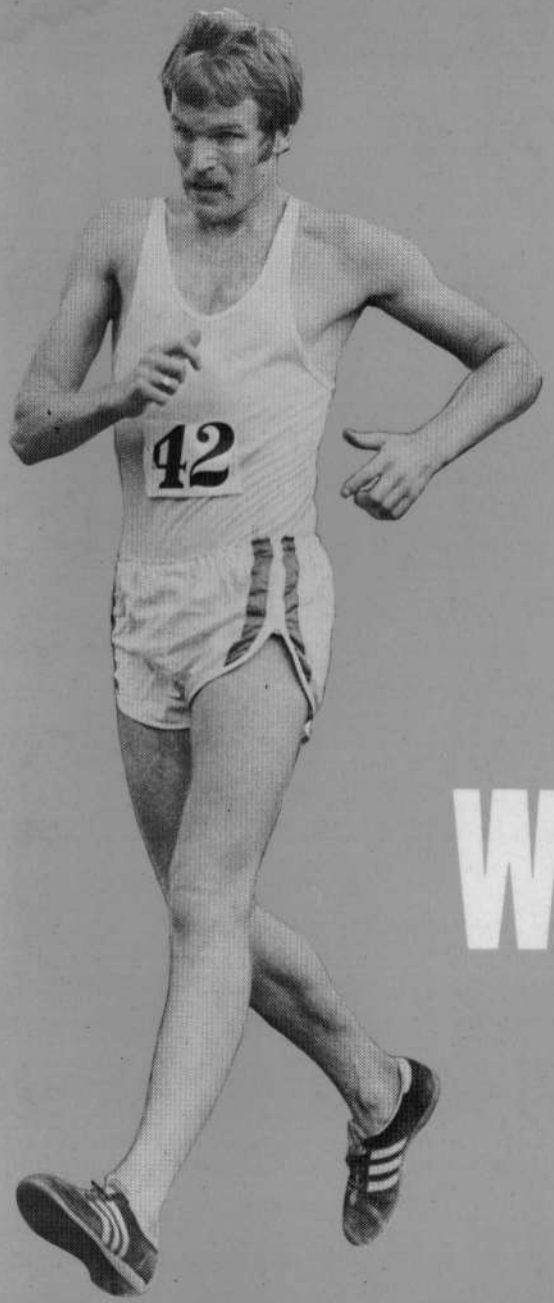
British Amateur Athletic Board



RACE WALKING

by

Julian Hopkins

£1·25

OFFICIAL PUBLICATIONS

of the

British Amateur Athletic Board
and Amateur Athletic Association

INSTRUCTIONAL BOOKS. Written by National and Staff Coaches and other leading authorities. These books, published for over two decades, have won world-wide acclaim from coaches, athletes and enthusiasts.

DECATHLON *by* Tom McNab *(National Coach)*
DISCUS THROWING *by* Wilf Paish *(National Coach)*
HAMMER THROWING *by* Howard Payne *(British Commonwealth Champion and University Lecturer in P.E.)*
HIGH JUMP *by* Frank Dick *(National Coach)*
HOW TO JUDGE FIELD EVENTS *by* Cyril Sinfield
HOW TO JUDGE TRACK EVENTS *by* Dan Davies
HOW TO ORGANISE AN ATHLETICS MEETING
HOW TO TEACH THE THROWS *by* National Coaches Paish/Johnson
HURDLING *by* John le Masurier *(Principal National Coach)*
JAVELIN *by* Wilf Paish *(National Coach)*
LONG JUMP *by* David Kay *(National Coach)*
MIDDLE AND LONG DISTANCE, MARATHON AND STEEPLECHASE *by* Denis Watts (*Pr. Nat. Coach)* and Harry Wilson *(Nat. Event Coach)*
MOBILITY EXERCISES *by* Peter Harper *(ex National Coach)*
POLE VAULT *by* Dr. Alan Neuff *(Senior B.A.A.B. Coach)*
RACE WALKING *by* Julian Hopkins *(National Event Coach)*
SHOT PUTTING *by* Carl Johnson *(National Coach)*
SPRINTING AND RELAY RACING *by* Bill Marlow *(National Coach)*
STARTING AND TIMEKEEPING *by* John Aspland and Harry Hathway
STRENGTH TRAINING *by* Ron Pickering *(ex National Coach)*
TRIPLE JUMP *by* Tom McNab *(National Coach)*

A.A.A. HANDBOOK *(incl. Rules for Competition)*. Published each spring
B.A.A.B. HANDBOOK. Published each spring
BRITISH ATHLETICS. Back numbers available 1961, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1972, 1973

I.A.A.F. AND APPROVED PUBLICATIONS

I.A.A.F. HANDBOOK *(English or French)*
I.A.A.F. SCORING TABLES, Men
I.A.A.F. SCORING TABLES, Women
PROGRESSIVE WORLD RECORD LISTS (1913–74)
GUIDANCE FOR WALKING JUDGES
I.A.A.F. BULLETIN *(4 times each year)*
METRIC CONVERSION TABLE *(International Edition)*
METRIC CONVERSION TABLE *(Standard Edition)*
TRAINING DIARY

For up to date price list please send S.A.E. to:—

B.A.A.B./A.A.A. Publication Sales Centre
5 Church Road, Great Bookham, Leatherhead, Surrey, England

RACE WALKING

By

JULIAN HOPKINS
(National Event Coach)

INSTRUCTIONAL BOOK

CONTENTS

Previous Edition 1957 (Harold Whitlock)
This Edition 1976 (Julian Hopkins)

This book has been photoset in Times Roman and printed in England by King & Jarrett Ltd., London 3/76.3M.

Jim Erickson

About the Author . . .

Julian Hopkins is a Senior B.A.A.B. Coach in race walking who started coaching in 1969. In 1970 he helped to form the British Race Walkers' Club. He was appointed National Event Coach in 1974 and now coaches walkers of all abilities up to international level. He has acted as coach to the G.B. team on several occasions including the Lugano Trophy Final in 1975. As a physics teacher he is greatly interested in the scientific approach to athletic training and strongly convinced of its validity.

He has competed regularly in walking events since 1960, winning several county championships and national team medals, and has represented the B.R.W.C. abroad.

Acknowledgements

The Author would like to thank internationals Ron Wallwork and Tony Taylor for all they have taught him over the years. He would also like to acknowledge a debt to Dr. Peter Travers of St. Luke's College, Exeter, for providing detailed information on mobility exercises.

Photographs

The cover photograph of Roger Mills (Great Britain), bronze medallist in the European 20 km. Championship, 1974, is by Mike Street, and the outside back cover by Horst Müller. The sequence of Golubnichiy is by Tissot van Patot, and the one of Frenkel was supplied by Denis Dugast. Other plates: Kannenberg—Tony Duffy; Nihill—Ed Lacey; Selzer—Mike Street. The plate of Simu was supplied by Palle Lassen.

Bibliography

Astrand, Per-Olof and Kaare Rodahl, "Textbook of Work Physiology". McGraw Hill Book Co., U.S.A. (1970), Chapter 14.

Farley, Bob, "A method of calculating stride length from leg length in race walkers". "Athletics Weekly", Vol. 22 No. 47 (1968).

Fruktov, Anatoliy, "Race walk technique" in "The Complete Runner". World Publications, U.S.A. (1974).

Harper, Peter R., "Mobility Exercises". B.A.A.B. (1971).

Hopkins, Julian, "W. Germany v. G.B. Walks match, technical report". "Athletics Coach", Vol. 8 No. 3 (1974).

Jesse, John, "Strength, Power and Muscular Endurance for Runners and Hurdlers". The Athletic Press, U.S.A. (1971).

Laird, Ron, "Competitive Race Walking". Tafnews Press, U.S.A. (1972).

McNab, Tom, "Athletics—Track Events". Brockhampton Press (1972), pp 75–79.

Pickering, Ronald J., "Strength training for athletics". B.A.A.B. (1975).

Rudow, Martin, "Race Walking". World Publications, U.S.A. (1975).

Schmolinsky, Gerhardt (Ed.), "Leichtathletik". Sportsverlag, Berlin (1963) pp 148–159.

Whitlock, Harold H., "Race Walking". A.A.A. (1957).

Magazine: "Race Walking Record" (monthly). Published by the Race Walking Association.

1. Introduction

Now that race walking has become more widely accepted at all levels of athletic competition, the time has come for a more thorough appraisal of the event. The wide range of topics considered in this booklet illustrates what a challenge this event represents to walkers and their coaches. Some people contend that race walking is an artificial form of competition because it is natural to cover a distance on foot by running if speed is the prime requisite. This point of view overlooks several facts. Firstly, all organised competition is "artificial" to some degree. In many athletic events, for example, performances are restricted by the rules themselves. Secondly, walking is certainly a natural form of movement! It is usually taken for granted but sometimes, when children are playing, "spontaneous" walking races take place as a result of a challenge. It is not surprising, therefore, that race walking emerged as an athletic event, growing, as it did, out of the man to man challenges of the professional era. As amateur athletics grew so race walking developed in this country at the end of the nineteenth century. The inclusion of race walking in the London Olympics of 1908 marked the start of international competition which was, however, to remain rather limited until recent years. A major stumbling block to the development of race walking, particularly at international level, was the lack of agreement as to what constituted walking and what did not. Gradually the International Amateur Athletic Federation (I.A.A.F.) evolved a definition of race walking which is now employed for judging purposes in all international competitions. The rule was amended as recently as October, 1972, and now reads as follows:—

> *"Walking is progression by steps so taken that unbroken contact with the ground is maintained. At each step, the advancing foot of the walker must make contact with the ground before the rear foot leaves the ground. During the period of each step when a foot is on the ground, the leg must be straightened (i.e. not bent at the knee) at least for one moment, and in particular, the supporting leg must be straight in the vertical upright position."*

The I.A.A.F. rule also lays down how the judging of walking races should be carried out. Before the race, the judges elect a Chief Judge from amongst their ranks. During the race the judges act in an individual capacity, but when in the opinion of (a) two of the judges, one being the Chief Judge, OR (b) three judges other than the Chief Judge, a competitor's mode of progression fails to comply with the definition, he is disqualified from the race. The competitor is informed of his disqualification by the Chief Judge. A walker can also be cautioned during a race if he is in danger of failing to comply with the definition. The decision to issue a caution to a walker is made using the same procedure as for a disqualification. A walker is, however, not entitled to a second caution during a race.

