Part 1
Arthur Lydiard's Lecture

Transcribed, edited and footnotes added by Nobuya "Nobby" Hashizume, who wrote:

Many people feel that Arthur Lydiard was a man who knew everything there is to know about running. He could help anyone, in any part of the world, run faster and farther because of his understanding of the "hows" and "whys" of training. His athletes' success in the 1960 Rome Olympics, where Peter Snell and Murray Halberg won gold medals and Barry Magee won a bronze, focused his attention on their coach, a shoe-maker from Auckland, New Zealand. Many countries offered him a role coaching not only their athletes but also their training staff, wanting him to oversee a full athletics program. During a spell as Finnish national coach, his influence produced three gold medals (Lasse Viren, Pekka Vasala, Tapio Kantanen) and a bronze at the 1972 Olympics in Munich, with a set of next generation athletes coming to fruition in the 70s and 80s. Lydiard was awarded the White Cross for his efforts – the Finnish equivalent of a knighthood – and is the only non-Finn to have received this award. Meanwhile, his training methods were adopted all over the world. In 1990, Lydiard conducted clinics in Tokyo and Osaka. What follows is an edited transcript of the Lydiard seminar in Osaka in April 1990.

I'm one of those people who realize that there are great champions everywhere – every village, every town, every country.

I always say to young athletes: "When you look back over your performances last year, you are likely to see that on the day you went out and ran your best time, everything went right. The trick is to know why. If you know WHY you ran so well, you can structure your training so that on the day of the Japanese Championships, or the Olympics, or the big race you are training for, you can produce your top form.

"If you can do this, then you know something about training. Until you can do it, you don't know anything about training; you're just a good athlete who one day could run a good race."

There's a need for a better evaluation of each day's training, leading to a better structuring of long-term training programs.

There are three basic practices we have to consider: (1) aerobic development, (2) anaerobic development and (3) the development of sprinting speed. One development period follows another, and the training has to be systematic.

You must always adhere to the physiological and mechanical fundamentals. Getting away from these fundamentals leads to an imbalance in training. A good control and understanding of anaerobic training is absolutely crucial. You must know when to incorporate it into the program and when to leave it out. Athletes who understand how to control anaerobic training can control their ultimate form, allowing them to peak on the day.

In Japan, you've done very well in conditioning athletes with marathon-type training but in many ways this is over-accentuated. It doesn't matter what exercise you get involved in – whether it's cycling, lifting weights, swimming or running - you can do too much [of it] or too little. We can train too fast, or not fast enough. You can train at the right time, or you can train at the wrong time. Coaching is about deciding what is best.

Mr. Hirose [the host] is right when he says that Japanese runners have become obsessed with marathon training and haven't considered other aspects deeply enough. I watched the young women in a race – a half-marathon – a couple of days ago and I hardly saw one that has been taught to run properly! All of them were running tight around the shoulders, throwing their arms around. This type of bad technique will lead to wasted effort and loss of forward momentum. You must learn to relax. Relaxation is the key to good running.

If we are going to produce good runners we have to understand that, in doing all this marathon training, we can overdo it! We can develop too much muscular viscosity. Usually, when I go to a country, I have to encourage people to do more of this training. In Japan, I think maybe you should have another look at the amount you are doing, and learn to compromise a little.

We should all know that the aim in training is to develop sufficient endurance to maintain necessary speed over the distance. In other words, to run a 3'43" 1500 meters, you must set a pace of 400 meters per minute. Now, most athletes can't maintain the pace of 60 seconds a lap in order to run that time.

We should also understand that our performance level is governed by our aerobic threshold and our anaerobic development is limited by the optimum level achievable for a human being.

As I said, I think in many cases, based on my time here observing Japanese runners, you do a little too much of the marathon conditioning. You are wrongly evaluating anaerobic repetition (interval-type training), probably doing too much of it, and in so doing, canceling out some of the good conditioning that you've developed. In the long run, this means that you are losing control of your top peak form. Also, speed is not being developed sufficiently. There has to be concentration throughout the whole year on the development of speed. I'm not talking about anaerobic speed here; I'm talking about sprinting speed.[1]

Aerobic Capacity

If we look at the development of our oxygen uptake level, we can understand that, in some cases, there are people who are able to run 140 kilometers (90 miles) today, do

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the same tomorrow, the same the next day and even the next day after that. They continue doing this. Through conditioning of their blood vascular system and capillaries, they have developed the ability to benefit from a quick recovery time. There is a man in New Zealand called Max Telford who can run 240 miles (384 km) without stopping, yet he can 't run a marathon any quicker than 2:30. He can't go any faster but he can turn around and go back in the same time. He's sacrificed his speed to a large extent. This is why years ago, when I ran 250 miles (400 km) a week testing out theories, I found that it was too much. I discovered that we got the best results when we ran about 160 kilometers (100 miles) a week in our main training sessions and jogged in the morning, six mornings a week, for no more than an hour.[2] If we did more than that, we started to tighten up.

