forest trail or grassy field. Just pick a tree or a marker to run to and jog back after each run. Do this until you

have done enough, making yourself tired with speed④. The one important thing to keep in mind is to make your distance at least 200 meters or more; it takes a distance of this much to lower your blood pH level generally.

Anaerobic training is essential if you want to race well. Bear in mind, however, that if you overdo anaerobic work, you will sacrifice the very thing you have worked so hard to achieve, your good (aerobic) condition, which determines your performance level.

Sharpening

You have built your aerobic capacity and developed your anaerobic capacity. Now you need to keep your ability to tolerate oxygen debt high without dragging your condition down. This is where the sharpening period comes in. Doing short sharp sprints of 50~100 meters with 50~100 meters floats in between allows you to tire your muscles without lowering your overall blood pH. Doing sharpening once a week is most effective for maintaining your 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.

- 1) Lydiard is comparing the number of ATP produced from one glycogen molecule (38 ATPs in aerobic metabolism vs. 2 ATPs from anaerobic metabolism)
- 2) As the chart indicates, the faster the speed becomes, even a slight speed increase requires greater oxygen demand
- 3) Lydiard used an old information to explain the oxygen debt mechanism in a very simple term. However, Dr. Peter Snell, now the renowned exercise physiologist in the country, has corrected the actual numbers presented by Lydiard as follows:

More realistically the limit of oxygen debt is approximately 4.0 liters. It requires 4.31 liters of oxygen for a 70kg male to run a 16-minute 5000m. If this individual's maximum oxygen uptake is 3.5 liters/min., he would incur 0.81 liters of oxygen debt every minute; he could go on at this speed for only 5 minutes ($4 \text{ liters} \div 0.81 \text{ liters/min.} = 5 \text{ minutes}$). If he increases his oxygen uptake level to 4.06 liters/min., then he would incur 0.25 liters of oxygen debt every minute ($4 \text{ liters} \div 0.25 \text{ liters/min.} = 16 \text{ minutes}$). Now he can go on completing 5000m in 16 minutes! The numbers are different (more complicated) but the principles still work exactly the same.

- 4) Lydiard recommends either the total distance of fast segments being approximately 5000m or total time, including recovery jog, to be approximately 30~45 minutes as a guide

MARATHON CONDITIONING

It is first necessary to understand that, while the object of training is to develop your anaerobic capacity to exercise, this can only be done in relation to your oxygen uptake level and capacity to exercise aerobically. In other words; it is necessary to run as many miles or kilometers as you possibly can at economic or aerobic speeds to lift your oxygen uptake to your highest possible level as the foundation upon which to base your anaerobic or speed training①.

To gain the best results for the time spent in training, it is important to run at your best aerobic speed; i.e. at speeds at a level just under your Steady State or Maximum Oxygen Uptake. This is theory and can be applied in practice.

Even very slow running will effectively increase general cardiac efficiency and therefore raise the oxygen uptake. However, by running at speeds much below the maximum oxygen uptake level, it is going to take much longer periods of time to gain the same results than if the rates of speed were at faster aerobic levels. 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 the optimum results are to be achieved in the time spent exercising.



Four of the original "Arthur's Boys" training on famous Waiatarua, a mountainous 22-mile course: photo courtesy of Garth Gilmour Collection

To train at speeds above the oxygen uptake is anaerobic exercising with the net results of the development of lactic acid that causes a lowering of the blood pH with the ultimate results of neuro-muscular breakdown in the working muscles. This means that the volume of exercising will be limited according to the oxygen debts being incurred. Seeing that, in this marathon conditioning phase, it is important to do a large volume of training and it has to be economic, or aerobic. The net results of the aerobic exercise is carbon-dioxide we breathe out; and water and salt we perspire. We are really

endeavoring to lift the pressure by the heart upon the cardiac systems generally, to an economical level to bring about the development of the under-developed parts – the smaller arteries, arterioles, capillary beds and veins.

To carry out this "near best aerobic" training practically, it is necessary to time your runs over measured courses, and to progressively increase the running efforts as fitness improves②.

It can take many years to gradually and continually develop general cardiac efficiency. This is the reason why marathon runners are usually better performers at ages nearer to

forty rather than in their earlier years; that is if they continue with systematic long aerobic training.

I always tell runners that, “Miles make the champions”, and that initially this “grind” of running all mileage possible between competitive seasons is of prime importance. The more miles that you are able to run aerobically in training, then the greater endurance you will be able to develop. So there is really no limit to the mileage that a coach should place upon his athletes, providing that the supplementary miles run above the required faster aerobic running are of as easy effort at the lower aerobic speeds. In other words; it is wise to run once a day at faster aerobic speeds and, supplementary to this running, to jog as many miles as you find time and energy for; even if it is only for a fifteen minutes jaunt.

The fast aerobic running should be approached this way: Decide how much time you have daily for your training and balance your conditioning schedule upon this. Measure out several different courses over different terrain that allow for reasonable traction^③. One course for each week day, if possible. This for psychological reasons. It does help to overcome the boredom that can be experienced at times during this training.

Start training by first running against time rather than timing miles run. Get yourself running fit so that you are capable of running long distances continuously. Do this by running on out-and-back courses by running out, say, for 10 minutes and turning about and running back in nearly the same time. If it takes longer to return, then you realize that you went too fast upon the outward journey and so were forced to slow down upon the return journey. You will soon learn about your present capabilities and fitness and so adjust your running efforts accordingly. Progressively the running time daily should be increased so that as your oxygen uptake improves you will find the training progressively easier, and your possibilities of increasing the running time greater^④.

A schedule such as this should be the ultimate aim for a man, less for younger athletes, prior to starting a schedule designed to have you running against the watch for mileage;

Monday:	1 hour
Tuesday:	1.5 hours
Wednesday:	1 hour
Thursday:	1.5 to 2 hours
Friday:	1 hour
Saturday:	2 hours or more
Sunday:	1 to 1.5 hour

This running should be done easily and the miles covered of no real account. The time spent training is the most important part^⑤.

Do not go straight into such a schedule, but work up to it according to your fitness and ability to train.

Once you are sure you can run for two hours without any real problems, then start out training to the watch per mile as follows: Run over your measured courses for one week, without any influencing factors such as a watch, per mile pace, or another runner. Try to run evenly in effort and as strongly as your condition allows.

Start a watch at the start of the runs, so as to be able to take the overall time for each run at the conclusion; this giving 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.

The following week, you should use these times for control and then run the same course at the comparable times by checking each mile time as you pass your mile markers. For example, if you took one hour to run a ten-mile course the trial week, then the next week you would set out to run six-minute per mile, allowing for hills and hollows.

After a week or so, you will find that the previous times used for 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 your average mile time down to 5'55" per mile or thereabouts. In this way, it is possible to keep running at your near best aerobic effort rather than too fast or too slow and so to gain the best results for the time spent in training⑥.

I discovered years ago, through trial and error methods, that the best results in this respect were gained by running about 100 miles weekly at my near best aerobic efforts and that, supplementary to this, by running at easier efforts as many miles as I possibly could. I also found that by alternating the length of the runs by running 10 miles one day and 20 miles the next, rather than by running 15 miles a day (the same weekly total), that I gained the better results. This was due to the gaining of better muscular capillarization through the longer continued training (efforts of two or more hours), this in turn allowed for better utilization of oxygen.

The total weekly mileage that you manage to do will be governed by your climactic conditions and available time for training. However, it is important to realize this point; that it is not the distance that will stop you in training as much as the speeds. If you keep the running efforts to a level 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 fast⑦.

When I say that your aim should be to run a weekly schedule such as the following, I mean it only as a guide and that you should adjust it to suit your own daily program, fitness, and age⑧.

Monday:	10 miles (15km) at 1/2 effort over undulating course.
Tuesday:	15 miles (25km) at 1/4 effort over reasonably flat course.
Wednesday:	12 miles (20km) at 1/2 effort over hilly course.
Thursday:	18 miles (30km) at 1/4 effort over reasonably flat course.
Friday:	10 miles (15km) at 3/4 effort over flat course.
Saturday:	22 miles (35km) at 1/4 effort over reasonably flat course.
Sunday:	15 miles (25km) at 1/4 effort over any type of terrain.

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. The longer the better.

Running action should be relaxed with the arms following through with a low and loose action⑨; the thumbs brushing the side seams of the training shorts. The hips should be held comfortably forward; 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 to develop a shuffling action.



Peter Snell (l), shown here winning the gold medal in 1500m at Tokyo in 1964 to become the last man to have won the classic middle distance double of 800-1500 in the same Olympic Games, won 800m final as a complete unknown in 1960 Rome Olympics; followed in less than an hour by his teammate, Murray Halberg (r) winning gold medal in 5000m: photos courtesy of Garth Gilmour Collection

- 1) The basis of the Lydiard program principles is to balance your training with [aerobic](#) and [anaerobic](#) development. It has never been his intention to eliminate anaerobic training from your program and only perform aerobic training (100 miles a week). Everything is important and everything has to be combined in a proper balance. Aerobic development is merely the base upon which you will develop more race specific training (anaerobic development) later as well as race more frequently and continue to improve.
- 2) This does NOT mean you should time each of your run and expect to get faster and faster every time you run. You should keep prescribed “effort” for each run and, as you get fitter, you should notice you are now running at faster speed at the same “effort” than before.
- 3) When the traction is better, you can run at faster speed at the same effort and therefore further within the given time; providing greater pressure to the cardiovascular system. Again, this does NOT mean Lydiard’s runners always run on the road. They never shyed away from running on muddy rugged cross country course for general conditioning or soft grassy area when their legs were sore.