Until recently, the rules of competition for events in this country (held under the jurisdiction of the Amateur Athletic Association or the Race Walking Association) were somewhat different. The definition of walking consisted of only the first sentence of the I.A.A.F. rule, i.e. a walker in this country was only required to maintain continuous contact with the ground. However, in 1974 the I.A.A.F. rule was adopted in full but the method of judging remained the same, i.e. in G.B. any walking judge has the power to disqualify a competitor who in his opinion is failing to comply with the definition of walking. The judges operate independently of each other and there is no provision for issuing cautions to competitors.

Since 1956, major international competitions have included road walks at 20 km. (12 miles, 742 yards) and 50 km. (31 miles, 102 yards), although many other distances are regularly contested on both road and track in this country and abroad. In international events of 50 km. (or 30 miles) and over, refreshments are provided by the race organisers at 10 km.

(or 6 miles), and thereafter at every 5 km. (or 3 miles). The walkers are allowed to nominate their own refreshments but they must be consumed at one of the refreshment stations. If such a race takes place on the track, refreshments can be taken (from an official station) after one hour has elapsed. Again, the A.A.A. and R.W.A. rules differ from those adopted internationally in that no limitations are placed on refreshment points except that "Attendance is permitted in events over 10 miles but not before 7 miles has been covered".

In recent years, competitive standards in race walking have risen very sharply. In particular, walkers from East Germany and Russia have set remarkable new levels of performance which can be attained by few "Western" athletes. As a result, a gap is starting to open up between these two nations and the remainder. This is particularly noticeable in the Lugano Trophy Competition—a team competition organized by the I.A.A.F.—which has been dominated recently by these two countries. Although this country continues to produce one or two top class performers, it is clear that few of our walkers are reaching "world class" at the present time. We urgently need to raise our standards at all levels and attract more athletic talent into the event. This booklet is an attempt at least to raise the level of instruction in race walking by placing the technique of the event and the various training methods on a more scientific basis. If, as a consequence of reading this booklet, walkers and their coaches rethink their approach to training and racing in an attempt to reach higher standards, then this booklet will have served its purpose.

2. The Technique of Race Walking

Introduction. The technique of race walking is clearly governed by the I.A.A.F. walking rule, (see page 5) in that:—

(a) the heel of the walker's leading foot must touch the ground before the foot of the trailing leg leaves the ground;

(b) the leg supporting the walker's weight must be straight at the knee when it reaches the vertical upright position.

Mastery of technique is essential so that the walker:—

(i) is not disqualified for infringing the rule;

(ii) does not waste energy by making unnecessary movements.

If a sound technique is not developed in the early stages of a walker's career, faults will certainly delay his progress when he starts to walk at high speeds.

At this stage, a fine distinction may be drawn between TECHNIQUE and STYLE. Technique may be defined as the movements required by body mechanics for the execution of walking within the confines of the rule. The "style" of a walker is the sum total of all the individualistic movements and body attitudes which distinguish his walking action from that of anyone else. In other words, in order to proceed efficiently and not be disqualified, all walkers will adopt virtually the same technique. A walker will in the course of time, develop his own "style" which will depend on the relative length of his body levers, his joint mobility and so on.

Leg Action. Although race walking is a highly developed technique, it is only an extension of "ordinary" walking. If a person is asked to walk with an ordinary "man-in-the-street" action and then to speed up, he will automatically adopt the race walking technique to maintain ground contact. As he speeds up, his arms bend to 90° at the elbow and his hip comes through with the swinging leg.

Clearly, a walker's speed depends on two factors: (a) the length of each stride, (b) the frequency of striding. In fact,

Speed of walker = Length of stride × Frequency of striding.

In order to reach the top, a walker will probably have to make in excess of three strides per second each up to 4 feet (1.2 metres) in length. The modifications a walker makes to the length and frequency of his stride will depend on leg length, joint mobility, innate speed of muscular action and so on. Evidently, no two walkers will walk at the same speed using exactly the same stride length and stride frequency. These factors are quite individualistic.

From photographic studies of race walking, a number of facts emerge:—

(1) Only one leg swings (or recovers) at a time.

(2) Whilst one leg is swinging through from the rear, the other leg functions firstly in a supporting capacity. When the body weight (Centre of Gravity) is ahead of the supporting leg, this leg then changes its function to that of driving the body forward.

(3) There is a brief period of "double support" in which both feet are in contact with the ground.

(4) The "supporting driving" phase of the leg action takes longer on each stride than the "swinging phase".

When the speed of walking is increased:—

(1) The strides are longer and the rate of striding slightly increased.

(2) The period of "double support" becomes shorter.

(3) The "swinging" phase becomes relatively longer, but is still shorter than the "driving supporting" phase.

Action of the forward leg. When the heel of the advancing foot touches the ground, the leg should be on the point of straightening or be slightly flexed. If the latter is the case, the leg should straighten soon after contact. By the time that the leading foot has unrolled on to the ground, the leg should be quite straight. In the 50 km. event, leg straightening usually occurs a little later than in shorter, faster races. At high speeds, as the rotation of the leading thigh about the hip comes to a halt, the rotational tendency (angular momentum) of this limb is transferred to the lower leg. As a result the leg all but straightens on contact due to the speed with which the thigh swings through. Because of the considerable forward momentum, the body rotates rapidly about the straight leg. When the leading foot makes contact, the leading leg decelerates the body as it is in front of the walker's Centre of Gravity. Any tendency for the leg to strike the ground straight and tense should therefore be avoided. To ensure this the muscles of the thigh (quadriceps) should be as relaxed as possible as the leg swings through, but once contact has been made these muscles should be rapidly tensed to straighten the leg.

Action of the rear leg. When the body's Centre of Gravity moves ahead of the supporting leg, that leg begins to accelerate the body forward. To achieve high speeds, it is essential that the rear leg remains straightened for as long as possible. In this way, a greater forward velocity is obtained due to prolonging the thrust from the rear leg. Amongst top walkers two factors are evident here;

(a) the drive from the rear leg is pronounced and never hurried through;

(b) the rear leg bows out at the back (hyperextends) as it thrusts against the ground.

Foot Action. The leg action can only be completely successful if the feet are used correctly with as full a range of movement as possible. The foot of the rear leg should not leave the ground until the foot has rolled right up onto the toes. At high speeds the foot will be

nearly vertical before leaving the ground. In this way, the body is levered a little further forward giving the leading foot a little more time to swing forward before making contact. If the rear foot only rolls up as far as the ball of the foot before it leaves the ground, then it would appear (from photographic evidence) that nearly 3 inches (7.5 cm.) is lost from the stride length. The leading foot must strike the ground at the heel and then smoothly unroll onto the ground as the leading leg advances. The smooth rolling action of the feet requires good foot and ankle mobility. Some walkers take the foot through in a splay footed manner. This would appear to keep the swinging foot nearer to the ground throughout its movement, but several tendencies have to be avoided. Firstly, the leg must not make a detour on swinging through and secondly, the feet must point directly in the line of motion on driving and landing. In general, the feet should be brought forward close to the ground so that ground contact is soon re-established.

Trunk Position. When the rear leg drives back against the ground, the body is not only accelerated forward but has a tendency to fall forward (rotation about the foot in contact with the ground). This is prevented by the swinging leg coming through to establish ground contact. Any unnecessary inclination of the trunk, in either direction, will upset the balance of the body and the co-ordination of the walking action. A forward lean will produce too much forward rotation whilst a backward lean will make the trunk harder to accelerate forwards. However, photographs clearly show that when the body is accelerating most rapidly, a natural adjustment is made to the angle of the trunk. The forward lean is barely perceptible to the onlooker and probably never exceeds about 5° to the vertical. The trunk begins to return to the vertical when the front leg makes contact, decelerating the body. The trunk should be vertical by the time the feet pass each other.

As the head accounts for about 10% of the upper body weight, and as it is so far from the body's Centre of Gravity, its movements can appreciably affect the balance of the whole body. It is desirable that the head maintains its natural alignment with the eyes looking well in front of the body.

Walking on gradients. In general, the trunk should be as erect as possible during each stride. However, during road races, changes in gradient will force the walker to adjust his body lean. When walking uphill, the lifting effect of the leg drive which the walker usually tries so hard to eliminate, must be used to lift the body up the gradient. As a result, the body will have a greater tendency to rotate and forward lean will be increased. The forward lean should not be exaggerated as this can cause difficulties in bringing through the rear leg. Walking downhill presents a more difficult problem for there is an increased risk of disqualification. Due to the gradient, the walker's Centre of Gravity is too far forward producing too much forward rotation. As a result, he adopts a slight backward lean. In race walking, the upper body must be as relaxed as possible and this is especially true in the case of downhill walking. Jarring of the back and legs and possible loss of contact may result otherwise.

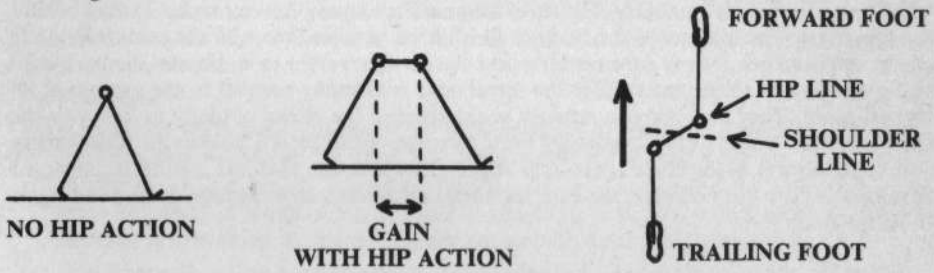
Hip Action. If an untrained person gradually increases his walking speed, then it is noticeable that as the leg swings to the front, the hip on that side also moves forward. This is essential, for if the hips were incapable of these co-ordinated movements, walking would be restricted to quite low speeds.