Even my middle-distance runners like Peter Snell and John Davies did the same mileage. What do the middle-distance runner and distance runner have in common? They both require a high oxygen uptake level, – the governing factor of performance – they need speed and they need anaerobic development. This is why I adopted a uniform training schedule up until the last 10 weeks, at which point we decided which event each athlete was best suited for and adjusted our training plan in accordance. In this way, I conditioned runners like Snell to have superb stamina. I coached him so he could easily run over far greater distances than he might normally without tiredness setting in. When he reached the last 200 meters of an 800 or 1500 meter race, he wasn't in the least fatigued. He could always use his powerful sprint finish.

I try to explain to young athletes what their approach should be. It's crucial that they achieve balance. It's simply not enough to train athletes only telling them what to do and how to do it. You must also teach them why they are doing it. Every day's training schedule should be explained in terms of the physiological and mechanical reactions that the athlete is trying to achieve in each exercise. Runners who know not only what to do and how to do it but why they are doing it are better motivated and produce better results.

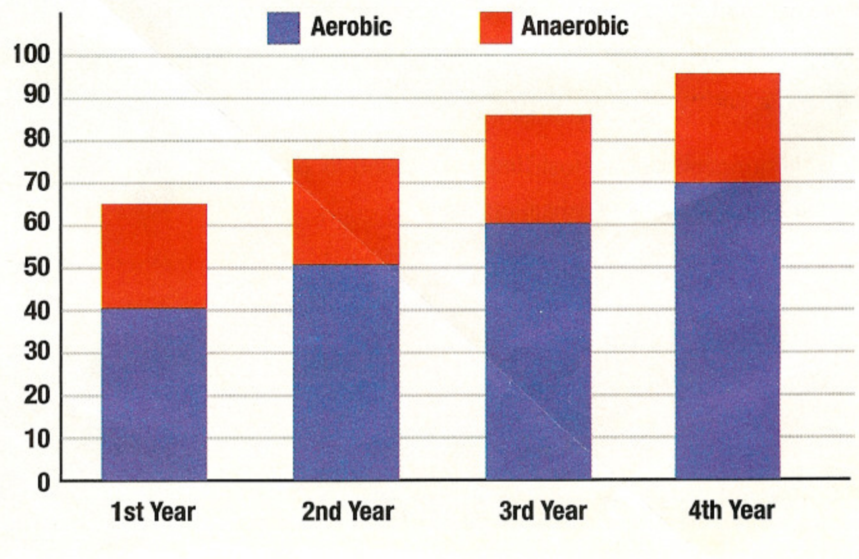
Let me further explain my thinking in regards to the factors which govern performance level. I stress the importance of having a high oxygen uptake level and the limitations of anaerobic development. The following chart should be of use. This is how I clearly explain to my athletes the approach they should take in training:

The vertical axis is the oxygen in liters per minute (milliliters per kilogram per minute). In a great endurance athlete, the ability to assimilate, transport and use oxygen occurs at a rate in excess of 7 liters per minute (85 milliliters per kilogram per minute). Now, if I find a high school athlete with an oxygen uptake level of, say, 3 liters per minute, I'll try to explain to them that this is not a permanent, limiting factor and that it can be improved. There is a great deal of potential for the development of the cardiac system in an individual. Years ago, they used to say it was limited; today we know that it is unlimited. We don't know its full potential.

What can be ascertained for definite, however, is that as a human being, our ability to incur oxygen debt is limited to 15–20 liters. If I give this athlete with a 3½ liter uptake level sessions of anaerobic training to perform – which takes about 4 weeks to develop to its maximum – and we develop an aerobic capacity of, say, 18 liters, we now have developed this athlete's anaerobic capacity. This is now the performance level of the athlete. It's physiologically impossible to increase this anaerobic capacity any further.

I explain to the athlete that when he carries out work that requires 4 liters of oxygen per minute, he is incurring an oxygen debt of 1 liter per minute (4 liters/min. required; 3 liters/min. capacity). He can only keep going for 18 minutes at that speed (18 liters total oxygen debt; 1 liter debt each minute). If we increase the workload to 5 liters per minute, he is incurring an oxygen debt of 2 liters per minute (5 liters/min. required 3 liters/min. capacity) and can only keep going for 9 minutes (18 liters debt; 2 liters debt each minute).[3] We can see that the oxygen debts not only double, but square and cube. So as we get faster, with a small increase in speed, the oxygen debt increases exponentially, eventually causing neuromuscular breakdown.