- 4) As you get fitter and running at the same speed becoming easier and easier (please refer to #2), you should keep the effort the same; meaning you should be running faster at the same effort.
- 5) The first step should be to get to the point where you can run for 2-hours comfortably regardless of the pace.
- 6) In order to achieve the best possible training effect for the time spent training, it is important to control your running speed as well as possible so as to keep the same “effort” level, or cardiovascular pressure, while running. If you stay at the same speed; be it 6-minute-mile pace or 10-minute-mile pace; if you stay at the same speed while you are getting fitter, you are running at less and less effort. This does not however mean that you should running progressively faster all the time so as to put psychological pressure on yourself. For this purpose, it MAY pay to use heart-rate monitor to stay at the certain HR range regardless of the minute-per-mile pace.
- 7) Lydiard always advised that it is “much better to start out too slowly than too fast.” At this point of development, it is more important to go far (longer) to develop muscular endurance and general endurance. If you start out too fast, the situation in which many of us invariably get ourselves, you may have to finish your workout prematurely (70 minutes instead of 90 minutes), missing out the vital elements at this stage of development.
- 8) It takes time to reach full-scale Lydiard program of running 100-miles-a-week at prescribed effort; otherwise you might sacrifice a vital ingredient of conditioning program—effort. It is important to have a long run of up to 2-hours at least once a week; however, you can also shuffle around your schedule such as convert miles into kilometers (100km a week, or approximately 62 miles a week, instead of 100 miles a week) for younger athletes; or stay on the time-based program (with two 1.5-hour runs and one 2-hour run a week); or keeping 3 long runs a week and make other days simply easy days; or even have 2 long runs instead of 3. Suite the program to the individual needs and situation.
- 9) It was Lydiard’s belief that, the less you bring in upper-body movement in running, the better. The important thing is relaxation. The minute you clench your fists and carry your arms high, invariably shoulders get tightened up and start to waste energy. You stick your elbows out (laterally) and you start to sway from side to side and waste energy. It is not the matter of how high or low you carry your arms but how relaxed you carry your arms while running.

HILL RESISTANCE

(Introduction of Anaerobic Running and Leg-Speed Training)

Hill Circuit Training

When the marathon conditioning period of training is completed, or no further time can be spared, it is necessary to develop speed and start to develop the anaerobic capacity to exercise.

It is necessary to bring resistance to the leg muscles to develop the muscle fibers; in particular, the white (fast twitch) muscle fibers that are mainly responsible for giving better speed.

I have found that a form of isotonic exercise will develop white muscle fibers better than isometric exercise and that quite quickly the speed can be developed①. By springing up-hill, with a series of short and sharp resistance, you can use your body's weight as resistance for your leg muscles.

The up-hill springing will also stretch the muscles and tendons to the extreme experienced during competitions and other training and assist in added flexibility and speed. It will also help to eliminate the possibility of pulled muscles and strained tendons later.

Ankle flexibility is of great importance to the runner; and with strong and flexible ankles, the runner is able to increase stride length.

A good running technique is also important; and by learning to run with the hips comfortably forward, the runner is able to bring the knees up higher. This in turn allowing the feet to follow through higher, so 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, the runner can run at relatively the same speed more economically. This is of great importance to the marathon runner as well as to the track runner.

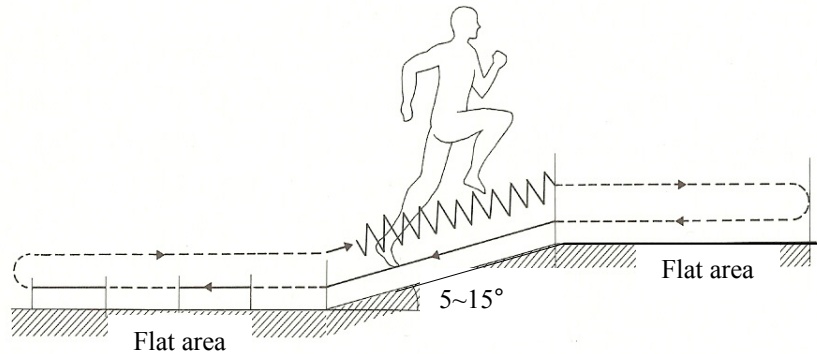
By using hills for this training, it is possible to develop all these abilities during the same training session, so saving valuable time②.

The training that I suggest in the following paragraph is not easy to do and can be quite testing. A runner needs to be well conditioned to be able to do one hour workout properly. A runner should also understand what he is trying to achieve by using the exercise, so as to apply it according to his fitness and capacity to train with respect to development and age③.



Lydiard (r) himself demonstrating Hill Training Technique to John Davies (l): photo courtesy of Garth Gilmour Collection

Find a hill with a raise of near one in three, or a little steeper; on grass, forest trail, or road; that will give good traction so that it is possible to spring up-hill without slipping. It should be about 200 to 300 meters long 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, that would bring into a more gradual down-hill, leading to the flat at the bottom; it is better for the down-hill running and seems less tiresome psychologically^④.



Pekka Vasala of Finland, 1972 Munich Olympic 1500m champion, performing Hill Training in Auckland, New Zealand: photo courtesy of *Auckland Star*, New Zealand

Approach the training this way: Warm-up for at least 15 minutes, this being sufficient; discard unnecessary clothes at the base of the hill, so as to allow for the maximum freedom of movement. Then start springing up-hill with a bouncing action and slow forward progression^⑤. It is necessary to use the body's weight for the 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 loose at the sides. Hold your 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. Should the exercise be too tiring to go all the way up the hill, then jog some yards before doing more. Use it according to your needs and ability.

At the hill top, jog about easily for near three minutes before running down-hill with a fast relaxed striding action; this will develop fine leg-speed and also stretch leg muscles for better stride length^⑥. Should the hill that you have selected be too steep for this exercise, then it is better to take it easily as you

run down. The down-hill section should be such that allows the runner to stride down fast without fear of losing control and falling.

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 meters to 400 meters with each circuit. If the circuit is short, do the windsprints only every 15

minutes⑦. It is not advisable to suddenly go into great volume of intense anaerobic training as very many people do. So it is logical that this anaerobic training should initially be not too intense, and in reasonable volume⑧. By only doing windsprints on the short stretch at the bottom of the hill and by only doing it every 15 minutes, it is not possible to do too much. Use whatever distance you like, but for the best results, you should try to use 50, 100, 200, and 400-meter windsprints.

Go through the circuit again, etc., until you have been working out for an hour, or according to ability to exercise this way. Then cool down for at least 15 minutes.

This training should be done three days weekly with the alternate days for leg-speed running, three a week⑨; and one day a long run of 1.5 to 2 hours should be completed at an easy effort.

Leg-Speed

Find an area that is nearly flat with a gradual decline and about 120 to 150 meters long. Warm-up for at least 15 minutes and then run over the course ten times as follows, with a three minutes interval. Do not rush through this training and realize that it is important to have a full three minutes interval.

Each time during the run, think of moving the legs as fast as possible and do not be conscious of stride length. Keep as relaxed as possible in the upper body. The same action can be obtained by going down stairs 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: MOVING THE LEGS FAST. This way, it is possible to overcome viscosity in the leg muscles and develop fine speed.

After the tenth repetition, cool down for at least 15 minutes.

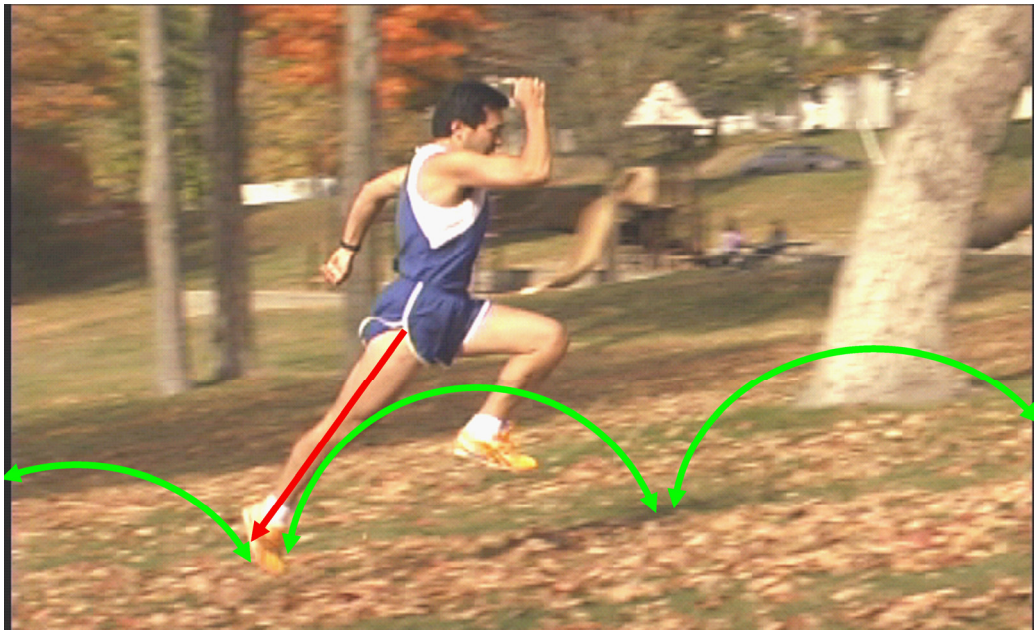
It is wise to train twice a day, everyday, even while doing this training and track training and racing; even if it is only for 15 minutes each morning⑩.

During this period of training, your legs will get tired. However, if this exercise is maintained for at least two weeks, it becomes progressively easier and gives fine results.

The best results come from four to six weeks of this training.