Closer analysis shows that the hips undergo motions in two planes simultaneously—vertical and horizontal. As the rear foot breaks contact and starts to swing through, the hip on that side comes through as well, but starts to sink downwards. The hip reaches its lowest point as the swinging foot passes the supporting leg. From here, as the leg continues to full stride, the hip moves forward and also rises again to its original level at the completion of the stride. The hip of the supporting leg rotates in the opposite sense, i.e. when this leg enters the supporting phase, the hip is at its lowest position, but as it becomes more nearly vertical, the hip rises until it is at its normal height as the swinging leg passes.

This sounds complicated, but it must be remembered that the hip movements are a *natural* adjustment for fast walking. On no account must they be emphasised or exaggerated. In particular, all the hip movement should be in the horizontal (especially) and vertical planes. There must be no swaying in the lateral plane as this would in no way aid the walker and would probably upset his balance.

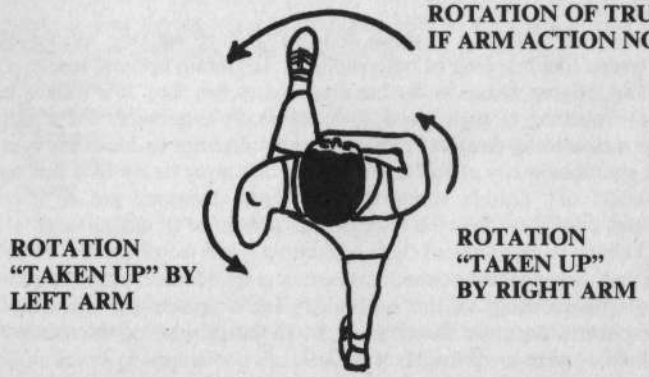
What is to be gained by these hip movements?

(a) There is a considerable increase in stride length. If the stride length is limited by leg length and the greatest angle between the legs at full stride (about 50°), then it can be seen that the maximum stride length is restricted to about 3 feet (for a walker of average height). If one hip advances with respect to the other, the top of the "triangle" is flattened, in effect, and up to about 8 inches (20 cm.) can be added to the stride length.



(b) The rise and fall of the body on each stride is virtually eliminated. Such a rise and fall, caused by the legs opening and closing, is dangerous for contact. Also, since it raises the Centre of Gravity of the body considerably on each stride, it is wasteful of energy as the body would be doing work against gravity.

Arm Action. The need for arm action arises from the fact that the line of action of the drive from the rear leg does not act through the Centre of Gravity of the body. Instead, the line of action acts up through the hip. If, for example, the right leg drives the body forward then the trunk will tend to twist in an anti-clockwise direction viewed from above. The trunk's weight is too great to twist rapidly enough to keep up with the rate of striding so the rotation is "taken up" by the arms.



In this particular case, the right arm swings forward and then across the body while the left arm swings backwards behind the body. So the arms work together to absorb the rotation. Experiments show that walking at a particular speed requires more energy if the arms are not used than if they are. A walker can easily convince himself of this by attempting to walk quickly with his arms held down by his side or folded behind his back. When the leading foot makes contact, the arm action reverses with both arms reaching the lowest point on their swing as the feet pass each other. At lower speeds, leg drive is reduced so the arm action will be less vigorous.

The arms are able to absorb this "eccentric" leg drive more easily than the trunk due to their smaller weight. In the extended position, most of the arm's weight is too far from the shoulder joint for fast rotation, but if the arms are bent to 90° at the elbow, they can be swung rapidly. Arm actions show considerable variation due to differences in arm length and weight, and in shoulder mobility. The usual range is from a point several inches (5 cm.) behind the hip, across the midline of the body to finish level with and close to the pectoral muscle on the opposite side. Many continental world class walkers seem to emphasise the backward swing of the arm to the extent that the upper arm is virtually parallel to the ground at its highest point. They pull the arm straight back, keeping the elbow virtually in line with the shoulder joint. Some walkers (notably West German world record holders B. Kannenberg and G. Weidner) swing their arms only slightly towards the mid-line during the forward movement. They do, however, increase the range of movement by swinging the hand up to shoulder level.

Shoulder movements. These should be kept to a minimum although they cannot be eliminated. When the arm swings forward, the reaction to the force at the shoulder causes the opposite shoulder to rotate backwards slightly, absorbing the forward twist. Similarly, the backward arm swing causes the opposite shoulder to rotate forwards. Provided the shoulders are relaxed, these movements can be easily accommodated. Certain vertical movements can also be seen in the shoulders. As the feet pass each other, the shoulder on the side of the supporting leg drops a little whilst the other shoulder rises. These natural movements will be quite smooth provided the shoulders are relaxed. If they are tense and rigid, both shoulders may rise simultaneously. Tense back muscles may transmit these vertical movements to the hips, upsetting their smooth rhythm and perhaps leading to loss of contact.

Conclusions. The preceding analysis shows that race walking should be regarded as a "technique" event, like hurdling or pole vaulting. To obtain optimal results a good technique is essential. The judging situation further emphasises this fact. If a walker has a good technique and he is walking at high speed, it is physically impossible for a judge to be certain whether he is maintaining contact. The judge must attempt to focus his eyes on both of the walker's feet simultaneously at full stride (when they may be up to 4 feet apart) during the very brief period of "double support". A judge's decisions are of necessity based on impressions and can in no way be regarded as absolute. A walker with a poor technique is far more likely to be disqualified than one with a good technique for a number of reasons. If he fails to maintain contact at moderate speeds, the "break" might be visible to a judge, whilst lack of straightening of the supporting leg is a case for disqualification. Various factors like an appearance of "floating" high off the ground or the trunk bobbing up and down might lead a judge to disqualify a walker.

Postscript on arm action. The question is often asked:—Can the arm action influence the leg action? Two possibilities arise:—

(1) When one arm swings forwards and the other backwards, both are simultaneously accelerating upwards. This requires an upward force. The equal and opposite reaction to this force presses the body downwards. This, in turn, increases the upward pressure from the ground through the supporting leg. It is this ground pressure which propels the body forwards and tends to lift the trunk. Care has to be exercised to ensure that the latter effect does not result in loss of contact. When the forward foot has made contact, the arms reverse their motion and their downward acceleration will have the effect of slightly reducing the load on the supporting leg.

(2) When the right arm swings forwards and the left arm backwards, the reaction on the trunk to the forces involved moves the left hip forwards and the right hip backwards in synchronisation with the leg action. When the arms reverse their movement, the reaction on the hips will reverse. So the arm action can help to maintain the walker's stride length.

To summarise:—

(a) Arm action takes place automatically in walking at all speeds to absorb the eccentric leg drive, thus stabilising the trunk and reducing the energy requirements.

(b) A walker can consciously emphasise his arm action in an attempt to improve his leg drive and range of hip movement. There is something to be said for a straight forwards/backwards arm swing as this will reduce unnecessary lateral hip movements.

(c) Whatever arm action is employed, it should always be smoothly co-ordinated and not lead to any undue tension in the trunk.

3. Some General Considerations

Before the training methods for race walking can be formulated, the exact nature of the event must be investigated so that the training undertaken will be logical and efficient. In any athletic event, the following components are required in varying degrees:—

1. Technique
2. Endurance
3. Strength
4. Mobility
5. Speed

Technique. This has already been discussed at some length in the previous chapter. It is the "foundation stone" of the event.

Any athletic skill is learnt by constant, careful repetition of the correct movement patterns. The most recently learned movements will fatigue first, so that the new movement pattern must be carried out slowly at first. This allows corrections to be made if faulty movements occur and the walker learns to appreciate the correct "feel" of the required action.

Endurance. After technique, this is the walker's most important prerequisite. Even the shortest walking races fall into the category of endurance events. For training purposes it is convenient to divide endurance into two types:—

(a) **General endurance.** This is the capacity of the body to keep working for a prolonged period at any easy to moderate effort. It implies a conditioning of the circulo-respiratory system and metabolic processes of the body to delay the onset of fatigue. Without this basic conditioning, the walker will suffer many breakdowns in training and racing.

(b) **Specific endurance.** This is the capacity of the body to keep working at the high level of intensity demanded by the event. A 20 km. and a 50 km. walker both need general endurance but the specific endurance for the shorter event requires the ability to maintain a speed (at top level) of about 4:30 per kilometre, for the longer event about 5:00 per kilometre. Consequently, the walker has to train accordingly and specialise in his event for top results.

For performance in continuous endurance events, an athlete uses stored energy from the food he has eaten. To convert carbohydrates and fats into energy, an athlete needs a continuous supply of oxygen which he extracts from the air he inhales. This is called *"aerobic"* (with oxygen) exercise. So to improve his performance capability, a walker must improve his maximum oxygen uptake (*aerobic power*). During a race a walker can only use a fraction of his full aerobic power, but with endurance training this fraction will improve. To absorb oxygen readily and use it efficiently, the circulo-respiratory system becomes more powerful and the muscles become more effective in converting foodstuffs into energy. Two of the outward signs of this adaptation, which can be observed, are:—

(a) a lower pulse rate when the athlete is resting;

(b) a faster recovery after exercise as indicated by a more rapid fall in pulse rate.

Strength. The strength of a muscle is a measure of the ability of that muscle to exert a force against a resistance. As forces are responsible for initiating or changing all movements in sport, strength is an important factor.

A walker does not, however, require the great explosive strength of a jumper or thrower. He requires what is called dynamic strength, i.e. the ability to perform a number of repetitions of an action powerfully. Indeed, the walker will be seeking to improve both the strength and endurance of the muscle groups he uses in his event. Great strength as such is of little value to him.

The following muscle groups require strength training for race walking:—

(a) Muscles at the front of the thigh (quadricep group). These are used to straighten the leg.