Now in the case of the athlete with an oxygen uptake level of 3 liters, once this 4-week period of training has been carried out, our performance level has been reached. The athlete can do all the anaerobic training he likes but, once maximum is achieved, it's physiologically impossible to improve performance further by trying to elevate his anaerobic capacity to exercise. The only way we are going to get this performance level up is to get the base aerobic capacity up. So if I can bring that base up



from, say, 40ml/kg/min. in the first year to 50ml/kg/min. in the second year, I can improve the performance level with the same anaerobic development. It is the aerobic threshold that governs it; not anaerobic development. It is the aerobic threshold that can be improved year by year with carefully planned marathon training.

So I try to explain to my athletes, "You don't make yourself great doing anaerobic training, you make yourself great doing aerobic training." Remember too that you have to understand when to back away from the anaerobic training. You can do too much of it and affect your physiological condition adversely.

Talking about aerobic development, I've found that if you work on a time, rather than mileage basis, you get better results. This is particularly true in young, developing people. For instance, if we say we are all going for a 25-kilometer (15-mile) run, some people might finish a half hour before others who aren't quite as fit and haven't done as much background training. Commonly, these people start to do too much training on a time basis. In other words, some people would only take an hour and a half to run 25-kilometers in training, others might take 2 hours. The important aspect is that they run an hour and a half in relation to the fitness level and background training.

When you are working with young people, it is also important, before they go through the fast growth spurt, to understand that their ability to use oxygen in comparison to their body weight is greater than adults. They are, therefore, better equipped to run long distances. If we look at the Africans – Kenyans, Tanzanians, and Ethiopians – who are now beating most people in the world, we'll see that it's not because they have scientific laboratories to train and test athletes but simply because they do a lot of running – they run to school and they run home again. We have to encourage our young people to do a lot of aerobic running and not to race too much. At that age they have highly sensitive nervous systems and can't stand a lot of anaerobic training or pressure.

We must also look at natural ability and basic speed. In your country, Japan, like my country, we are not very fast ... We're too slow for the 100 and 200 meters in most cases. Even our fastest runners, though they are national 100-meter champions, in the world listings they are way back in the hundreds. Success at the national level often clouds the scope of the international scene. A runner may prefer to run the 100 meters to be national champion, instead of looking at himself as a potential 800-meter runner, which owing to his basic speed, would probably allow him to have more success at the international level. We've got to make our good athletes think internationally, not nationally.

I put my athletes through years of training to find out how they can maximize their speed potential. You can't make a slow person fast but you can improve their speed. I use times over 200 meters to ascertain which event a particular runner is best suited for. I use 200 meters because at the 100 meter distance a sprint start can have a big influence and at 400 meters endurance plays too big a part. In 200 meters we can get a good indication of the athlete's basic speed.

For instance, if you have an athlete who can meet 22 seconds or better for 200 meters, he is fast enough today to be a great 800-meter runner at international level. If he is slower than that, however, there is little prospect that he will have success at that distance and it may be to his advantage to look for longer races. If you lack speed, you lose the economy of running action while trying to maintain pace.

Anaerobic Capacity

Let's talk about anaerobic development and our understanding of it. Anaerobic development determines the ability to carry out a workload that requires more oxygen than our body can assimilate, transport and use. The net result of this activity is the buildup of pyruvic and lactic acids. After a heavy workload of anaerobic training, the body can require 48 hours or more to recover. If we carry out the anaerobic training properly, we can ensure that the pH level of an athlete's blood hits a low during exercise. In such training, it pays to pull the level as low as possible, allowing it to return to normal before repeating the activity. Carrying out high levels of anaerobic development interspersed by 2 days complete rest achieves this.

An athlete that trains poorly, either with people who are too fast for him, or under a program that covers too much anaerobic work, will maintain a lower-than-normal blood pH level for long periods of time. If you examine the blood tests of such people, you'll find that their platelets will be very low. Recovery times are slowed and because of the effects on enzyme functions, the immune system can be adversely affected. Usually, athletes who continually get breakdowns, muscle pulls and other injuries and are continually developing coughs and colds will be undergoing an excessive amount of anaerobic workouts.[4]

Too much anaerobic training can also lead to 'staleness.' Symptoms include nervousness, loss of appetite and insomnia. These are psychological products of the physiological reactions brought about by maintaining a lower-than-normal blood pH level for a sustained period of time. I want to stress again: when we use anaerobic training, we must be very, very careful. An understanding of the processes involved is essential. It's better to underdo such training than over do it. Most people massively over do it.

Remember too that once you start doing anaerobic training, you've got to maintain the program. If you start doing it too early in the season, you'll create an imbalance in training by trying to develop the ability beyond the level at which the human body is comfortable. Also note that the day you start doing anaerobic training and stop your aerobic conditioning is the day your performance level has been determined for that season.[5]

Now, it's important to realize that there is no one in the world that can determine the precise amount of anaerobic training an athlete will need. You can't train to hypothetical figures. Too often I see coaches take their athletes down to the

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track and say something like, "I want you to run 15 laps at the rate of 65 seconds a lap," without the athletes having any say in it. Coaches usually set their athletes a round figure like 10 or 15 or 20 repetitions. Now if the athletes went to the coach and said, "Coach, why do I have to do fifteen 400-meter reps? Why not 12 or 13 or 17?" the coach wouldn't be able to tell him. He decided upon 15 simply because it was aesthetically pleasing. The athlete might very well get tired on his 12th rep and decide he's had enough. However, he is going to have to do 3 more circuits simply because the coach wrote down a round figure.