A schedule during this period could look like this:

Monday, Wednesday and Friday - Hill training
Tuesday, Thursday and Saturday - Leg-Speed
Sunday - Long run



Lydiard's Hill Bounding: "Like a deer going over a fence..."

- 1) Speed, which has been deliverately ignored up until this point to avoid premature peaking, comes back very quickly once you start sharpening works.
- 2) Hill training as prescribed by Lydiard is a form of plyometrics exercise using your own body weight as a resistance. If you cannot find any form of hill around your area, you can perform same types of exercises in the gym or elsewhere. However, a type of hill circuit designed by Lydiard and described here can include all the necessary indredients in a form of continuous running.
- 3) It is absolutely important to NOT rush into this exercise. It is quite demanding and can knock your legs around a lot. It helps a lot if you include some form of hill exercise and/or include some hilly course running during the latter part of marathon conditioning phase. If you are including this type of hill training into your program for the first time, Lydiard would recommend to do total of 15 minutes on the first day and see how your legs feel the next couple of days. If you handled it well, increase it to 30 minutes, then 45 mintues, etc. Goal is to be able to handle up to an hour of total hill training ; plus 15 minutes of warm-up and 15 minutes cool-down.
- 4) It does not necessarily have to be a circuit. Lydiard conveniently found a circuit with down-hill section slightly less steep. Down-hill striding should be done fairly fast (you should be able to lean into the hill, not lean backward for a braking action) without fear of falling or too much shock to hurt your knees or heels.
- 5) The slower the forward momentum you are running at, the more resistance you will be feeling in your legs. If you make your runs up the hill too fast; not only the resistance will be less, the exercise becomes too much anaerobic which is not desired at this point.
- 6) Down hill running exercise should not be neglected. It not only develops fine leg-speed by having to pull your trailing leg faster; it also serves as excentric exercise to teach your legs to take pounding.
- 7) As everything else, the transition from one type of exercise to another should be performed gradually. At this point these windsprints performed at the bottom of the circuit should be done

only slightly faster than tempo pace (or approximately $\frac{3}{4}$ effort); not at the “sprinting” speed. It is because the prematurely heavy dose of anaerobic training at this early stage is not desirable.

- 8) The original Lydiard hill circuit was a 2-mile long loop (800m uphill, 800m jogging stretch, 800m downhill and 800m stretch at the bottom); each loop took about 15 minutes (4 circuits for an hour). When Lydiard started advising people beyond his sight (by correspondence), he realized that most people didn't have the hill as long and, if they did windsprints at the bottom every time they came down, they started doing too much windsprints=too much anaerobic training.
- 9) Original “Arthur's Boys” were performing an hour hill training 6 days a week with a 22-mile long run on the seventh day. It was total of 94 miles a week (2-mile warm-up, 8-mile hill circuit, 2-mile cool-down, 6 days a week; plus 22 miles on Sunday). If you cannot handle too much hill exercises in the initial stage, or you perform plyometric exercises in the gym instead, etc.; it is important to keep up with your aerobic development by doing some long runs besides weekend long run. Otherwise, it pays to perform some leg-speed exercise as Lydiard advises here particularly if you don't/can't do down-hill exercise, which serves as leg-speed practice, for whatever the reason.
- 10) As was during marathon conditioning phase, it pays to jog in the morning as supplementary exercise as for maintenance of aerobic development as well as recovery. However, it becomes even more important to have perhaps slightly longer aerobic jogging (30~45 minutes) in the morning from here on (hill phase, anaerobic phase as well as coordination phase) because you are now engaging more exacting workouts.

TRACK TRAINING

A period of about 10 weeks is usually sufficient to carry out the necessary track training leading up to the first important competition^①. If these 10 weeks are divided into three sections as described below, it is possible to develop the necessary abilities and gain fine co-ordination, with the optimum performance coming upon the desired date.

1) Anaerobic/Speed Development: (4 weeks)

The first four weeks should be used for the further development of the anaerobic capacity to exercise and speed. When developing the capacity to exercise anaerobically, it is important to realize what you are trying to do and what physiological development you are trying to achieve. It is possible to develop an ability to incur about a 15-liter oxygen debt^② and this is done by exercising anaerobically. Developing big oxygen debts in training stimulates the body's metabolism to create buffers against fatigue. If this is understood, it will be realized that it does not really matter what form of running it takes, as long as you are making yourself very tired with the volume of anaerobic exercise; and finish the training session knowing that you could not do much more nor any better^③. Therefore, it doesn't matter whether you use repetitions or interval training, over different distances with different intervals, you don't even need to time them; as long as you come off the track or from your training quite fatigued. However, as a practical guide, it is advisable to get fast running into a total of about three miles, or 5,000 meters, or thereabouts; i.e. 12 x 400 meters, 6 x 800 meters, 5 x 1,000 meters, or 3 x 1 mile, etc.; with recovery jog of the equal distance in between. If one athlete takes longer intervals or more volume of fast repetitions than another to gain the same reactions physiologically, then he will just need to train for a longer time.



Lydiard (r) giving precise advise to Olympians, John Davies (with glasses; third in 1500m in 1964) and Bill Baillie (fifth in 5000m in 1964): photo courtesy of "Arthur's Boys" by Joseph Romanos

So, in many ways, it is important to evaluate your training every day, so as to understand the effects of each day's training; and not to follow some or any schedule blindly.

I advise athletes to run their hard anaerobic training during this period of four weeks by doing it for three days weekly on alternate days^④. 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.

The younger the athletes, the less anaerobic training should be used in the schedule; and the ratio of anaerobic to aerobic training only increases as the athletes get older and fitter^⑤.

It is only necessary to do four weeks of this training for three days weekly to gain the desired results to develop near to the possibility to incur a 15-liter oxygen debt. If you continue with this type of training in great volume and intensity for much longer, you will start to adversely affect your body's metabolism and pull the condition down through the effects of the lower blood pH.

On the alternate days, it is wise to concentrate upon developing your speed to near its maximum by carrying out sprint training workouts of suppling and loosening exercises, sprint starts and sprint races, and leg-speed running.

A typical workout could be: Warm-up by running easily for about 15 minutes, doing exercises for 10 to 15 minutes, running easily for 5 more minutes; followed by runs over 70 to 100 meters, concentrating upon the following elements, with a jog between each run of 3 minutes; the runs to develop stride length by exaggerating the length of the strides and pushing off hard with the back leg; another by running tall, bringing your knees high and getting up high upon the toes; and another by moving the legs as fast as possible to develop quick leg turn-over. Then the last set of runs covering all these things⑥. These runs can be done two or three times with each exercise. Also 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 that I have made.

All middle distance and distance runners should race in sprints and train to develop their leg-speed as this increases their economy of action and reserves energy for the latter stage of the competition⑦.

When doing sprint training, be sure that you do not try to rush through it like when doing repetition training; give yourself sufficient recovery after each run⑧.

On the seventh day, it is best to go for a long easy run, the distance or time of running being in keeping with your age and development. In the case of a mature and fit person, it could be for 2 hours or more, at an easy effort.

2) Co-ordination and Sharpening: (4.5 weeks)

After these first four weeks of track training, another four-and-a-half weeks period should start with the aim being to co-ordinate the training so far done. Now that speed, stamina, and the anaerobic capacity to exercise are more or less developed, it is necessary to have you running smoothly through-out your competitions without apparent weak spots showing in your running. 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, then your body will adjust and manage them efficiently. The same can be said about running over distances. If you have the basic condition and run over certain distances often in a controlled way, you start to improve in performances. So at this stage of training, there are these aspects to consider:

It is still necessary to do some anaerobic training, only at this time you need to drop the volume and increase the intensity. In other words; if you run, say, 400 meters twenty times, it takes a long time and you get very tired with the training. Whereas, if you run five laps around the track by sprinting 50 meters in every 100 meters, floating the other 50

meters, in all twenty sprints; you will also be extremely tired, though in this case it will only take about seven minutes to complete the exercise, if you are a mature person. This is called sharpening, or putting the knife edge upon the anaerobic capacity training; and this way we can get into racing shape without seeming to pull the good condition down. At this stage, it is usually best to use this training once every week, say, upon Monday.

THE PETER SNELL SCHEDULE FOR TOKYO OLYMPICS 1964
ALSO USED BY JOHN DAVIES
BY ARTHUR LYDIARD.

At the end of March and early April Snell was becoming jaded and feeling his races. I meant a complete conditioning period was necessary, so starting from April 15th he averaged 100 miles weekly until June 28th. He then did the hill work schedule, which I advocate, from June 29th until August 9th, averaging near 90 miles weekly.

On August 10th he started back training which was very difficult without an all weather track in winter. The schedule as carried out is as follows: Each morning he jogged about 5 miles on a golf course and road.

August:	10	220 - 20 times. Averaged 27.45
	11	3 miles. 14m 47.6s.
	12	660 - 1m 27s. 100 yds - 11s - 2
/p	13	3M (50 yd dashes)
	14	220 - $\frac{1}{2}$ - 6. Averaged 26.5s
	15	440 - $\frac{1}{2}$ - 20. Averaged 61s
	16	22 miles Waiatarua 2 hours 22 mins.
	17	220 - 20 times. Averaged 27.8s
	18	3 Miles - 14m35s
	19	880 - 5 times. Averaged 2m 13s
9	20	Injured leg. Hard track. No training.
	21	" " " "
	22	" " " "
	23	22 miles 2 hours 35mins.
	24	5 mile jog
	25	Leg still sore. No training.
	26	" " " " "
d	27	" " " " "
	28	440 stride-outs 4 times
	29	6 mile jog
	30	22 miles 2 hours 23 mins.
	31	220 striding

Hand-typed day-to-day training schedule of Peter Snell by Lydiard himself leading up to 1964 Tokyo Olympic Games: courtesy of Marty Liquori

On Tuesday, a time trial could be run over or near to the distance being trained for. When training for 5,000 and 10,000 meters, it usually pays to use 5,000 meters for your time trials with the occasional 10,000 meters. When training for 800 meters and 1,500 meters (1 mile), it often pays to use under distance time trial; such as 600 meters for 800 meters, and 1,200 meters for 1,500 meters (1 mile). This because the speed involved causes larger oxygen debts and recovery sometimes taking longer.