(b) Muscles at the rear of the thigh (hamstrings). These produce some of the rear leg drive.

(c) Muscles of the calf. The final part of the rear leg drive comes from this group.

(d) Flexor muscles of the hip. This group helps to pull the swinging leg through.

(e) Stomach muscles, especially the oblique group. These help to maintain correct posture whilst the oblique group help to pull the hip of the swinging leg forward.

(f) Muscles of the lower back. These also help to maintain correct posture.

(g) Muscles over the front of the chest (pectorals). These pull the arm across the body.

(h) Muscles on top of the shoulder joint (deltoids). These pull the arm backwards and forwards.

The principles of strength training (*Progressive Resistance Exercise*) are well established:—

(a) A muscle must work against a large resistance (at least two-thirds of the maximum resistance which can be moved).

(b) The resistance must be progressively increased if the muscle is to continue gaining strength.

(c) A small number of repetitions (say 5–10) of an exercise with near maximum resistance will place the emphasis on strength development.

(d) A large number of repetitions (say 15 or more) of an exercise with moderate resistance will place the emphasis on the development of muscular endurance.

Mobility. This refers to the range of movement which a person has in the joints of his body. Improved joint mobility is advantageous for a number of reasons:—

(a) Technique is more easily acquired and correctly executed.

(b) The chance of injury to muscles or ligaments round a joint is reduced.

(c) The muscles operating a joint are strengthened by mobility exercises.

The latter occurs because, in mobility exercises, the joint is *slowly* moved to its extreme position. An attempt is then made to produce further movement by means of a powerful but *controlled* muscular effort. This is the key to improved mobility. "Stretching exercises" which use fast, unco-ordinated limb movements are not very effective and can cause injury to muscles or ligaments.

In race walking, the following require excellent mobility:—

(a) The ankle joints (for full drive from the feet).

(b) The hip joints (for full range of hip movement).

(c) The spine (for correct posture and hip movement).

(d) The shoulder joints (for full range of arm movement).

In addition, the muscles of the lower back require stretching (to aid back relaxation, so important in fast walking), and so do the hamstrings which must stretch easily so that the leading leg straightens fully on contact.

Speed. In this context, the walker's basic speed is being considered, i.e. his maximum rate of performance. As for distance runners, a walker's basic speed must be measured over a short distance (200–300 m.) as he cannot maintain his absolute "flat out" speed for very long. Clearly, basic speed places an upper limit on performance potential but this only becomes important when all the other physical qualities mentioned above have been developed to a high degree. Basic speed may be improved to a small extent with a better technique whilst increased strength, producing greater limb acceleration, should also have an effect.

4. Training Methods

1. Technique Training

The race walking action is only an extension of "ordinary" walking and should be taught as such. The pupil should learn to walk correctly at "ordinary" speeds before progressing to moderate race walking speeds. At each stage, the object is to maintain and improve the walking ability which the pupil already possesses. The following points should be checked at each stage in a walker's development:—

(a) Smooth, easy strides with continuous contact.

(b) Straightening of the supporting leg giving a strong forward drive with the foot "rolling" right up to the toes before lifting off.

(c) Leading foot making ground contact at the heel and pointing directly in the line of motion.

(d) No lateral swinging of the trunk or hips.

(e) Natural posture of the trunk with no backward or forward swaying.

(f) Smooth, natural arm action with the arms angled to about 90° at the elbow.

The various stages of technique training might go like this:—

Stage One. The pupil should be asked to walk as he would if walking quickly along the street. His arms should only be slightly bent at the elbow and his strides smooth and rhythmic. Special attention should be paid to the trunk which should be erect and as relaxed as possible. At this stage, the following will help the walker:—

(a) Plenty of hiking in the country or long walks at "ordinary" speeds.

(b) In a standing position with feet together, shifting the body weight from one leg to the other so that the process of leg straightening can be felt. With forward movement, this can be gradually developed into walking.

(c) Mobility exercises, especially for the hip joints (see page 33).

Stage Two. Once the ability to walk correctly at low speeds has been established, the walker can now attempt to increase his speed. This should result in:—

(a) A more powerful drive from the rear leg.

(b) An increase in stride length.

(c) A forward movement of the hip when the leg swings through.

(d) "Angling" of the arms to about 90° at the elbow.

An increase in speed should lead to longer (but still smooth) strides. If not, the walker must reduce speed and start again. This also applies if he loses contact or fails to straighten the supporting leg.

Stage Three. The walker should now practise walking at various speeds to consolidate his technique. If faults occur, they must be corrected as soon as possible. This usually requires reduction in speed and concentration on one fault at a time.

Stage Four. When the walker has mastered the basic technique, he can concentrate on a number of finer points:—

(a) His feet should be placed down in as straight a line as possible. For this, he can practise walking on a marked straight line.

(b) He should drive from his feet by "rolling" right up onto his toes so that the feet become almost vertical at high speeds.

(c) He must ensure that the drive from the feet is directly forward. There is a danger of the foot pointing outwards when the drive occurs.

(d) He should use a hip action which incorporates a vertical as well as horizontal movement. The hip of the swinging leg reaches its lowest point as the feet pass and then rises as the foot moves forward to make contact.

(e) He should pay attention to complete relaxation of the trunk and arms. He can practise tensing up various muscle groups while resting and walking so that he can recognise tension. Only then can he realise what relaxation "feels" like. The walker should try to produce a feeling of the trunk resting "motionless" on the hips. However, it is important to remember that relaxation does not imply a slackening of effort, but rather the ability to hold a hard effort with every movement under perfect control. The walker must think of walking "more easily" when he wants to go faster.

Whichever way walking is introduced to the pupil, the emphasis in the early stages is on the acquisition of a sound technique. Speed is of secondary importance and will develop later. Athletes learn the technique of an event by getting the "feel" of the correct movements rather than through a mechanical understanding of what they are doing. Coaching should be along these lines with technical explanations kept to a minimum.

The majority of people coming into race walking will require a parallel course of strengthening (especially the stomach and lower back muscles) and suppling (especially the hips) if they are to achieve a correct walking technique.

The cause and correction of some common faults. The cause of a particular fault in a walker's action may vary from case to case. Consequently, the corrections listed below are only given as a guide:—

Fault
Forward lean of the head. This can upset the walker's balance and his breathing.

Cause
Lack of control; natural reaction to fatigue.

Correction
Awareness of fault; then exercising self-control.

Fault
Backward lean of head and trunk, resulting in jarring of back and a pronounced shortening of stride length. Could lead to a "bouncy" action and loss of contact.

Cause
Fatigue due to poorly developed back and stomach muscles.

Correction
Exercises to strengthen these muscles (see strength training) and to improve posture (see mobility training). Conscious effort to lean "forwards" might help.

Fault
Forward lean of the trunk leading to tension, a reduction in stride length and trouble straightening the leading leg.
Cause
Fatigue due to poorly developed back and stomach muscles.
Correction
As above. Also conscious effort to lean "backwards" might help.

Fault
Trunk rises and falls on each stride, possibly leading to a reduction in stride length, a "bouncy" action with loss of contact.
Causes
(a) Foot of supporting leg lifted off ground when foot has only "rolled up" to ball of foot.
(b) Hips are not responding correctly to leg action.
Correction
(a) Reduction in speed and concentration on full range of movement of driving foot. Increase ankle mobility (see mobility training).
(b) Improvement of hip mobility (see mobility training).

Fault
Shoulders rise and fall as one resulting in tension, a "bouncy" action and possible loss of contact.
Cause
When obviously not due to over-vigorous arm action, cause is tension in shoulders and upper back.
Correction
Awareness of tension in trunk; then exercising self control. Mobility exercises for shoulder joints (see mobility training).

Fault
Unco-ordinated or excessive arm action resulting in lack of balance, tension in trunk and waste of energy.
Cause
Lack of awareness of correct action. Pressing too hard for speed when technique not adequately developed.
Correction
Walking on the spot in front of mirror. Walking at lower speeds concentrating on control of arm action.

Fault
Not straightening the supporting leg (reason for disqualification under I.A.A.F. Rule) resulting in incorrect leg drive, a "bouncy" action and possible loss of contact.
Causes
(a) Speed too great for walker's technique.
(b) Insufficient strength in quadricep muscles (used to straighten leg).
(c) Hamstrings unable to stretch sufficiently.
Correction
(a) Reduction in speed, with emphasis on pushing back supporting leg from when it first makes contact to when it completes its drive.
(b) Strengthening of the quadricep muscles (see strength training).
(c) Stretching of hamstrings (see mobility training).

Fault
Stride length is too short.
Causes
Insufficient hip movement. Various other faults also lead to stride length reduction (see above).
Correction
Improve hip mobility (see mobility training). For correction of fault due to other causes, see above.

Fault
Stride length is too long.
Cause
Swinging leg thrown forward with stiff appearance instead of swinging through smoothly. Perhaps accompanied by rear leg bending too soon.
Correction
Emphasise leg speed rather than stride length, ensuring that rear leg remains braced as long as possible.

Fault
Lateral swinging of hips causing loss of balance, tension in trunk and wastage of energy.
Cause
Trying too hard to achieve hip action (often by imitation) rather than allowing it to occur naturally. Too much lateral arm movement.
Correction
Return to slow walking. Gradual increase in speed with emphasis on smooth striding. A more straight back and forward arm action.

Fault
Leading foot appears to fall on making contact.
Cause
Foot swings through high due to incomplete hip action in vertical direction.
Correction
(a) Improve hip mobility (see mobility training).
(b) Walker should feel that swinging foot skims over ground before making contact.

Fault
Feet not placed down in straight line.
Cause
Poor sense of balance. Lateral movements of trunk resulting in poor balance.
Correction
(a) Exercises to improve balance.
(b) Walking on a marked straight line. Inner sides of soles should fall on, but not over, line.
(c) Change in arm action may help, for it might have caused poor balance.