One of the reasons why Americans don't produce very many good middle-distance and distance runners, with millions of people there running, is simply because coaches determine with hypothetical figures exactly what athletes should do in anaerobic training. Yes, as a coach, you may be able to determine pretty closely what your athlete can do. You may even be right in saying he can do fifteen 400 meters in 65 seconds with such-and-such interval. The main thing, however, is to explain to the athlete not only how to train and what to do, but why he is doing it. It is important to convey the physiological reactions the runner is aiming to bring about with his training.

Once achieved, these reactions serve as a valid indicator of when to stop. It is the athlete that should determine when he has hit the wall and needs to finish, not the coach. The key to training is to train to your individual reactions to the training.

It's important to realize that, in terms of volume, a good deal of training will need to be done. If I say to an athlete out on the track, "I want you to complete 5 circuits and every 100 meters sprint 50 meters as hard as you can," the athlete will probably be out there for about 8 or 9 minutes.[6] After this time his legs will be extremely tired, starting to suffer neuromuscular breakdown, in which his muscles no longer contract. Now if we take standard blood samples from the leg muscles of this athlete and an arterial sample from his ear lobe, there will be two very different pH readings: low in the leg muscles; not as low in the arterial blood. As an analogy, if I were to get down and do 50 push-ups, my arms would get tired. I myself am not tired but my arm muscles no longer contract. If we are going to get an effective reaction, we train for longer periods.[7]

Now suppose I say to the same athlete, "I want you to go out and run 800 meters 6 times, alternately running and then jogging laps." Doing this he will be running with lower anaerobic effort but incurring an oxygen debt, which in turn will create lactic acid and start to lower the pH level of his blood. His legs, however, won't become fatigued so rapidly and his muscles won't get so tired generally because he will be getting more recovery time. If that athlete runs six 800 meter repetitions, alternating the pace in the way described, he'll be out there for a half hour or more. If we then take blood samples again, we will find that the pH of blood taken from the ear lobe will be much closer to the lower levels we wish to achieve.

If we are going to do anaerobic training then, we must ensure we do a large volume of it to be effective and realize that we shouldn't train at full tempo.[8]

Through trial and error, I have found that if athletes do hard anaerobic training 3 days a week for a period of 3½ to 4 weeks, they develop they anaerobic capacity to near maximum. Note that the coordination training which follows brings in development races, which are another short, sharp anaerobic workout. If it hadn't been developed in the preceding time, these will ensure the maximum anaerobic potentiality is fulfilled.

As we approach the end of our 4 weeks of hard anaerobic training, we are faced with something of a dilemma: if we continue at such a rate, we'll pull our condition down. If we under-do it or stop doing it, we'll lose the development that we have. To solve this problem we can do what are called "sharpeners."

These are circuits in which we sprint 100 in every 200 meters or 50 in every 100. Because they are short and sharp, they help to maintain anaerobic development. If athletes stop when they have had enough, this can be done without adversely affecting conditioning.

Every athlete is different. In the schedules I write I include hypothetical figures, of course, but these are only for guidance, and I explain to the athletes that they are not compelled to strictly follow them. I think too many coaches are too dogmatic and they are determined to make their athletes do things as they've written, instead of taking into consideration what in my opinion is more important: the reactions of the athletes themselves.

Now let's move on to the coordination of training; the last 6 weeks in a 10-week program.

Coordination

When we compete, we have to accustom our body to what we expect it to do on the day of the event. That is, run a certain distance in a certain time.[9]

At 6 weeks prior to competition I usually get an athlete to run the distance at near racing speed, on his own, with no watch and without calling out the lap times. By noting them down myself and looking at the overall time, I'll get an indication of where we are exactly with that athlete at that stage of training. One thing I've learned is that it's very easy to sharpen a well-conditioned body to racing pitch.[10]

Once sharpeners and faster workout have been introduced, we see these times come down very rapidly. In wake of this, try to gradually increase the tempo of work in the last 6 weeks. Go out and see how fast you can run in those first few weeks and then gradually increase the pressure session by session.[11] Say, for instance, that we have a 5-kilometer runner and he runs his first trial in 15 minutes, without the watch and with no competition. We know where we are exactly with that athlete at that stage. Now about 3 days later, we'll send him out for another 5,000 and this time we'll give him lap times and we'll have him run a little more quickly than when he ran 15 minutes. Progressively, each week, we'll have him increase the tempo, gradually getting the athlete to run faster.[12]