From the time trials, you can observe weaknesses in your running. You can also have someone record your lap times during the run and you can see where you may have slowed down. It is then necessary to use appropriate exercises to strengthen the weaknesses that are apparent. This is where the training is mainly co-ordinated.

For instance; if you could run the early part of a time trial easily and were tiring near the latter stages, it would be advisable to run in over-distance races or time trials during 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 it would be wise for you to run in under-distance races or trials during the next days⑨.

All athletes are different in their reactions, so you would have to be a little experimental in the later stages of training to determine exactly how to co-ordinate the training. But the trials (and development races) will give you necessary information very much.

On Wednesday, sprint training should be done and a club-level sprint race or two competed in. This means the long distance runners, too. A middle-distance race could be used as well.

On Thursday, you could do any training that you consider necessary from the information found out from the time trials; however, it is also wise to work at pace judgment over, say, 400 meters two to four times at the speed that you intend to race at. You can also do more sharpeners if you think that you require this training.

On Friday, leg-speed can be done over 120 meters, say, four to six times after warming up and exercising.

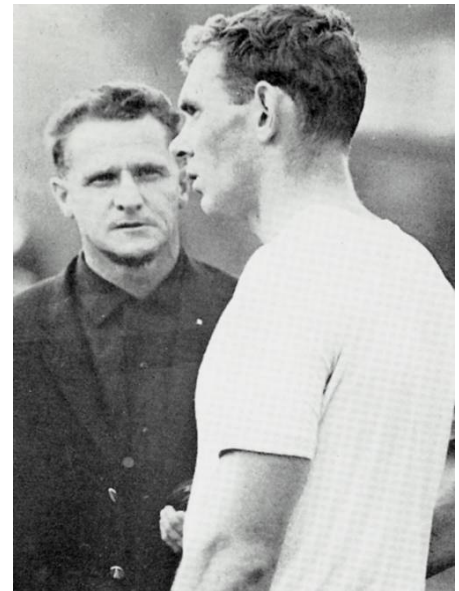
Saturday can be open competition day with you looking for the best possible competition available. The races during this period are considered development races; since you are training hard and are tired to a degree, it is not possible to give your best effort¹⁰. These races should be over- and under-distances, according to your needs and considering your time trial reactions.

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

3) Freshening Up: (1.5 weeks)

During the last one-and-a-half weeks, you should try to freshen up by lightening your training so as to build up your reserves mentally and physically for the coming important competition. Some call this “Super Compensation” and other words. This is important and the time for this freshening up should be decided by the individual through trial and error methods as individuals differ in this respect, though usually 10 days is about right on the average. You should train every day, but easily. The fast training should be small in volume and the longer runs should be at low efforts.

When the main competitions are reached, it is important to realize that you have trained to race. You should not continue to train hard as many athletes make the mistake of doing. It is necessary to keep fresh and sharp. You cannot be fresh and sharp if you are doing hard repetition training, etc. Therefore, a typical training week during competitive season would go something like this; Saturday: race, Sunday: long easy run, Monday: a few sharpeners, Tuesday: sprint training or leg-speed, Wednesday: race at a club, Thursday: jog, Friday: leg-speed, etc. Reserve your energies for your races and just train enough to keep your condition to a good level. Your races will indicate your general condition.



Lydiard (l) giving 3-time Olympic champion Peter Snell (r) some advise; as the race comes near, detailed communication between the coach and the athlete becomes critical: photo courtesy of Manfred Dressel

Every morning except upon days for a long run, you should go for your morning easy runs, as this helps to keep your blood pH level high and make your recovery better. It also continues to further develop general cardiac efficiency.

Without being too specific, this is basically the way to approach training for middle distance and distance running. As long as the exercises used daily are evaluated and you decide that the training to be used is what is required, then you are sure to start to gain a fine balance in your schedule and get the results you desire. You can train hard and not succeed unless the training is approached in an intelligent way.

- 1) This is sometimes referred in the schedules in Lydiard's books as “The First Important Race” or “The Race”. This does not mean that it is the only race you will be training for. Once the top

racing conditioning is attained, assuming you have built adequate aerobic base and with proper training that follows, you can continue your competitive form and keep improving for some time.

- 2) Please refer to (3) in chapter 2: “INTRODUCTION TO THE LYDIARD SYSTEM”. As Dr. Snell pointed out, more recent research suggests the more realistic number for the limit of oxygen debt is more like 4 to 5-liter. It is however still very much a limiting factor as Lydiard suggested and the principles of the Lydiard system still applies – if not be illustrated better.
- 3) The goal of anaerobic training is to “make yourself tired with volume of speed training”. This is why, as far as Lydiard was concerned, it really doesn’t matter what form the anaerobic training takes; how far the fast running section, how fast you run them, how many times you repeat them, etc.; as long as you achieve your desired physiological effects.
- 4) Again these numbers are very much an individual matter. If it takes longer for you to recover from a hard anaerobic workout than others, you may need to take two or three days, instead of one, before you perform the next anaerobic workout; therefore you may need to take longer than four weeks to develop your anaerobic capacity to maximum.
- 5) Lydiard always warned that young athletes are highly sensitive to lowering of blood pH level due to excessive use of anaerobic training (intervals/repetitions/races). It would be much better to use early season races to develop anaerobic capacity for younger athletes. Most coaches and athletes at high school and college level overdo anaerobic training as well as racing several times a week.
- 6) Speed is developed by longer strides and faster strides. Faster strides can be attained by shortening the lever of your lead leg. This also helps to bring your knees high. Longer strides can be attained by lifting your knees high and straightening your kicking leg. Any form of exercises to enhance these elements will help.
- 7) Lydiard used to have his runners, even marathon runners, participate in a sprinting event to develop better speed and economy of running action.
- 8) In a strict sense, as far as Lydiard was concerned, interval/repetition anaerobic training is NOT speed training. In anaerobic training, you may start fast run after premature recovery because its goal is to “make yourself tired with speed” by developing buffer against this type of fatigue. For speed development training, it is important that you are almost completely recovered so you will not tighten up and tense up.
- 9) Careful evaluation of each day’s training and your reaction to each workout is critical during this phase of program. Analyzing lap times for time trials and rearranging the following workouts are absolutely vital.
- 10) You cannot train hard and race hard at the same time. Too many athletes try to race hard while still training hard or continue to train hard once competitions start.

HOW TO SET OUT A TRAINING SCHEDULE

1. Count back from the first important race date. How many weeks?
 2. Allow ten days for freshening-up①.
 3. Allow six weeks (including freshening-up) for co-ordination training.
 - Sharpeners, trials, development races (under and over distances).
 - Pace judgment training.
 - Fast relaxed striding.
 - If needed, 300 and 500 meters.
 - Fast anaerobic.
 4. Allow four weeks for anaerobic development.
 - Anaerobic training two or three days weekly.
 - One day long aerobic run.
 - Other days sprint training of sorts and/or easy running.
 5. Allow four weeks for hill resistance training.
 - Hill training two or three days weekly.
 - One day long aerobic run.
 - Some windsprints every 15 minutes during hill training.
 - Other days leg-speed and fast relaxed runs over 100 meters or easy aerobic running.
 6. Conditioning training is time left.
 - A) Conditioning starts with only aerobic mileage (flat and hills).
 - B) Then include a day easy fartlek and strong runs over about 5k and 10k②.
 - The 10k only once every two weeks and the 5k three times every two weeks.
 7. Continuation of racing.
 - Non-race week/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.
-
- 1) Depending on the individual, training pattern and the distance being raced, the length of freshening should vary. Freshening for the marathon, for example, should be anywhere from 2 weeks to 4 weeks.
 - 2) These “Time Trials” are more or less “Tempo Runs” during conditioning phase and should not be raced. Seasoned athletes can include 10km~10 miles once or twice a week –shorter distances (3~5km) should not be run too fast.

TRAINING CONSIDERATIONS

- 1.** You need to be at a peak for the day. It is not necessarily the best athlete who wins, it is the best prepared.
- 2.** Choose the event that best suits you internationally. Basic speed is the governing factor.
- 3.** The aim is to develop sufficient endurance to maintain the necessary speed over the race distance to be successful.
- 4.** In middle distance and distance events, a high aerobic threshold is necessary.
- 5.** Stamina can be continually developed.
- 6.** Anaerobic development is a limited factor.
- 7.** Once anaerobic training is started, it must be continued, otherwise development is lost.
- 8.** Once conditioning is finished, the performance level is determined.
- 9.** Conditioning requires many kilometers in training. It can only be accomplished aerobically.
- 10.** It is a mistake to use anaerobic training during the conditioning phase.
- 11.** Anaerobic development only takes 10 to 12 weeks to achieve maximum levels.
- 12.** Anaerobic training should be done in relation to reactions, not by using hypothetical figures such as number of repetitions, etc. The athlete should decide how many reps is enough.
- 13.** Evaluate everyday's training and train by daily reactions, using the schedule for guidance.
- 14.** Balance in training must be maintained between aerobic-anaerobic and speed development.
- 15.** It is a fallacy that anaerobic training develops speed. In fact, it counteracts speed.
- 16.** Training can be done too fast or too slow, too much or too little, at right or wrong times.
- 17.** Understand the how and what of training as well as why each day's training is important physiologically and mechanically.
- 18.** Co-ordination of training is important.
- 19.** All middle distance and distance athletes require: (a) A high aerobic threshold; (b) Anaerobic development; (c) Speed; and (d) Co-ordination. One development follows another. Training needs to be systematic.
- 20.** No one can determine exactly what an athlete should do in anaerobic training. The athlete should determine that in each session and not train to hypothetical figures.
- 21.** Anaerobic development requires volume of training, i.e. longer repetitions, not short sharp ones or short intervals. After three weeks of heavy overload anaerobic training, the athlete needs to decide whether to back off during the fourth week and start the shorter sharper workouts. This is to maintain the anaerobic development achieved but not sacrifice good condition at the same time.