Fault
Feet placed down splayed out, making it impossible to "roll off" feet fully. Consequently there is loss of drive and tendency for rear leg to flex too early.
Cause
Walker has flat feet or is naturally splay footed.
Correction
(a) Exercises to strengthen muscles of feet.
(b) Medical treatment might be required.

In connection with fault correction, film of the walker in action can be usefully studied by the coach and walker. Even better than this is the use of a video-tape replay system, which allows analysis minutes after the walker has been in action. Unfortunately, this excellent coaching aid is only available in a few training centres at present.

2. Endurance Training

Broadly speaking, training for general and specific endurance can be divided into two types, (a) continuous methods and (b) interval methods.

(a) **Continuous Methods.** These include all training sessions in which walking (or running) is carried out for an extended period of time without any breaks for recovery. This type of work trains the whole metabolism to use food and oxygen efficiently to produce energy. In particular, the athlete will improve the fraction of his maximum oxygen uptake which he can employ in a prolonged effort. This improvement of general endurance will be brought about most efficiently if the athlete works at about 75% maximum effort for at least one hour but preferably for two, three or more hours. The correct speed can be gauged by using 75% of the speed that the walker can hold over a short distance like 3 kilometres. This means, for example, that a walker with a best of 13:30 for 3 km. will cover about 10 km. every hour in this type of work.* Continuous methods can also be used to improve specific endurance provided the speed corresponds to the walker's racing pace. Continuous endurance training certainly requires considerable time, but the resulting condition of the athlete is firmly established which then allows him to build up more specific fitness.

(b) **Interval Methods.** Interval training consists of walking (or running) a certain distance at a predetermined pace. This effort is followed by a recovery period in which the athlete moves at a greatly reduced pace or rests completely. This cycle of work and recovery can be carried out a number of times before fatigue becomes a problem. Due to the recovery periods, higher speeds can be used in interval training. This results in optimum adaptation of the circulo-respiratory system to aerobic exercise and an improved maximum oxygen uptake (aerobic power).

The speed of an effort in interval training should be the same as that planned for a race or slightly faster. During this time the walker's pulse rate will reach near maximum values, but will start to fall at the onset of the recovery period. When the walker's pulse rate has returned to about 120/min. he is ready for the next effort. Research in this field seems to indicate that efforts of 3–5 minutes are most beneficial for improving an athlete's aerobic power. This points to efforts of 800 or 1,000 m. for the walker. However, distances as short as 400 m. or as long as 3,000 m. can probably be used to good effect.

Interval training as outlined above will improve the walker's specific endurance. The interval principle, however, can also be used in general endurance training. By using recovery intervals to replace food and fluids, a walker can cover a greater number of kilometres in a session.

*The pulse rate may be checked during a brief stop. It should be in the range 130–160/min.

Interval training at racing speeds will also improve a walker's pace judgement and enable him to practise his walking technique under pressure. Such training is demanding and should be used sparingly. In particular, **it is important for a walker to be well conditioned through continuous endurance training before indulging in interval work.**

For various reasons mentioned above, it is desirable that interval training should be carried out on a track with efforts and recoveries accurately timed. Some experimentation with pulse counting will be required to establish the correct recovery period at the outset. This is hard to do accurately since the pulse rate is falling as the counting is taking place. The best procedure is probably to take the time for 10 beats (on a stopwatch) say 1½, 2 and 2½ minutes after an effort. From the calculated pulse rates, the length of time required for the rate to fall to 120/min. can be estimated.

Practical considerations

(a) **Variety.** Both kinds of endurance training can become monotonous if carried out in an unimaginative way. The table on page 21 shows the wide range of sessions which can be used to good effect by the walker. Careful choice of sessions, combined with the use of various road courses and tracks, should bring sufficient variety for any athlete.

(b) **Progression.** If a walker is to improve then, as he becomes fitter, the sessions he undertakes must be of higher quality.

In continuous endurance sessions, the walker will gradually increase the time he spends working at 75% maximum effort. As his racing speed improves, he will need to increase the pace of these sessions to keep at the correct work level.

In interval sessions, there are several variables:—

1.	Distance of the "effort".	This can be varied, but 800–1,000 m. should give the best results.
2.	Speed of the "effort".	This will be increased as the walker's racing speed improves.
3.	Duration of the "recovery".	This will be shortened as the walker's pulse recovery improves.
4.	Number of "efforts".	This will be increased as the walker's special endurance improves.

(c) **Running.** Although the running action is very different from race walking, it employs mostly the same major muscle groups and places the same demands on the circulo-respiratory system. As a result some running can be carried out by a walker, if he desires, to improve his general endurance. The very different nature of the two actions means that there is very little chance that running will be detrimental to a walker's technique. Running adds variety to a walker's training, for it gives a feeling of greater freedom and allows him to train across country, perhaps in the company of other athletes. When snow or icy underfoot conditions rule out walking, running can be used to advantage. The only thing that has to be guarded against is too much running on hard surfaces. This can cause sore calf muscles and there is the possibility of achilles tendon trouble. Running on grass or soft paths is best but, as this is not always possible, the use of shoes with a low, soft (microcellular) heel is recommended for road sessions.

(d) **Food.** If the walker is planning to compete over long distances in which feeding will be vital, then he must experiment with the type of "food" and frequency of feeding during his long sessions. All walkers should determine in training which foods suit them best with regard to their pre-race meal. Nutrition will be considered in some details in Chapter Six.

(e) **Weather conditions.** The walker should train in all weather (except fog) so he knows that he can cope with adverse conditions in a race. It will also test his will-power and tenacity. Training in strong winds and running through mud or snow provide extra resistance which is very useful for building up strength. The walker should experiment with the type and amount of clothing he wears in different conditions. He should not avoid training in hot conditions whilst further adaptation to humid heat can be brought about by wearing extra clothing.

(f) **"Warm up".** This is the period of time before training or racing in which the body is prepared for hard physical work by gentler exercise. Investigations have shown that sufficient warm up not only helps to prevent injury but also delays the onset of fatigue and improves the oxygen uptake in subsequent exercise. The aim of warm up is to raise the level of activity of the circulo-respiratory system whilst decreasing the activity in other systems not directly involved in the exercise, e.g. the digestive system.

The "warm up" itself should be progressive, starting with very easy speeds and gradually building up the tempo. As well as slow walking and some shorter efforts working up to racing pace, the "warm up" should include mobility and stretching exercises. A walker must experiment to find which "warm up" procedure suits him best. The minimum "warm up" time is about 20 minutes, but there does not appear to be any benefit in extending the process much beyond 30 minutes.

"Warm up" is essential before any fast walking is undertaken. For long sessions at easy speeds, a separate "warm up" is not really necessary as the walker can cover the first couple of kilometres at a reduced pace instead. Such a session might, however, be preceded by some mobility exercises.

After any hard or extended effort, the walker should "warm down", i.e. bring his body gently back to its normal state. This will prevent blood vessels in the muscles from closing down too rapidly, trapping "stale" blood in the muscles and causing soreness and stiffness. "Warm down" will usually consist of easy walking and jogging.

3. Speed Training

A walker needs to do some walking faster than racing pace as this ensures that, as he improves, he has the ability to handle greater speed. Speed training also has the important psychological effect of making racing speeds seem easier. For speed training the walker can use several methods:

(a) Interval training over short distances (400–800 m.). The pace does not need to be excessive. A 20 km. walker aiming for 1 hr. 30 min. has to cover each 400 m. in 1:48. For speed training there does not seem to be any advantage in covering each 400 m. much faster than 1:40. Similarly, a 50 km. walker aiming at say 4 hr. 10 min. requires 2:00 for each 400 m. His speed training will require about 1:50 for each 400 m. effort. Generally, a speed about 10% above racing pace is sufficient.

(b) Races or time trials over short distances like 3 km. or 5 km. These are very useful. As the returns from speed training are small and since it is very exhausting, it will only form a small proportion of a walker's training. It should be carried out when the walker is fresh, as muscles only react favourably to speed training if they are not fatigued at the outset. Technique must be carefully watched in these sessions, and if the walker starts to struggle badly to maintain form the session should be ended.

Suggestions for endurance and speed training sessions.

A. CONTINUOUS METHODS

METHOD	EFFECT	PERIOD	COMMENTS
Long hike in the country (preferably mountains) with a pack.	General Endurance	Active Rest	Provides relaxation and recovery.
Medium pace (75% maximum effort) walk for up to five hours.	General Endurance	Build-up, Transition and Racing	Gives confidence and consolidates technique.
Cross-country running for up to two hours.	General Endurance	Build-up	Provides variety and recovery.
Mixed running and walking for up to three hours.	General Endurance	Active Rest and Build-up	Only for walkers with good technique.
Medium pace walking for up up to two hours, with sections at racing pace.	General and Specific Endurance	Transition and Racing	Fartlek ("speed play") style training.
Walking at racing pace over a fraction of racing distance.	Specific Endurance	Transition and Racing	Good for pace judgement. Check on progress.
Walking faster than racing pace racing pace over a short distance.	Speed	Transition and Racing	Races or time trials over 3–5 km. are very good.
Walking at maximum effort over distance less than or (rarely) equal to racing distance.	Special Endurance	Racing	Time trails should be used sparingly.

B. INTERVAL METHODS

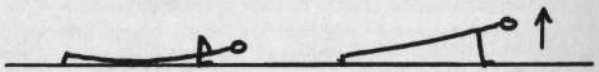
DISTANCE OF EFFORT	SPEED	RECOVERY INTERVAL	NUMBER OF OF EFFORTS (EXAMPLES)	EFFECT
20–30 km. walk	About 75% max. effort	About 30 minutes for feeding	3×20 km. or 2×30 km.	General Endurance
400–3,000 m. walk	Racing pace	Pulse rate recovery to 120/min.	10×1,000 m. or 12×800 m.	Specific Endurance
400–800 m. walk	About 10% faster than racing pace	Pulse rate recovery to 120/min.	10×400 m. or 5×800 m.	Speed

4. Strength Training

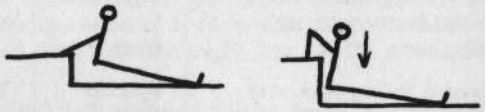
(a) **Gymnastic Exercises.** These exercises use the athlete's own weight as resistance and as such are very useful for beginners. The low resistance enables many repetitions of most exercises to be carried out and this is good for the development of muscular endurance. In some cases, harder variations of an exercise can be used as the walker becomes stronger. These exercises will lay down a general strength level to which more specific strengthening through weight training can be added later.