Depending upon the reactions of the athlete, we can determine what training to use in conjunction with these time trials. Under-distance or over-distance fast runs can be prescribed after communication between athlete and coach. For instance, if we have a young runner who comes in after his 5,000-meter run and says, "I don't know, coach. I'm not tired but I couldn't go any faster," we'd know he's not sharp enough yet and that he would likely benefit from some under-distance races and fast trials. If an athlete runs powerfully over the initial stretch but begins to tire at the end, it will be beneficial for him to carry out some over-distance fast runs. Now all athletes are different in their reactions, so you'd have to be a little experimental in the later stages of training to determine exactly how to coordinate things but in general the trials serve as a good rubric.

Just to explain this coordination when I trained 5,000-meter runner Murray Halberg in 1960, he ran strongly and evenly over 5,000 meters at near-racing speed. Now in those days, all the athletes he ran against were interval trained. They went out and ran fast, had a rest, ran fast, and had a rest. When it came to the actual race, they were still looking for their rest periods! Halberg, however, was able to run strongly all the way. I told him that when there were about three laps to go the pace would slacken while the other athletes attempted to have a rest. During this time he could put in a 60-second 400-meters and blow them away! He got an 80-meter lead on the field in one lap simply because they'd been trained to have a rest and he hadn't. That won him the gold medal. People said to me afterward that they couldn't understand how in the Olympic final, in front of 80,000 people, the rest of the field just watched Halberg run away and were unable to do anything about it. The answer is simply because they'd been trained incorrectly. **AT&F**

(1) *For Lydiard, sprinting speed, or pure speed, is different from anaerobic speed developed by doing intervals or repetitions.*

(2) *These morning runs are recovery jogs at easier effort.*

(3) *Lydiard used these figures to simplify the nature of oxygen debt. Recent studies suggest, however, that the limit of oxygen debt in humans is closer to 4–5 liters. Dr. Peter Snell, who trained under Lydiard and is one of the leading experts in exercise physiology, has proposed a new and more valid formula. Please refer to footnote (3) in chapter 2 in* Arthur Lydiard's Athletic Training.

(4) *Most metabolic actions and reactions, if not all, are performed in the alkaline condition. With excess lowering of blood pH level, enzyme activities will be affected adversely.*

(5) *This does not mean that you aren't going to improve your times for the season anymore. In fact, with all the sharpening and coordination training, this is where your times would start to come down. However, because your performance level is governed by your aerobic, not anaerobic capacity, once you stop working on its development, you will have determined your performance for the season.*

(6) *These circuits are known as "sharpeners" and play an important role during the coordination phase in maintaining anaerobic capacity without affecting good conditioning.*

(7) *Lydiard is referring to the muscle groups that are involved in that particular activity – in this case, legs. Because of short, sharp sprints with little recovery, lactic acid will build up very quickly in the working muscle groups. With a better understanding of interval times and repetitions, lactic acid build-up in the legs can be suppressed, allowing it to build up through general fatigue, bringing down blood pH throughout the body.*

(8) *If the intervals/repetitions are performed too fast, or without sufficient recovery, you may have to finish the workout prematurely, failing to achieve an overall lowering of pH throughout the body.*

(9) *It's important to accustom your body to continuous effort. Lydiard introduced the time trial because he realized that if you sharpen with repetitions alone, your body will expect a "recovery period" during the actual competition as well.*

(10) *If you have followed the Lydiard program and done lots of base-building aerobic training with strict control over speed and anaerobic development, your body will react well, becoming sharpened quickly. If, however, you lack a good aerobic base, all these strenuous time trials will soon ruin your conditioning.*

(11) *With all the quicker workouts, times should come down naturally, not be forced to get faster. You should not try to squeeze the time out too quickly by trying to run these trials faster.*

(12) *This is a classic example of the "Date Pace/Goal Pace" concept. You can draw a graph line from the first trial to your target goal time and determine exactly how much faster you should be running each session you train.*

Part 2

Arthur Lydiard's Lecture

Transcribed, edited and footnotes added by Nobuya "Nobby" Hashizume, who wrote:

Many people feel that Arthur Lydiard was a man who knew everything there was to know about running. He could help anyone, in any part of the world, run faster and farther because of his understanding of the "hows" and "whys" of training. His athletes' success in the 1960 Rome Olympics, where Peter Snell and Murray Halberg won gold medals and Barry Magee won a bronze, focused his attention on their coach, a shoe-maker from Auckland, New Zealand. Many countries offered him a role coaching not only their athletes but also their training staff, wanting him to oversee a full athletics program. During a spell as Finnish national coach, his influence produced three gold medals (Lasse Viren, Pekka Vasala, Tapio Kantanen) and a bronze at the 1972 Olympics in Munich, with a set of next generation athletes coming to fruition in the 70s and 80s. Lydiard was awarded the White Cross for his efforts – the Finnish equivalent of a knighthood – and is the only non-Finn to have received this award. Meanwhile, his training methods were adopted all over the world. In 1990, Lydiard conducted clinics in Tokyo and Osaka. What follows is an edited transcript of the Lydiard seminar in Osaka in April 1990. The first part of this article appeared in Vol. 14, No. 7 of AT&F.