THE SCHEDULE

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

Training should be done over all types of surfaces① and trial runs over courses similar to that to be raced over. Training should also be applied in volume according to age and condition.

Regular running on hills will help you in developing and maintaining your speed. Try to fit in some hill springing, uphill running or bounding with a driving action, and some steep hill or step running whenever you can②, but don't overdo it.

The schedules are only for guidance. They give a balanced method of training for a specific event, but think of them as a flexible guide line, allowing for age and general conditioning. Study your reactions to the training from day to day and if you feel stale or suffer from any soreness, allow time for recovery③.

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. Fast training can lead to injury and will certainly only make you more tired.

Don't race your training, except when full efforts are called for in the schedule. Run strongly and easily in effort, always keeping something in reserve. As you feel improvement, gradually increase your training tempo④, but never use that reserve.

When runners are well conditioned, it is not too difficult to maintain top form for months⑤, providing simple precautions are taken, not to try to train hard and race at the same time and allowances are always made for recovery from races. To keep FRESH and SHARP is the secret.

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 one (e.g., between cross-country and track seasons, etc.).

- 1) Lydiard was known to recommend running mainly on the road during the conditioning phase but in actuality road was not the only surface his runners trained on. They trained on various surfaces particularly rugged cross country courses for better over-all general conditioning.
- 2) Training on the hills is one of the best forms of speed development training.
- 3) If in doubt, go for a nice easy jogging.
- 4) Speed improvement should come naturally; it should not be forced.
- 5) "The most important race" on the schedule is not necessarily the only race you have trained for. With adequate aerobic conditioning earlier and appropriate training from week to week, you should be able to continue racing and continue to improve for some time.

I. **CONDITIONING** (*As long as possible*)

Monday: Aerobic running 3/4 to 1 hour.
Tuesday: Aerobic running 1 to 1.5 hours.
Wednesday: Run hilly course 1/2 to 1 hour.
Thursday: Aerobic running 1 to 1.5 hours.
Friday: Jog 1/2 to 1 hour.
Saturday: Run hilly course 1/2 to 1 hour.
Sunday: Aerobic running 1.5 to 2 hours.

Monday: Run hilly course 1/2 to 1 hour.
Tuesday: Aerobic running 1 to 1.5 hours.
Wednesday: Time trial 3,000 or 5,000 meters.
Thursday: Aerobic running 1 to 1.5 hours.
Friday: Relaxed striding 200 meters by 4 to 8 times.
Saturday: Time trial 5,000 or 10,000 meters.
Sunday: Aerobic running 2 hours or more.

II. **HILL RESISTANCE** (*4 weeks*)

Monday: Leg-speed 100 meters by 6 to 10 times.
Tuesday: Hill exercise 1/2 to 1 hour.
Wednesday: Fast relaxed running 100 meters by 6 to 10 times.
Thursday: Hill exercise (or jog) 1/2 to 1 hour.
Friday: Leg-speed 100 meters by 6 to 10 times.
Saturday: Hill exercise 1/2 to 1 hour.
Sunday: Aerobic running 1 to 2 hours.

III. **ANAEROBIC TRAINING** (*4 weeks*)

Monday: Sprint training.
Tuesday: Repetitions.
Wednesday: Easy fartlek 1/2 to 1 hour (jogging and striding or sprint training).
Thursday: Repetitions.
Friday: Relaxed striding (fast and easy).
Saturday: Repetitions.
Sunday: Aerobic running 1 to 2 hours.

IV. **CO-ORDINATION TRAINING (4 weeks)**

Monday: Windsprints (total of 2,000~4,000 meters); either 50 meters every 100 meters or 100 meters every 200 meters; 10 to 20 times.

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 1 hour.

Wednesday: Development races or Time trial; a sprint and middle distance.

Thursday: Fast relaxed striding or Pace judgment or Easy fartlek or Fast runs in repetition over 300 meters by 3 or 500 meters by 2.

Friday: Jog 1/2 hour.

Saturday: Development races; over or under race distance.

Sunday: Aerobic running 1 to 1.5 hours.

V. **LAST TWO WEEKS OF FRESHENING UP**

Monday: Windsprints 50 meters by 12 to 20 times.

Tuesday: Easy fartlek or Aerobic running 1 hour.

Wednesday: Time trial over race distance (FAST).

Thursday: Fast relaxed striding 100 meters by 6 times.

Friday: Jog 1/2 hour.

Saturday: Race or Time trial half the race distance.

Sunday: Jog 1 hour.

Monday: Windsprints 50 meters by 10 to 16 times.

Tuesday: Time trial 400/600 meters or 1500 meters.

Wednesday: Fast relaxed striding 100 meters by 6 times.

Thursday: Jog 45 minutes.

Friday: Jog 30 minutes.

Saturday: THE FIRST IMPORTANT RACE.

Sunday: Jog 1 to 1.5 hours or more.

VI. **CONTINUATION OF RACING**

Monday: Easy fartlek 3/4 to 1 hour.

Tuesday: Relaxed striding 200 meters by 6 times.

Wednesday: Race or time trial.

Thursday: Easy fartlek 1 hour or Jog 3/4 hour.

Friday: Jog 1/2 hour.

Saturday: Race or time trial.

Sunday: Jog 1.5 hours.

RACE WEEK/NON-RACE WEEK SCHEDULES

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 1500 meters by 3 or 800 meters by 6 times.
Tuesday: Aerobic running 1 to 1.5 hours.
Wednesday: Time trial 3,000 meters or 5,000 meters.
Thursday: Aerobic running 1 to 1.5 hours.
Friday: Fast relaxed striding 100 meters by 10 times.
Saturday: Time trial 3,000 meters or 5,000 meters.
Sunday: Aerobic running 1.5 hours or more.

CROSS COUNTRY (Race Week)

Monday: Windsprints 100 meters by 6 to 10 times.
Tuesday: Easy fartlek 1/2 to 1 hour.
Wednesday: Time trial 1,500 to 2,000 meters.
Thursday: Fast relaxed striding 100 meters by 6 times.
Friday: Jog 1/2 hour.
Saturday: RACE.
Sunday: Aerobic running 1.5 hours or more.

ROAD (Non-Race Week)

Monday: Repetitions 1 mile by 3 or 880 yards by 6 times.
Tuesday: Aerobic running 1.5 hours.
Wednesday: Time trial 3 miles.
Thursday: Aerobic running 1.5 hours.
Friday: Fast relaxed striding 100 meters by 6 to 10 times.
Saturday: Time trial 3 miles.
Sunday: Aerobic running 1.5 hours or more.

ROAD (Race Week)

Monday: Windsprints 100 meters by 6 to 10 times.
Tuesday: Easy fartlek 1/2 to 1 hour.
Wednesday: Time trial 1 mile.
Thursday: Fast relaxed striding 100 meters by 4 to 6 times.
Friday: Jog 1/2 hour.
Saturday: RACE.
Sunday: Aerobic running 1.5 hours or more.

RUNNING A MARATHON

The point of marathon training is to develop fine general cardiac efficiency, which basically means the improved intake, transportation, and utilization of oxygen. With continued running, the intake and transportation improves quickly, but the improvement in usage by the muscles takes longer①. This necessary development of muscular endurance can only be brought about with continuous exercise of muscle groups for long periods.

Muscle group exercise, particularly for periods of two hours or more, not only affects under-developed capillary beds but also develops new beds, giving an important increase in muscular endurance. So, to be successful in marathon racing or running, it is essential to go for long runs often. 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 terrain②. Because marathons are run most of the way at fast aerobic efforts, there is normally little need to do a lot of anaerobic training; this means that to develop the anaerobic capacity to race marathons, time trials over 5,000 and 10,000 meters are sufficient.

The use of fartlek or speed-play training is of value. Fartlek training is done by mixing all sorts of running over golf course-type terrain. Set yourself a time to train for and, 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 try to bite off too much at the beginning. Always run to your individual fitness level and not at someone else's. That can involve you in anaerobic running (to run at someone else's speed). In conditioning training, you can never run too slow to improve the oxygen uptake; but you can run too fast to run yourself in trouble.

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

Train well within your capabilities. Start your races at steady effort and don't be trapped into going too fast at the beginning.