Arms and shoulders

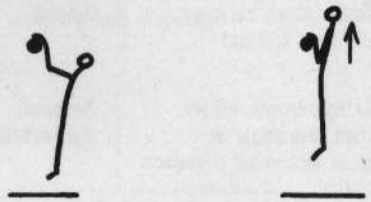
1. Press ups
   Also with feet raised (ultimately press up from headstand to handstand).



2. Dips
   Also on parallel bars.



3. Chins
   Also using undergrasp.



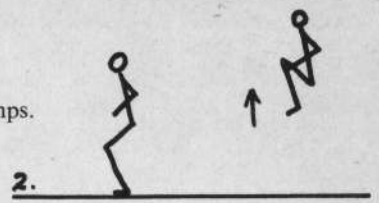
4. Rope Climbs
   Also without using legs for assistance.

5. "Wheelbarrow racing".

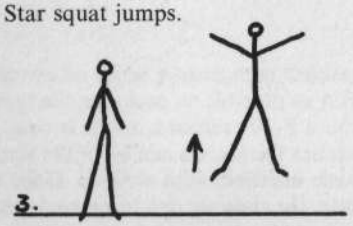
Legs

1. Hopping and various forms of bounding.

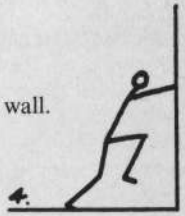
2. Tuck jumps.



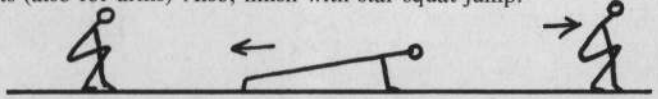
3. Star squat jumps.



4. Running against the wall.



5. Squat thrusts (also for arms) Also, finish with star squat jump.

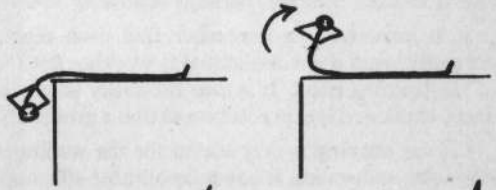


6. Partner carrying: Running, double foot jumps, step-ups onto bench (less than 18 inches high to avoid possibility of knee trouble) and heel raises.

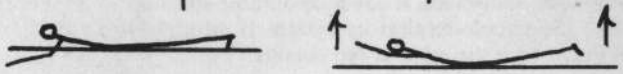
Trunk

1. Sit-ups
   Feet anchored under bar. Also on inclined board.

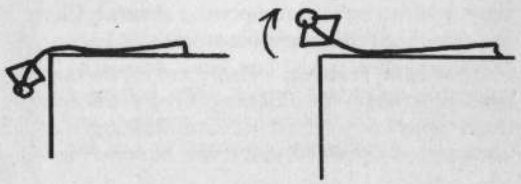
2. Twisting sit-ups
   Feet anchored by partner. Up and down with full twist to right. Repeat without twist and then with twist to the left.



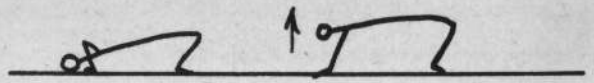
3. Back extensions.



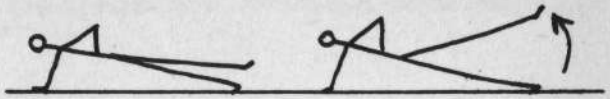
4. Twisting back extensions
   Feet anchored by partner.
   Same sequence as for twisting sit-ups.



5. Crab position
   Press up from crab position. Also walking in crab position.



6. Side support leg raises.



(b) **Circuit Training.** In this form of training, the athlete completes a series of exercises ("a circuit") in a predetermined order, working as quickly as possible on each exercise before moving on to the next. A circuit usually consists of about 8–10 exercises, and it is usual to complete about three circuits without a break. The exercises themselves can be of the simple gynmastic type (as above) or they can include resistance exercises with weights. Once the athlete has learnt how to perform each exercise correctly, the training can be carried out in several ways.

1. A fixed number of repetitions of an exercise is completed in the shortest possible time before moving on to the next exercise without a break. Some preliminary testing is required to find out the number of repetitions to be used for each exercise. It is usual to find the maximum number of repetitions the athlete can perform working rapidly and then fix the exercise "load" at half that number. For some exercises it is more convenient to find the maximum number of repetitions that can be performed in 30 or 60 seconds and to take half this number as the load.
2. The athlete works for a set period of time (say 30 seconds) on each exercise, completing as many repetitions as possible. After a short recovery period (spent jogging), the individual moves on to the next exercise.

Although the second method is simpler in operation, the former provides more motivation if the total time for (say) three circuits is noted. This time provides a target for future training. When the initial total time has been reduced by about one-third, more repetitions can be added to each exercise (perhaps following re-testing).

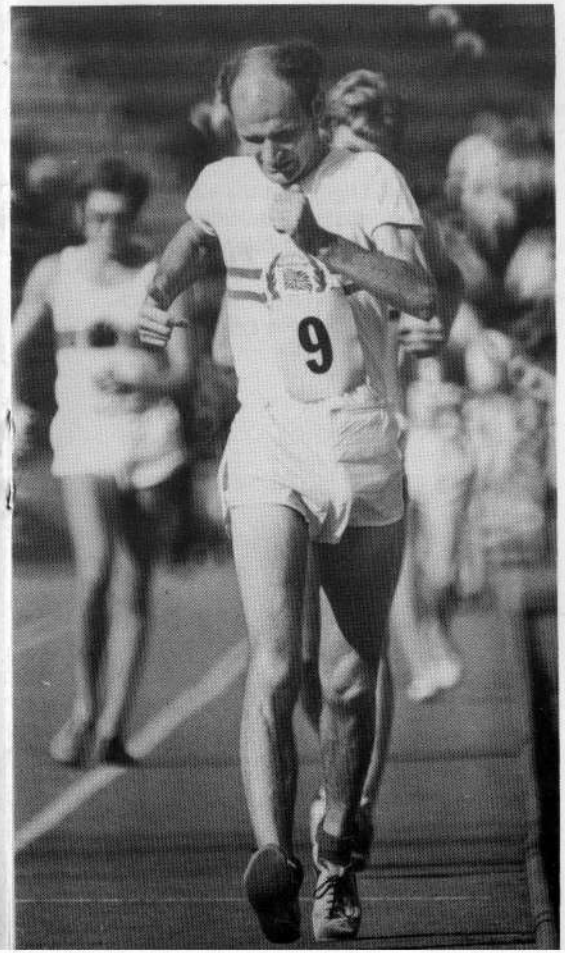
It is important to remember that each repetition of an exercise should be performed correctly, even if the individual is working flat out. If not, the athlete is missing a great deal of the training effect. It is also necessary to choose exercises in a sequence that employs the arms, trunk and legs in rotation so that a group of muscles is not rapidly worked to exhaustion.

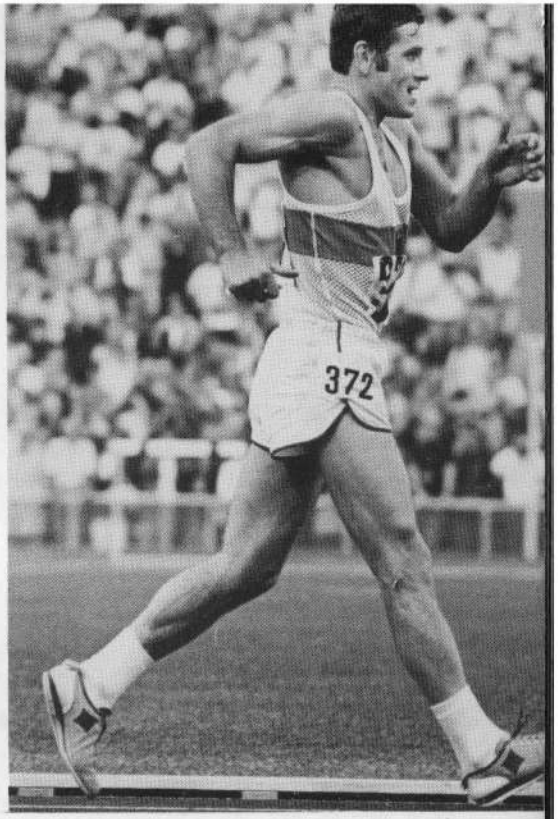
Circuit training is very useful for the walker because, as well as improving strength and muscular endurance, it has a favourable effect on general endurance. This is due to the fact that the circulo-respiratory system is strongly stimulated and the individual's pulse rate remains high throughout the circuits.

This form of training is popular with many athletes as it is a concentrated form of conditioning with a built-in competitive element. Circuit training should be carried out at least twice and possibly three times per week.