Racing Begins

It's important to realize that the time trials at the six-week period are purely to develop the athlete for the coming races. Athletes should never race seriously until they are properly prepared for it and when they start, the hard training should be finished.[1] All their effort should now go into honing their race times. Remember two words: you've got to keep FRESH and SHARP. If you do aerobic or anaerobic exercises at this point, you should ensure that they are moderate in intensity and duration. They should aim to be short and sharp.

Doing this when I coached Snell in Tokyo in 1964, we jogged an hour in the morning very easily. He raced 6 races in 7 days and won two gold medals. On the last day, when he won the 1500 meters, it was very easy for him. It was like a training run! He won by 40 meters. He said afterwards he didn't feel that he had run hard. When we used to go to the track during the daytime we'd see other athletes still training hard. Providing you make sure that you allow sufficient recovery time following hard races and providing you have good base conditioning, you can hold your form for a long time once you are fit.

Speed Development

Now we are going to talk about speed: an area that is crucially important and, from what I've observed in the last few days, one that's not emphasized enough by Japanese runners. Most middle-distance and distance runners do a lot of conditioning. They think anaerobic repetition work, like running 200 meters or 400 meters, develops speed.[2] In actuality, it counteracts it! When you see people doing a lot of repetitions, invariably they start to tighten their shoulders and neck muscles. This is because their quadriceps are getting tired. Once this fatigue sets in, athletes quickly find themselves unable to lift their legs and starting to tense up.

It's essential to understand that relaxation is the key to good running. If you look at the video of Flo Jo winning the 100 and 200 meters at the Seoul Olympics, you will see her running in a completely relaxed fashion, even at her top speed. In her upper body she was actually smiling; her jaw was loose! If you watch footage of Carlos Lopes winning the marathon in Los Angeles or Carl Lewis winning the 100 meters, you will see that they have exactly the same running actions. The only difference is that Lewis brings up his knees higher and his arm action is much more exaggerated. They are both upright, with their arms coming through inside their shoulders in a loose and relaxed manner. Their hips are firmly under the torso. If you set your hips back, you can't get your knees up and you lose your stride length and stride speed.

Striding technique is essential to master. Fundamental speed is produced in two ways: longer strides and faster strides. The optimum stride is achieved when the upper leg is horizontal to the ground. If my knee goes down, my stride shortens. Of course, if I bring my knees up, my foot comes up higher. When Carl Lewis sprints, his heel is right up on his butt. From mechanics we know that a short lever moves faster than a long lever. For example, if I were to give any of you a 3-meter rod to move, you wouldn't be able to move it very fast. If I gave you a short stick, you would have more success. A stride following through like kicking a football, with your knee almost straight, is a slow stride; a stride following through with high foot elevation (right underneath your buttock) is a fast stride. Of course you wouldn't run a whole marathon with high knees but by exaggerating the movement in practice drills the body will learn the correct running action.

When you run, you should run like you walk. When you walk, your posture is upright and your arms swing loosely, coming through inside your shoulders without the elbows sticking out laterally. Now, if you clench your fists and tighten your shoulders, or bring your arms up and tighten your shoulders, something has to go back. Either your hands or your shoulders will go back. A few days ago I saw all the Japanese girls running in this fashion, needlessly wasting effort. When you throw your shoulders, you are throwing kilos over there and kilos over there. It's very uneconomical. Your body is moving in a zigzag pattern instead of straight. When we do sprint drills such as high knee, striding and bounding exercises, anyone who throws their arms around will fall over.

The first thing I teach athletes I am

coaching is to run in a relaxed manner. When I take them for long runs, I show them how to run with relaxed posture. Always relax. I can't stress this enough. The athlete's arms should come through straight, just brushing the side of their running shorts. The reason why cross country skiing is better than running for cardiac development is because you are using a lot of energy in the upper body with the sticks. The less you bring the upper body into running, the better. Use your arms as little as possible and you won't use as much energy.

I see runners lifting weights, trying to develop muscles in their upper body. I've asked them why they do it and they tell me that they have to be strong and move their arms faster. It makes no sense. When I train athletes, I try to make their legs go faster, not their arms. Nobody can move their legs as fast as they can move their arms. Your arms always coordinate with your leg action. If you gain muscle mass on the upper body, you are only going to run slower.