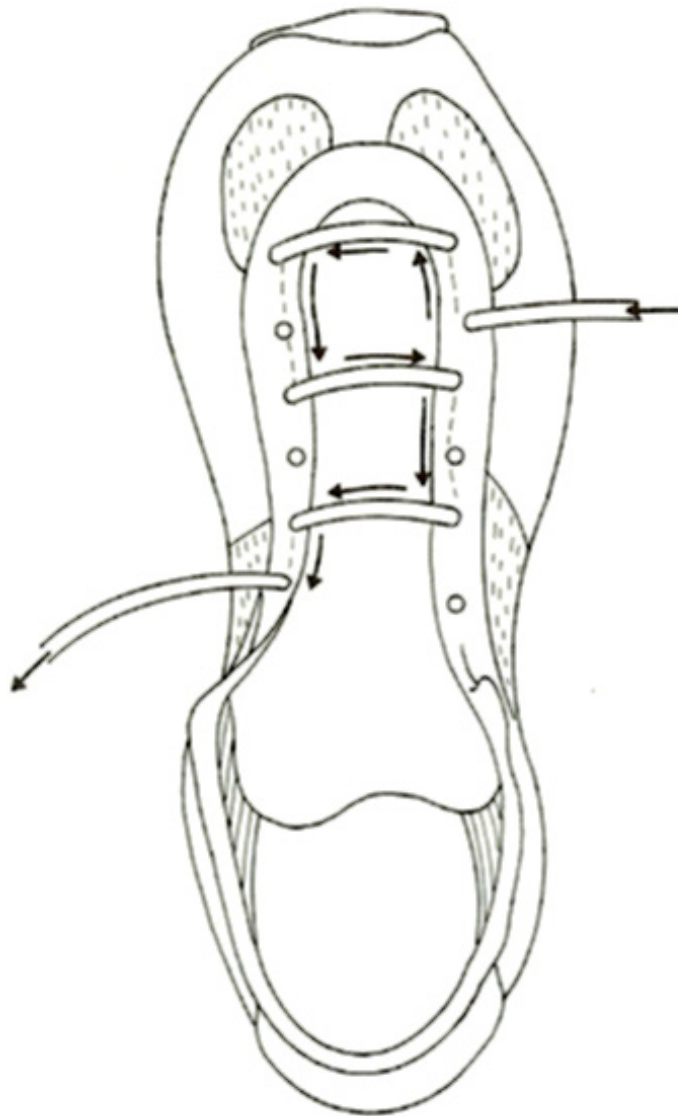
- 1) Ability for oxygen intake and transportation depend on cardio-circulatory system. Utilization of oxygen depends on capillarization of the working muscles and it takes longer than cardio-circulatory development.
- 2) Running over hills during conditioning phase is particularly important. This will allow muscle tone (power and flexibility) to be activated; two elements most likely be neglected during the slower-paced running. It will be worth noting that the original Lydiard's runners were often running extremely hilly area in Auckland, New Zealand.

WHEN YOU RUN A MARATHON, BE SURE THAT YOU...:

- 1.** Keep to your normal balanced meals the days prior to the race. Protein, carbo-hydrate & fat are all necessary for a balanced metabolism in a marathon race.
- 2.** Eat up to 8 oz. of honey supplementary to your normal meals the two days prior to the race.
- 3.** Finish eating about three hours before the start.
- 4.** Eat a light breakfast preferably of cereals, honey and toast with tea or coffee.
- 5.** Have good fitting clothes and shoes that will not chafe and are suitable for the conditions on the day.
- 6.** Use lubricant (olive oil, lanolin) under arms and crotch.
- 7.** When putting on your running shoes, 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.
- 8.** Do not run much before the start. Save your energy.
- 9.** Stretch and loosen a little.
- 10.** Start well within your capabilities and warm up to the run as you go. Hold yourself in check. It will pay off later.
- 11.** Do not exaggerate your knee-lift. From the start, try to relax and not lift the knees higher than necessary to save the muscles that lift the legs.
- 12.** Ignore the other runners. Run at efforts that suit you.
- 13.** Prepare electrolyte drinks for a hot day. Make the mixture weaker than directed. Add some honey.
- 14.** Do not take salt tablets.
- 15.** Drink water and electrolyte drinks throughout the race on a hot day. A glass just prior to the start can help.
- 16.** Keep your body wet. Sponging is the best insurance against dehydration and high body temperatures.
- 17.** Do not surge in the race and waste energy.
- 18.** Do not use anti-perspirants.

HOW TO LACE YOUR SHOES

Lacing is more important than most runners realize. Your shoes should be laced so that when they are tightened, they don't pull down on the sinews and metatarsals on the top of your foot, as shown below. Any other lacing tends to create 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^①.



1) Please check with the “[Lacing the Lydiard Way](#)” site for detailed diagram.

NUTRITION AND MORE

The time to experiment with your diet is not before an important race, but when the wrong reaction won't affect your training too severely.

Carbohydrate, protein, and fat are all necessary in the balanced diet①. But for those runners who are following the marathon conditioning program, you will find that you need a higher caloric intake. It is difficult to get the extra calories from bulky foods; they are harder to digest. It is recommended to use honey, especially prior to big races, to provide the calories/energy you need without causing intestinal distress.

You should evaluate what you are eating and what you need. It pays to study all you can about the latest information on minerals and vitamins. However, some people assimilate more minerals than others; each person is unique in his or her requirements.

Natural foods are the best source of nutrition 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 vitamin and mineral requirement is higher than normal, and deficiencies could cause a lot of break-down in your body. You must be sure to replace the amounts that you lose if you want to continue to train and compete effectively. You can get many of the minerals you need from electrolyte drinks, but be sure to check the label before you buy them. Some quick lesson of minerals and vitamins are as follows:

Calcium: Your body contains about 3 lb. of calcium --more than any other mineral. Most of the calcium is in your bones and teeth, but the remaining ten percent is vital. Calcium allows your muscles to contract. You can unknot muscle cramps by taking extra calcium. Without the proper amount in your system, your body takes the necessary amount from your bones to make up the deficit. It also helps eliminate lead from system.

Magnesium: If you are experiencing sleepless or restless nights, perhaps you are deficient in magnesium. Magnesium is a natural tranquilizer and relaxes jumpy muscles and nerves and counteracts irritability. It also aids in the digestion of protein, fat, and carbohydrate.

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. Severe potassium deficiency symptoms are nausea, muscle weakness, cramps, irritability, and finally, total collapse. Potassium helps against the effects of heat. Those who do not perspire much do not need so much potassium. Those who do and take salt need double doses. Food sources that contains potassium are bananas, oranges, tomatoes, cabbage, celery, carrots, grapefruit, apples, beans, and fish.

Iron: This is a vital oxygen carrying agent in the haemoglobin. It is also reported that iron can help against depression. Vitamin C will help body's absorption of iron. Daily dose of approximately 18 mgs is recommended.

Chromium: It helps body use insulin to help regulate blood sugar, which in turn helps prevent diabetes. It also culminates to help maintain muscle contractions and eliminate cramps.

Zinc: Almost nothing happens in the human body without zinc. It assists in making of the new cells, speeds the healing of burns and all kinds of wounds. It also assists recovery from lactic acid build-up.

Vitamin A: Assists against stress, shortcuts dangerous pollutants as benzene and dieldrin. It also keeps skin smooth, vision sharp, immune system strong, and anti-stress mechanisms efficient.

Vitamin B1 (Thiamine): Helps the carbohydrate metabolism to turn carbohydrates into glucose, which fuels the brain and the muscles. It is best to be taken in a B-complex form, but 5 mgs daily helps athletes. Any athlete who carbo-loads before a race should take sufficient thiamine which will turn all the pasta into energy.

Vitamin B2 (Riboflavin): This vitamin helps 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. Its most important role involves the red blood cells carrying oxygen to all body parts. Niacin keeps blood cells charged and they keep the body charged with oxygen. It assist in niacin and nicotinic acid. Nicotinic acid lowers cholesterol level as well.

Vitamin B6 (Pyridoxine): Important for memory and it serves as the synthesis of serotonin, a brain chemical that regulates memory. Taking "the pill" can deplete B6 and can cause state of depression.

Vitamin B12 (Cobalamin): It assists the nervous system relaying messages between body and brain. "The pill" also depletes this vitamin as well. Liver is the best source but any animal product will do.

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

Vitamin C: It is an all-purpose antidote. So powerful that it detoxifies heroin, nicotine, alcohol and cancer-causing pollutants. It also beats the heat. Increasing vitamin C intake a week or so before an event in hot weather will increase your competitive edge. It also assists body's ability to absorb iron which in turn helps oxygen carrying capacity. A thousand milligrams with a meal will boost iron absorption tenfold.

Vitamin D: Its main purpose is to allow the body to absorb calcium. Only vitamin naturally produced in the human body.

Vitamin E: It improves glycogen storage, which is translated as more fuel for the endurance athletes. It also improves the tone and strength of the heart muscle and protects cells from oxidation.

- 1) Lydiard preferred not to follow the strict carbo-loading, citing the fact that you also need fat for endurance (to run through the "wall") and protein for recovery from muscle break-down in the marathon. Balanced diet is the best way to go.

TRAINING TERMS

Long Aerobic Running means to be training at a fairly strong aerobic effort, not just jogging. Finishing in a “pleasantly tired state”. It does not mean racing your training, either. In theory at 70% to 100% of your aerobic capacity.

Easy Fartlek Running means easy “speedplay”. Running over undulating areas, if possible, mixing in some fast stride-outs, hill sprints, downhill striding, sustained runs for a minute or two, or whatever you feel like doing, without tiring yourself too much by taking easy jogging intervals whenever you feel like it.

Strong Fartlek Running is similar to the easy fartlek, however, it is used to develop the anaerobic capacity to exercise and you should finish in a tired state.

Hill Springing is used to strengthen the legs generally, particularly the ankles. Find a gentle slope and, after warming up, use a bouncing action with a slow forward momentum, pushing hard off the toes again on alternate feet, the ankles flexing and so stretching the tendons and muscles. The body’s weight acts as a form of resistance and helps to develop the fast twitch or white muscle fibers, so helping in speed development. It is important to have strong and flexible ankles to gain the optimum speed possible. You should only do what you feel your legs can take of this exercise. Initially a little, and then gradually increasing the workload when you know your reactions. A little often can help generally.