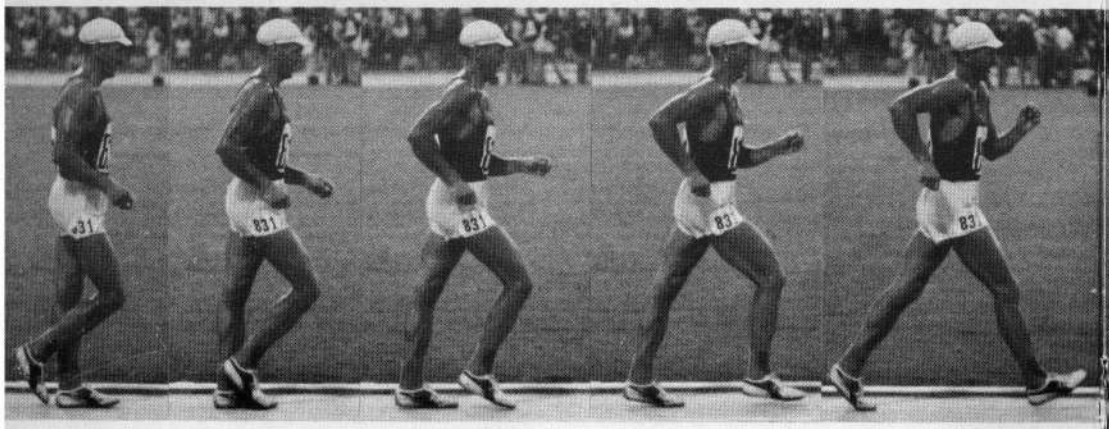
(c) **Weight Training.** This form of training has some important advantages over other types of strength conditioning. Firstly, the exercises can be chosen specifically to strengthen those muscles involved in race walking. Secondly, in weight training the resistance is accurately determined, and it can be conveniently increased as the individual grows stronger.

Bernd Kannenberg (West Germany) winning the 1972 Olympic 50 km. walk. An excellent illustration of the "double support" phase.

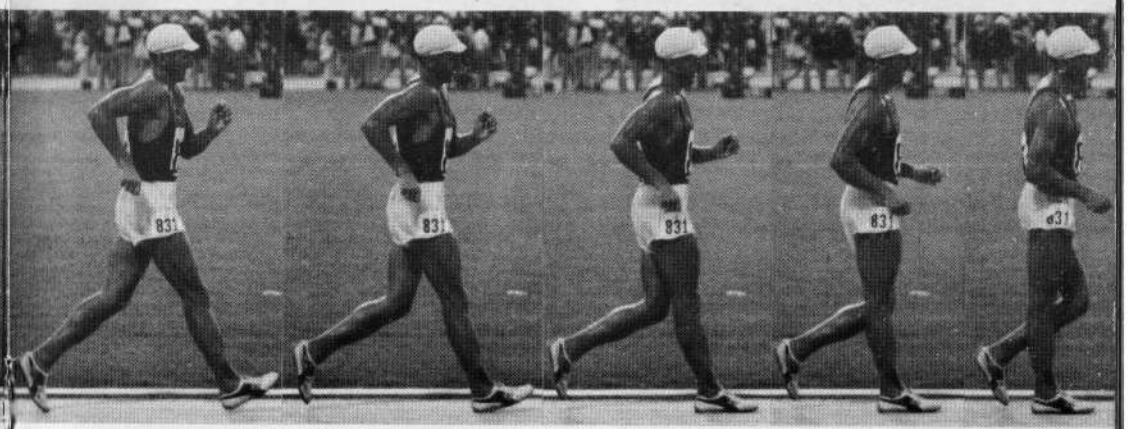




Paul Nihill (Great Britain), European 20 km. champion, 1969, and Olympic 50 km. silver medallist, 1964. A fine illustration of straight line walking. Note the position of the feet and the lack of lateral hip movement.



G.1 G.2 G.3 G.4 G.5

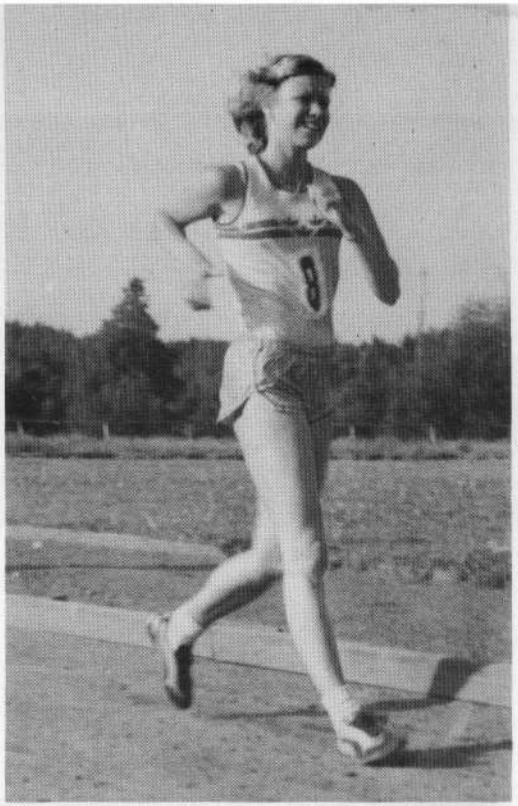


G.6 G.7 G.8 G.9 G.10

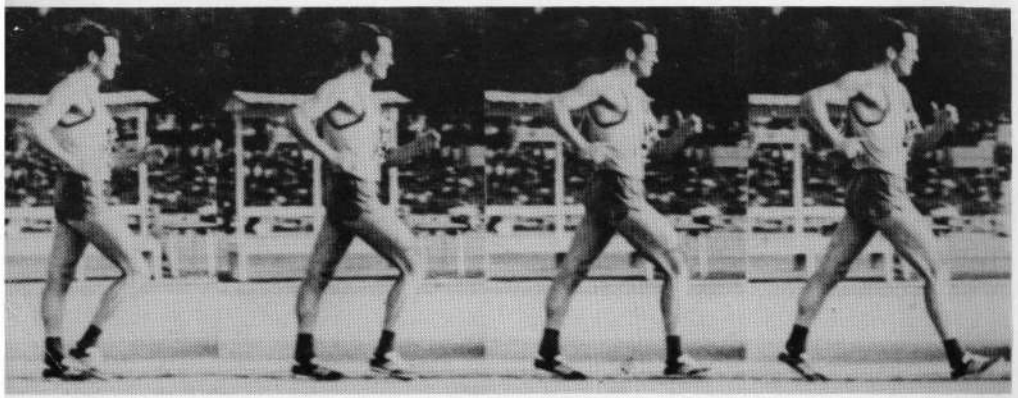
Vladimir Golubnichiy (U.S.S.R.), Olympic 20 km. Champion 1960 and 1968, European 20 km. Champion, 1974

G.1 shows a well balanced position with the left leg supporting the body and the arms at the low point of their swing. In G.2–4, the left leg remains braced as its strong drive accelerates the body forwards. This results in a slight forward lean of the trunk (G.3 in particular). Note also, from the position of the number on the shorts, the forward movement of the right hip. By G.5 the rear leg drive has almost reached completion and the vigorous but well controlled arm action has reached the end of its range. In G.6 the right foot, which has been swung forward close to the ground, is just about to make contact at the heel. Note how the right leg is not braced at this moment and that the rear foot has rolled right up onto the toes. By G.7 the forward leg is braced (note contracted muscles at front of thigh) and the arm action is reversing. In G.7–10 the trailing foot, which left the ground in an almost vertical position, is swung forward as low as possible. By G.10, the supporting leg is again straight in the vertical position.

eter Selzer (German Democratic Republic) is here
en finishing third in the 1974 European 50 km.
hampionship. Note the relaxed walking action,
ith the hip of the swinging leg coming through low
ompared with the hip on the supporting side.

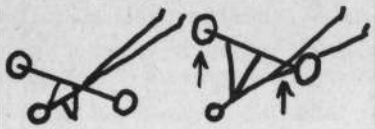
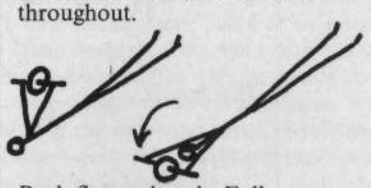
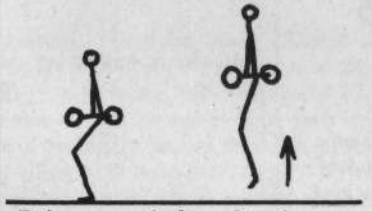


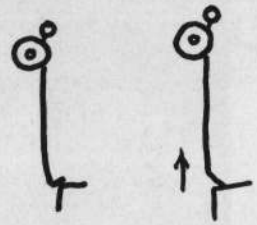
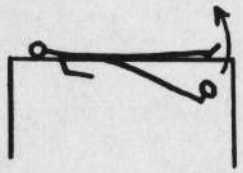
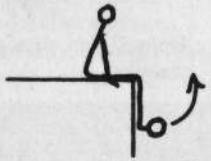
Margareta Simu (Sweden). In recent years there has been a big growth in women's race walking. Here Simu, holder of several world best performances, shows excellent form.



Peter Frenkel (German Democratic Republic), Olympic 20 km. Champion, 1972. Note the powerful drive from the rear leg coupled with excellent extension of the ankle joint, and the low swing of the forward foot.

Some recommended weight exercises

EXERCISE	DESCRIPTION	EFFECT	VARIATIONS
Bench Press	 Back flat on bench. Press from chest to full arm extension.	Large chest muscles (pectorals), front of of shoulders (deltoids), rear of upper arm (triceps)	Wide, normal or narrow grip.
Dumbell Flying	 Back flat on bench. Full range of movement with arms straight throughout.	Pectoral muscles. Deltoid muscles.	Bent arms.
Straight Arm Pullovers	 Back flat on bench. Full range of movement with arms straight throughout.	Pectoral muscles. Muscles under arm (latissimus dorsi). Also deltoids and triceps.	Bent arms.
Walking Arm Action	 Feet anchored by partner. Use arms as in walking.	Deltoid and pectoral muscles.	
Twisting Sit-ups	See section on gymnastic exercises.	Abdominal muscles. Oblique muscles.	Hold weight behind head.
Twisting Back Extensions	See section on gymnastic exercises.	Lower back muscles. Oblique muscles.	Hold weight behind head.
Squat Jumps	 Drive upwards from $\frac{1}{8}$ to $\frac{1}{4}$ squat. Good ankle drive.	Front of thigh (quadriceps). Rear of calf (gastrocnemius) etc.	Drive upwards with legs as straight as possible.