For every kilogram you have in fat-free body weight, it requires 0.17 milliliters of oxygen to run one meter. If you are a road runner trying to climb a hill, muscular arms will not help. You'll simply have more kilos to carry on your knees, resulting in you scaling the hill at a slower rate, expending more energy. If you are a steeplechaser and you have to lift extra weight over those fences, you are going to run slower. You are wasting energy with those extra kilos, even if they are muscle. Lasse Viren, whom I worked with in Finland, had very little muscle matter in his upper body at all. When he took his shirt off, he looked like a plucked chicken! There is no muscle there at all, just ribs sticking out. He won four Olympic gold medals.

Hill Training

In some of my writings you'll see photos of people lifting weights. The reason they are included is because I've lived in countries where it is dead flat and there are no hills whatsoever. There are no sand dunes and there is no stadium. When you are living in a flat area and you don't have any possibility to work on hills, then it's wise to use weights.[3] Apart from that, if there are hills, it's much better to leave the weights alone. The reason we use hill training for muscular and speed conditioning is because in New Zealand we all have to work day jobs; no one pays us to train. It's economical. If we start lifting weights, we still have to do our running and we still have to do our stretching. By working on hills, we are able to use our body weight as resistance. which is sufficient natural resistance. Working on hills also has the benefit of helping to increase stride length. Consequently we are able to combine the whole thing at once. There is no more rewarding way than training on hills. I can guarantee very good results from it.

Three areas are important for hill training. First: knee lift. There are very few runners in the world who can maintain their knee lift right throughout a race. Their knees start to tire towards the end. A level of knee lift is necessary to ensure a good stride is maintained. Not only do we have to have capillary development for muscular endurance, we also have to have muscle fiber development. This is known as power. By running up steep hills or stairs, we strengthen and develop both. There is no need to sprint up the hills; we're not trying for a hard anaerobic workout. We only need to climb at the speed sufficient to maintain our forward momentum, putting effort or stress on the legs. In fact, the slower we go up the hills, the more resistance we'll get on the muscles. When you go up a hill, remember to get your knees up! You must assume the correct posture, with your knees up, driving off the back leg.

Secondly, there is hill bounding. I saw a lot of runners here with their knees bent, never straightening their legs. Mifuyu (a runner/writer who escorted Lydiard in Japan) tried hill bounding yesterday and already has sore legs because she's been running with her knees bent. Straightening the leg provides power. If your legs are bent all the time, you get no power. By bounding up a hill, taking long powerful strides, bringing the knees up and driving hard off the back leg on a gentle slope, you'll start to notice you gain a lot more power and develop a better running action. Pekka Vasala, whom I helped in Finland and who won the 1500 meters in Munich Olympics, did lots of hill bounding. He had much success doing 200-meter hill circuits.

It showed very graphically in the final of the 1,500 meters when he came down on the straight. There is a picture of him — you could rest a board from his heel to his head. It was dead straight line. He was getting the maximum drive as he came down the straight. It was this that helped him win the gold medal.

The final thing I'm always pressing on the athletes — probably the most important of all — is the development of flexible, powerful ankles. We don't want our runners to look like weight lifters; we don't want our runners to look like gymnasts. They should look like ballet dancers. Ballet dancers are able to spring and bounce around because of their flexible powerful ankles. If we can make our runners like this, then they'll have speed. Both Murray Halberg and Lasse Viren had the same running action. It came from their ankles, allowing them to accelerate very quickly. To train our ankles we can use our body weight for resistance, elevating it as high as possible with slow, forward momentum. You should aim to land on the ball of each alternate foot. Being on a hill allows us to extend our ankles through the entirety of their movement, up and down. This in turn extends muscles and sinews in the front and back of the legs and strengthens all the muscles around the tendons, eliminating the possibility of tendonitis. I've never had an athlete suffer Achilles tendon or hamstring problems. Training on hills develops a balance of resistance across several muscle groups and therefore reduces the chance of strain.

Prepare yourself to do a lot of hill training. When I run a marathon conditioning session we go out jogging as a supplementary workout and during that secondary jogging we will do a little hill training. We won't do an excessive amount, just enough to activate the muscles in the legs.

Once the conditioning has been achieved, we usually do four weeks of concentrated hill training, with sessions running three days a week at least. We'll do anything from 15 minutes to an hour on

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the hills. We'll go into it gently to minimize risk of injury for those who go into the activity cold.

We determine how long we will stay on a hill by setting a fixed amount of time, not by monitoring the number of ascents athletes make. In this time period, we do what we feel our legs will allow us to. Although each exercise is important, the individual athlete will concentrate on the exercise that is most likely to be of benefit to him. This is usually the area in which he feels weakest.

Following a climb we'll jog around, allowing our legs to recover sufficiently before descending. When descending, stride out fast and in a relaxed fashion. In striding down the hill, because your lead leg is hitting the ground later than it normally would on the flat, it means you've got to pull your trail leg through faster. This helps you to gain leg speed.