Steep Hills or Step Running is used mainly to strengthen the upper leg muscles, though the legs generally benefit. Knee-lift is important in running all distances from sprints to marathons and the quadriceps, or front-upper leg muscles, often tire and cause the runner to lose stride length and leg-speed. You only do what you feel you can manage, giving your legs a good recovery before doing more of the exercise. Run up a steepish hill or steps, bringing up your knees so as to make the back leg drive fairly hard. Don’t try to go too fast up-hill. Make your legs feel the workload.

Hill Bounding is a variation of hill exercise. By using a more gentle sloping hill and with long bouncy high knee lifting strides, pushing hard with a back leg, and forcing arms through, running up the hill quite fast, like a deer going over a fence. Only do what you feel you can manage. Always take a good recovery jogging interval before striding down-hill again. The length of the hill should be in excess of 100 meters if possible.

Relaxed Striding is used to help you learn to relax during races. Continually training by running varying distances from 100 to 300 meters, keeping the upper body relaxed and concentrating upon running with a good technique, will help you to run faster without being basically fitter.

Fast Relaxed Striding is similar to relaxed striding, but run at your best relaxed speed.

Leg-speed is fast running over about 100 meters, concentrating upon pulling your legs through quickly rather than on the driving off the back leg, by using the quadriceps and lower stomach muscles. Try to maintain a near normal stride length and **MOVE THE LEGS FAST!** Then jog for 300 meters easily before repeating. Always run the fast work with the wind.

Repetitions are for anaerobic capacity development. Run one and jog one ①.

Time Trials are to co-ordinate the training. Run at about 7/8ths effort, trying to maintain the same effort throughout the whole distance. Don't increase the speed at the end by sprinting.

45m Windsprints Ovary 100m are used for sharpening and developing an ability to become accustomed to changes of pace in racing. Put markers at 0m, 30m, 75m, and 100m (30 meters-45 meters-30 meters segments) and sprint hard the middle 45 meters, jogging around the 30 meters before sprinting 45 meters again.

100m Windsprints Over 200m are similar to 45/100 windsprints in effect, though more effective anaerobically. Sprint the straights and float the bends of the track.

Pace Judgment Running is used over 400 meters in repetitions of 4 to 6 times usually, trying to run at the speed that you intend to average in your racing. You take whatever interval you feel you require for recovery as it is important to run the exact time if possible. Not under or over it.

Sprint Training consists of warming up, stretching, and doing exercises to concentrate on form. Use about 100 meters with the wind, if any, and use the exercises below, each one twice:

- 1) **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 tired. Do what you feel you can. Jog easily back and repeat.
- 2) **LONG STRIDING EXERCISE**--Then with a high knees lifting, long striding action with the arms being forced through and driving hard off the back foot, run the 100 meters twice with good recovery intervals.
- 3) **RUNNING TALL EXERCISE**--Follow with running tall exercise by keeping high on the toes, lifting the knees high and stretching the body upwards, tending to lift the torso from the pelvis.

Run over the 100 meters like this twice and take the necessary recovery. The running speed should not be too fast, concentrate upon keeping up tall.

Then try to combine the three exercises and run over the 100 meters twice as fast and relaxed as you can, with jogging interval. After these exercise are completed, run around the track up to six times using one straight to run fast and relaxed with a 300 meters jogging interval.

Jump Rope with a running action can be valuable when weather condition don't allow you to train outdoors. It has good value for oxygen uptake development.

Cycling is good for running and can be used at times if you are injured. It is also helpful for leg-speed.

Swimming can be used at times when recovering from injuries, though not too much is recommended for runners.

Jogging is very easy running.

- 1) Lydiard was never too concerned with type of training to develop your anaerobic capacity. He believed all the fancy formula for interval/repetition training is nothing but a lot of "eye-wash".

GLOSSARY

AEROBIC: “With oxygen”; exercising within a person’s ability to absorb, transport, and use oxygen.

AEROBIC ENDURANCE: A measure of the ability to do continuous work.

ANAEROBIC: “Without oxygen”; exercising that requires more oxygen than a person can take in. The approximate limit that a person can run anaerobically is two minutes, any longer than this results in oxygen debt, the formation of lactic acid and neuro-muscular breakdown, causing the runner to have to stop or slow down.

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: 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 a certain level of power output.

FARTLEK: Swedish for “Speed Play”, the changing of pace for varying distances during a workout. The effort are coordinated with the terrain, rather than by time or distance (e.g., spring up the hills, or fast relaxed striding on the downhills, etc.).

FAST-TWITCH FIBERS: Muscle fibers consisting of cells which use mainly anaerobic chemistry for energy. They can supply a great amount of power on demand, but have limited endurance. They are called upon during sprints and other such high-demand, short-duration effort.

HARD/EASY TRAINING: A method of training which alternates hard days and easy days, sometimes involving hard weeks and easy weeks.

INTENSITY: A measurement of the degree of effort used in an exercise. A high intensity effort involves near maximum effort, and a fast build-up of fatigue. A low intensity effort is marked by a slow build-up of fatigue and less than 90% effort

LACTIC ACID FATIGUE: Distress caused by lactic acid in the system to the point where the athlete can no longer tolerate it.

MAXIMUM OXYGEN UPTAKE: The maximum volume of oxygen which an individual can actually utilize (as opposed to the volume of inhaled air) in one minute.

OVER-TRAINING: Training too hard, as to exhaust the body’s energy systems and create undue fatigue levels. These fatigue levels cannot, then, be recovered from by the next

workout and the athlete's performance ability decreases. The athlete can then become more subjected to sickness, injury, and further decrease in ability.

OXYGEN DEBT: The result of running anaerobically, when the amount of oxygen required to perform the exercise exceeds the amount the runner can supply.

PEAKING: A process by which an athlete attempts to arrive at maximum performance levels for a particular meet or race.

REPETITIONS①: Exercise to develop anaerobic capacity. Run one fast, jog one.

SLOW-TWITCH FIBER: Muscle fibers consisting of cells which use aerobic (oxygen consuming) chemistry for energy.

SPEED: The rate at which a person runs.

SPEED TRAINING: Workouts designed to increase a runner's speed, for instance, 10 x 100 meters with a full recovery.

STALENESS: A condition brought on by over-training, 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 an oxygen debt. As a result, there is no build-up of lactic acid. Heart rate, cardiac output, and respiration have reached high constant level.

VO₂ MAX: A measure of an athlete's ability to take in oxygen, maximum oxygen volume.

- 1) Lydiard's definition of "repetition" training is not to predetermine the distance, time, number of repeats and length of interval. On the other hand, his definition of "interval" training is to predetermine how far, how many, how fast you run with what recovery interval.

TRAINING SCHEDULE FOR 10KM (sample)

	<u>Training Abbreviations</u>	<u>For 3 months</u>	M	A- 1 hr
			T	A- 1½ hrs
A	Long aerobic running		W	A- 1 hr
B	Easy fartlek running		T	A- 1½ hrs
C	Strong fartlek running		F	A- 1 hr
D	Hill springing & bounding		S	A- 1½ hrs
E	Steep hills or step running		S	A- 2 hrs to 2½ hrs
F	Leg speed	<u>For 4 weeks</u>	M	B- ¾ hr
G	Sprint training		T	D & E- 1 hr
H	45 metre windsprints every 100 metres		W	B- ¾ hr
J	100 metre windsprints every 200 metres		T	D & E- 1 hr
K	Repetitions		F	N- 200 x 6
L	Time trials		S	D & E- 1 hr
M	Pace judgement running		S	W- 2 hrs
N	Relaxed striding	<u>From here 1 week each</u>	M	K- 800 x 6
O	Fast relaxed running		T	W- 1½ hr
P	High knee lift exercising		W	L- 3km
Q	Long striding exercising		T	B- 1 hr
R	Running tall exercising		F	W- ½ hr
S	Callisthenics		S	K- 200 x 12-15
T	Skipping		S	W- 2 hrs
U	Cycling		M	K- 600 x 6
V	Swimming		T	W- 1½ hrs
W	Jogging		W	L- 5km
X	Sprint starts		T	B- 1 hr
Y	Hurdles practice		F	W- ½ hr
Z	Water jump practice		S	K- 400 x 10-12
			S	W- 2 hrs
	Notes		M	K- 800 x 6
			T	W- 1½ hrs
			W	L- 3km
			T	B- 1 hr
			F	W- ½ hr
			S	K- 200 x 12-15
			S	W- 2 hrs
			M	K- 600 x 6
			T	W- 1½ hr
			W	L- 5km
			T	B- 1 hr
			F	W- ½ hr
			S	K- 400 x 10-12
			S	W- 2 hrs

	<u>Training Abbreviations</u>	M	J x 10
		T	B- 1hr
A	Long aerobic running	W	L- 1000 mtrs
B	Easy fartlek running	T	O- 100 x10
C	Strong fartlek running	F	W- ½ hr
D	Hill Springing & bounding	S	L- 5km
E	Steep hills or step running	S	W- 2 hrs
F	Leg speed	M	J x 10
G	Sprint training	T	B- 1 hr
H	45 metre windsprints every 100 metres	W	L- 1600 mtrs
J	100 metre windsprints every 200 metres	T	O- 100 x 10
K	Repetitions	F	W- ½ hr
L	Time trails	S	L- 10km
M	Pace judgement running	S	W- 2 hrs
N	Relaxed striding	M	J x 10
O	Fast relaxed running	T	B- 1 hr
P	High knee lift exercise	W	L- 1000 mtrs
Q	Long striding exercising	T	O- 100 x 10
R	Running tall exercising	F	W- ½ hr
S	Callisthenics	S	L- 5km
T	Skipping	S	W- 1½ hr
U	Cycling	M	J x 10
V	Swimming	T	B- ¾ hr
W	Jogging	W	L- 1600 mtrs
X	Sprint starts	T	O- 100 x10
Y	Hurdle practice	F	W- ½ hr
Z	Water jump practice	S	L- 10km
		S	W- 1½ hr
	Notes	M	H x 20
		T	B- ½ hr
		W	L- 3km
		T	O- 100 x 10
		F	W- ½ hr
		S	L- 5km
		S	W- 1 hr
		M	H x 12
		T	B- ½ hr
		W	L- 1600 mtrs
		T	W- ½ hr
		F	W- ½ hr
		S	The race 10km
		S	
		M	
		T	
		W	
		T	
		F	
		S	
		S	

TRAINING SCHEDULE (your own)

	<u>Training Abbreviations</u>	<u>For 3 months</u>	M	
			T	
A	Long aerobic running		W	
B	Easy fartlek running		T	
C	Strong fartlek running		F	
D	Hill springing & bounding		S	
E	Steep hills or step running		S	
F	Leg speed	<u>For 4 weeks</u>	M	
G	Sprint training		T	
H	45 metre windsprints every 100 metres		W	
J	100 metre windsprints every 200 metres		T	
K	Repetitions		F	
L	Time trials		S	
M	Pace judgement running		S	
N	Relaxed striding	<u>From here 1 week each</u>	M	
O	Fast relaxed running		T	
P	High knee lift exercising		W	
Q	Long striding exercising		T	
R	Running tall exercising		F	
S	Callisthenics		S	
T	Skipping		S	
U	Cycling		M	
V	Swimming		T	
W	Jogging		W	
X	Sprint starts		T	
Y	Hurdles practice		F	
Z	Water jump practice		S	
			S	
	Notes		M	
			T	
			W	
			T	
			F	
			S	
			S	
			M	
			T	
			W	
			T	
			F	
			S	
			S	

	<u>Training Abbreviations</u>	M	
		T	
A	Long aerobic running	W	
B	Easy fartlek running	T	
C	Strong fartlek running	F	
D	Hill Springing & bounding	S	
E	Steep hills or step running	S	
F	Leg speed	M	
G	Sprint training	T	
H	45 metre windsprints every 100 metres	W	
J	100 metre windsprints every 200 metres	T	
K	Repetitions	F	
L	Time trails	S	
M	Pace judgement running	S	
N	Relaxed striding	M	
O	Fast relaxed running	T	
P	High knee lift exercise	W	
Q	Long striding exercising	T	
R	Running tall exercising	F	
S	Callisthenics	S	
T	Skipping	S	
U	Cycling	M	
V	Swimming	T	
W	Jogging	W	
X	Sprint starts	T	
Y	Hurdle practice	F	
Z	Water jump practice	S	
		S	
	Notes	M	
		T	
		W	
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		F	
		S	
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		S	
		S	

LECTURE NOTES

Evolution of training:

- Alfred Shrubb, Walter George, Arthur Newton, etc. (*early 1900s*)—Aerobic endurance.
- Paavo Nurmi (*1920s~1930s*)—Mixing forest trail and road running with anaerobic.
- Jack Lovelock (*mid 1930s*)—Peaking.
- Gosta Holmer^①, Gunder Haegg & Arne Anderson (*1930s~1940s*)—Fartlek.
- Dr. Woldemar Gerschler, Dr. Hans Reindell & Rudolph Harbig (*1940s~1950s*)—Anaerobic interval training.
- Emil Zatopek (*1950s*)—Aerobic base plus anaerobic development. Balance.
- Mihaly Igloi (*1950s~1960s*)—Use of short sharp repetitions.
- Percy Cerutti and Arthur Lydiard (*1950s~1960s*)—Marathon type conditioning. High VO₂ Max.
- Arthur Lydiard (*1960s to present*)—Co-ordination of training. Peaking.

Training Aims:

- Sufficient endurance to maintain necessary speed over the race distance.
- Good general cardiac efficiency.
- Muscular endurance, strength & tone.
- Anaerobic development.
- Speed development.
- Co-ordination of training.
- Peaking.
- Continuation of racing.
- Conditioning.

Endurance:

- Age –young vs. old
- Sex –male vs. female
- Years of experience.
- Time basis.
- Mileage basis.
- Amount of training.
- Speed of training.
- Why aerobic?
- Running technique.
- Types of terrain.
- Footwear.
- Clothing.



The image of Gosta Holmer, the father of Fartlek: photo courtesy of Kodansha, Japan



Jack Lovelock, leading the New Zealand's great miling tradition. Lydiard learnt the importance of "Peaking" from Lovelock; photo courtesy of "The Legend of Lovelock" by Norman Harris

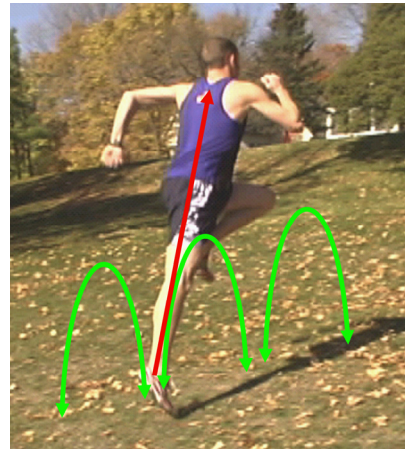
- 1) Gosta Holmer said one of the Lydiard's favorite quotes on training young athletes; *"If you can get a boy in his teens and encourage him to train and not race until he is matured, then you have laid the foundation of an Olympic champion."*

Speed and Technique Development:

- Resistance workouts with weights.
- Resistance workouts with hills.
- Need for springiness.
- Exercising for suppleness & flexibility.

Hill Training:

- Springing.
- Bounding.
- Steep hills or steps.



Hill Springing for flexible powerful ankles

Technique:

- Speed development through longer strides and faster strides.
- Need for relaxation.
- Upright torso.
- Position of hips.
- Arm action.
- High knees.
- Driving with the back leg.
- Running tall.
- Good extensions.
- Striding.
- Fast relaxed running.
- Racing sprints.
- Leg speed.



High Knee Drill

Anaerobic Training (Physiological Reasons):

- Types of training.
 - Repetitions.
 - Fartlek.
 - Trials.
 - Parlauf.
 - Racing.
 - Sharpening.
 - Interval training (four variables).
 - i. Speed of running.
 - ii. Number of runs.
 - iii. Distance of runs.
 - iv. Intervals.
- Balance needed between aerobic and anaerobic.
- Texan high school coach's experience.
- Bruce Kidd at Tokyo.
- Richard Tayler at Te Awamutu before 1974 Commonwealth Games.



Richard Tayler winning 10000m at the 1974 Commonwealth Games in Christchurch, improving his PR by almost 30 seconds: photo courtesy of "Gold Aren't Easy" by Dick Tayler and Spencer Jolly

Co-ordination of Training:

- Sharpening.
- Time trials.
- Pace judgement.
- Development racing.
- Technique workouts.
- Speed training.
- Aerobic training.
- Freshening up.
- Peaking.
- Continued racing and training.
- Fresh and sharp.

Injuries:

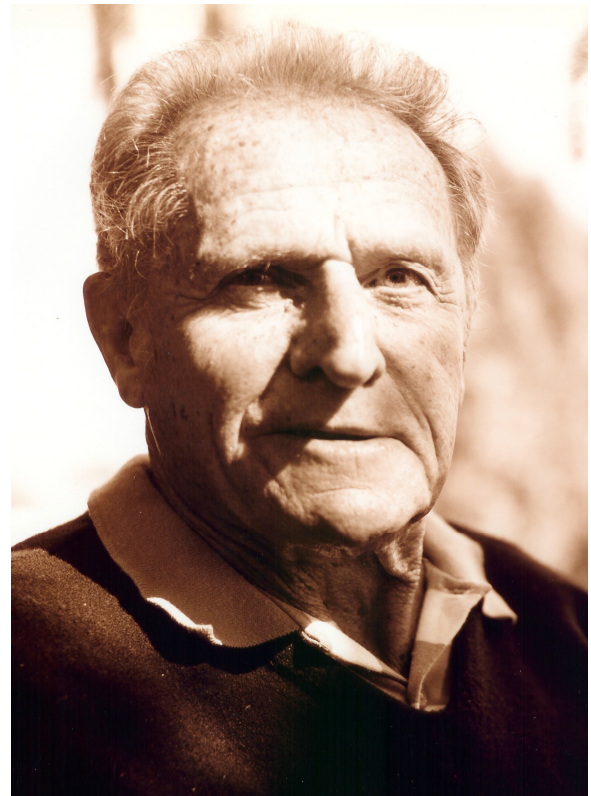
- Excessive anaerobic training.
- Wrong diet.
- Faulty equipment (particularly shoes).
- Attention to details.
- Stretching.

Other Aspects:

- Pulse rates.
- High altitude training.
- Carbohydrate loading.
- Sleep.
- Tactics.
- Pre-race meals.
- Training in smog, traffic fumes.
- Running in heat.
- Running in cold.

Diet:

- Balanced diet.
- Today's processed foods.
- Vitamin, mineral & enzyme supplements.
- Blood sugar levels.
- Use of relaxing agents.
- Body fat content.
- Sub-cutaneous fat.
- Unsaturated fats.
- Calcium gluconate.
- B15 Dimethylglycine.



Lydiard in his mid-80s was still actively preaching his principles around the world: photo, from the 1999 USA Lecture Tour, courtesy of Bud Coates