In 1965, I taught the East Germans to do a lot of leg-speed running on a gentle downhill slope and they continue to use it as a method to develop their sprinters even today.

"Spring" Drills

During the anaerobic phase, for about four weeks we concentrate on trying to bring in technique running. There are lots of sprint drills people can do but I've found it best to concentrate on four basic things: developing fast leg action in the thighs; trying to overcome muscular viscosity; trying to get the arms coming straight through and trying to get power and drive. These can be done in what I call "spring" drills. These are like hill bounding, only done on flat ground. When built up to gradually, stride-outs help develop leg action and posture.[4] I recommend doing this once or twice a week until the technique is perfected.

On the track, we'll do each of these four exercises twice over a 100 meter distance (or 50m for high knee exercises). We'll then try to combine them. It's important that athletes focus on their posture and knee lift. When they get 50 meters from the straight of the track, I encourage them to increase the pace, before jogging 250 meters at a more relaxed tempo once they hit the bend again. These repetitions are best repeated six or ten times. Once you get athletes running with good technique, always try to get them to do one session a week of around ten reps to ensure they stay in the habit.

If we can improve the technique of our athletes it means that they will be able to hold their early speed much more easily, economically conserving their energy. They will run with more power, more drive and the correct mechanics, allowing them to develop a strong sprint finish. A lot of athletes do a huge amount of long running but are unable to capitalize on their good condition because they simply don't have the technique. I make all my runners compete in sprint races at a club level. Distance runners hate sprinting because they think they'll look like fools but if you want to be fast, you've got to do it!

I've taken between three and six minutes off marathon runners' times by working on their speed.[5] Speed development is important to marathon runners as well as track runners. Every week, 52 weeks a year, runners should be doing conditioning, working on technique, and generally working on their speed.

How to set-up a training schedule

1. Count back in weeks from the first important race date.
2. Allow a week to ten days for 'Freshen-up' (depending on the event).
3. Allow six weeks (including freshen-up), or four to five weeks for Coordination raining.
4. Allow four weeks for Anaerobic Development.
5. Allow four to six weeks for Hill Resistance Training. Use the remaining time — hopefully 10-12 weeks - for Marathon conditioning.
6. Marathon Conditioning Period:
   1. Conditioning should start solely with aerobic running.
   2. Then include a day of easy fartlek and strong five- and ten thousand meter runs.
7. Hill Resistance Period (4 to 6 weeks):
   - Hill training two or three days a week.
   - One day: a long aerobic run.
   - Other days: easy aerobic running or leg-speed exercises.
8. Track Training Period (10 weeks):
   a. First 4 weeks: Anaerobic Development Training:
      - Anaerobic training (repetitions, fartlek etc.) two or three days weekly
      - One day a week: a long aerobic run.
      - Other days: sprint training or easy running.
   b. Last 4.5 – 5 weeks: Coordination Training: Sharpeners, development races (under- and over-distance), fast relaxed runs.
   c. Freshen-up: 1 week to 10 days.
9. Racing season begins. **AT&F**

[1]Many young athletes or high school runners tend to continue hard training even during the racing period, not taking into consideration that racing is a hard form of anaerobic exercise. To continue to train hard while racing hard can be fatal.

[2]Lydiard would often say, "you should not eat a cake half cooked." Everything is important —aerobic development, anaerobic development, conditioning, speed. You cannot test your true racing form until you develop all these. These repetitions are a workout to develop anaerobic capacity. They will make you run faster, building up lactate tolerance, but the nature of these workouts, accumulating lactic acid, will invariably tense up your running action. To teach your body a correct running action, speed routines should be performed in a relaxed state.

[3]Hill training is a form of resistance exercise and can be substituted with weights or plyometric exercises in the gym, such as jumping over boxes.

[4]This involves not just running faster. There is a specific exercise to teach you to bring your knees high, carry your foot high and bring your forward foot out front. Lydiard termed it "Stride-out" or "Striding". As it involves a lot of body coordination, Lydiard recommends practicing the movement while walking through it, then skipping through it before you actually run through it. This is not a resistance work and should not be performed with any resistance (i.e. headwind). You need to be able to run fast and in a relaxed state. Running into the wind invariably tightens you up and negates the very purpose of technique work. Along with downhill striding, running with the wind also helps to develop leg-speed.

[5]Lydiard took over the training of Terry Manners of New Zealand for the 1974 Commonwealth Games marathon. Manners was known as a mega_mileage runner but Lydiard cut back his training volume and worked on his speed with drills and shorter races. He cut his marathon PR by 3 minutes from 2:15 to 2:12, with Manners going on to win the bronze medallion at the Games. It should be noted here that Lydiard is not talking about speed developed by anaerobic repetitions. "Pure sprinting speed" can be developed by technique drills and/or hill exercises advocated by Lydiard in various forms.