EXERCISE	DESCRIPTION	EFFECT	VARIATIONS
Standing Heel Raises	 Ankle fully dorsiflexed on 2 inch block. Barbell well padded. Shoulders must not advance.	Rear of lower leg (gastrocnemius, etc.)	Single leg heel raises (holding dumbell). Seated heel raises.
Walking Leg Action	 Iron shoe (or weight disc) on free leg. Full range of movement with leg straight.	Hip flexors.	
Leg Extension	 Iron shoe (or weight disc) on free leg. Leg must be completely straightened.	Muscles of quadricep group.	Use leg extension machine.
Rear leg Curls	 Iron shoe (or weight disc) on free leg. Knee just over end of bench. Leg fully flexed, so heel brought to buttock.	Muscles of hamstring group.	Use leg curl machine.

It is not intended that all these exercises should be used in a session. Usually about 6–8 exercises will be quite sufficient. In choosing the exercises it is perhaps wise to point out several facts.

1. There is a certain amount of duplication of strengthening effect amongst the exercises.
2. The most specific exercises (as they are closely related to walking movements) are:
   Walking Leg Action, Walking Arm Action and Leg Extensions.

Also of fundamental importance to the walker are:

Twisting Sit-ups and Twisting Back Extensions.

It would, therefore, appear wise to include these exercises in any weight training schedule.

Training plan. There are many weight training systems. Each is designed to place varying degrees of emphasis on the development of strength, muscular growth and muscular endurance. The following plan is suggested for race walkers:

1. Firstly, the individual should learn each exercise carefully, making sure that a full range of movement is used in each case. The first six months or so of training should be devoted to building up basic strength. This will involve doing 8–10 repetitions of each exercise with the maximum resistance that can be handled, i.e. a resistance which *just* allows 8–10 repetitions to be completed in correct form. When the last repetition can be completed without straining, the resistance must be increased. After several months, a second set of 8–10 repetitions (again with maximum resistance) can be added whilst a third set can be included later to advantage.
2. After this initial phase, the walker should be ready to concentrate on the development of muscular endurance. Firstly, he should find the maximum weight with which he can just complete one repetition of an exercise (one rep. max. weight). For repetitions of an exercise, he should use two-thirds of his one rep. max. weight. This will allow about 10–12 repetitions of an exercise at the start. The idea is to add repetitions (to emphasise muscular endurance) until the individual is performing 25–30 repetitions of an exercise. When this level is reached, more weight can be added and the repetitions "worked up" again. Two sets of repetitions of each exercise should be adequate.

In order to save time it is wise, after completing the first set of an exercise, to do the first set of another exercise which involves a different set of muscle groups. In this way, one group of muscles is being exercised whilst another group is recovering, e.g. the first set of leg extensions is followed by the first set of straight arm pullovers, which in turn is followed by the second set of leg extensions, etc.

Frequency of training. For the most efficient development of strength and muscular endurance, the interval between weight sessions should be about 48 hours. This implies three sessions per week, e.g. Monday, Wednesday and Friday. Even in the main competitive period, at least one session should be carried out each week. If this is not done, the walker's new strength level will gradually decline throughout the most important part of the season and his preparatory efforts will have been largely wasted.

Weight training should always be carried out before a walking (or running) session, since unfatigued muscles respond best to strength training. This procedure will also reduce the risk of injury.

Important points

(1) When weight training, the athlete must always be safety conscious. Firstly, he must ensure that the barbell (or dumbells) is correctly loaded and that the collars are secure. Secondly, exercises should always be carried out in the correct manner. In particular, if the athlete is lifting a weight from the floor, he must go down to the weight, adopting a squat position. The lift must be carried out with the back *as flat as possible* and with the initial upward force coming from the legs. If this is not done, lower back injuries will probably result.

(2) In weight training, various psychological factors can often prevent an individual from lifting a weight or doing more repetitions of an exercise, even though he is physically quite capable of a superior performance. It is, therefore, important for the athlete to get himself into the right frame of mind before the session starts and, once underway, to concentrate 100% on the exercise he is performing.

(3) "Warm up" should not be omitted before weight training. Jogging, bounding and gymnastic exercises can be used quite conveniently.

5. **Mobility Training**

In all mobility exercises, the joint concerned should be slowly moved to its extreme position. An attempt should then be made to achieve further movement by means of a controlled but powerful muscular effort. Stretching exercises for the hamstrings should also be carried out in a slow deliberate manner. Sudden jerky movements designed to increase the stretching are ineffective and dangerous.

It is recommended that each exercise is performed three times, the extreme position being held for about 10 seconds whilst an attempt is made to increase the range of movement. If an exercise requires repeating on the right and left sides, then it should be carried out three times on each side in alternation.

A number of mobility exercises have been described below. It is certainly not intended that the athlete should perform all these exercises in a mobility session. He should choose at least several exercises from each group so that he develops good, all-round mobility. The exercises can, and should, be varied from session to session. A good mobility session will probably last 20–30 minutes.

Shoulder Joints

(1) Adopt a standing position with feet astride. Without bending at the elbow, raise both arms so that they are at 45° to the trunk. Press the arms back as far as possible, trying to increase the range of movement. Repeat with the arms at 90° to the trunk and then at 135°. Finally, repeat with the arms straight up above the head.

(2) Adopt a front lying position with the arms straight out above the head. The armpits are pressed to the floor. With the shoulders kept down, the arms are moved down sideways to the body. Throughout the movement, the palms are kept down, about three inches above the floor. The arms are then moved back to the starting position.

The Spine

(3) Adopt a back lying position. Lift the head only and tuck chin into chest. Lower slowly. Repeat the procedure but this time the head and the top of the shoulders come off the floor. Lower slowly, the head touching down last. Repeat procedure, raising body as far as the top of the shoulder blades. Lower slowly, reversing the process exactly. Repeat procedure as far as the whole of the shoulder blades. Lower slowly as before. Repeat procedure so the whole trunk is raised. Lower slowly as before. Repeat procedure as above, but now attempt to touch knees with the head. Unroll slowly so that the head touches down last.

(4) Adopt a front lying position and, with suitable modifications, repeat the procedure of exercise (3).

(5) Adopt a back lying position. Bending the spine laterally, try to touch the right foot with the right hand. Repeat on the left side. The shoulders and back must stay on the floor.

(6) Adopt a back lying position, and raise the backside. By walking the feet up towards the shoulders, raise it higher off the floor. Walk round as far to the left and right as possible keeping the backside high all the time. Walk down to the starting position.

(7) Adopt a kneeling position, head on knees, hands on the ground as far in front of the body as possible. Keeping the face to the floor, extend the trunk as far as possible. Straighten the arms so that the trunk is raised and return to the starting position.

Hip Joints and Lower Back

(8) Adopt back lying star position (legs at 60° to each other, arms at 90° to trunk). Raise the left knee to the right shoulder and try to touch the shoulder with the knee. Slowly straighten the leg and try to touch the floor with the foot above the hand. Return to starting position and repeat with the right leg. The shoulders must stay on the floor.

(9) Adopt front lying star position. Keeping the shoulders down, raise the left leg backwards. Then, twisting the trunk, try to touch the floor above the right hand with the left foot. Return to the starting position and repeat with the other leg. To improve performance, raise the leg as high as possible before twisting the trunk.

(10) Exercise (8) may be performed keeping the moving leg straight all the way through the exercise.

(11) Adopt a back lying position. Raise the legs and bend the knees up to the chest. Keeping the legs bent in this fashion and the shoulders flat on the floor, drop the legs sideways. Try to touch the floor with the knees. Recover and repeat on the other side.

(12) Adopt back lying position. Lift the legs together straight over the head, so that toes touch the floor beyond. Keeping the legs together and the shoulders on the ground, walk round as far as possible to the right and then to the left. Balance can be maintained by stretching the arms out to the left and right of the body and keeping them on the floor.

(13) Adopt standing position. Grasping an object on the left to maintain balance, raise the right leg off the ground so that the thigh is parallel to the floor and the lower leg at right angles to the thigh. Rotate the hip joint of the right leg in as large a circle as possible, maintaining the angle at the knee throughout the movement. Imagine a pencil attached to the hip joint drawing out a vertical circle. Rotate in both clockwise and anti-clockwise manner. Repeat with the left hip joint.

Hamstring Stretching

(14) Adopt the front support position, i.e. the highest position in an ordinary press up. Keeping the legs straight and the hands flat on the floor, walk up towards the hands. Walk up as far as possible, and then press back in an attempt to get the heels on the floor. Walk down again.

(15) Squat down and put your hands under your feet. Slowly rise and try to straighten your legs.

(16) Adopt a standing position with one leg crossed in front of the other and pressing backwards. Interlock the fingers and, with the palms down, press slowly down towards the floor. Recover and repeat with the other leg in front.

(17) Adopt the ground hurdling position (sitting position, left leg straight out in front of the body; thigh of right leg at 90° to left thigh; right lower leg at 90° to the right thigh). Try to put your head on the knee of the extended leg.

Repeat with the leg positions reversed.

Ankle Joints

(18) Adopt a sitting position on the floor with the legs straight out in front. Keeping the heels and big toes together all the time, perform the following movements:

(a) Push the feet forwards in an attempt to put the soles on the floor.

(b) Pull the toes back towards the knees.

(c) Turn the soles inwards in an attempt to make the little toes touch each other.

(d) Turn the feet outwards, pulling the little toes back as hard as possible.

The movements can be combined in any order.

(19) Adopt the back lying position, with the right leg bent up but with the foot still on the floor. Cross the left leg over the right leg, and slowly rotate the ankle of the left leg so that the big toe traces out as large a circle as possible. Perform with clockwise and anti-clockwise movement. Repeat the exercise with the right ankle. This exercise must be performed slowly and deliberately.

(20) Stand facing a wall with the big toe of the right foot touching the wall. Keeping the right foot on the ground, bend the right knee so that it touches the wall. Repeat the exercise with the foot several inches from the wall. Continue the exercise with the right foot at increasing distances from the wall, until the exercise cannot be performed without raising the right heel. Repeat procedure with the left foot.

(21) Adopt the standing position with the feet parallel. Keeping the left heel firmly on the ground, reach forward as far as possible with the toes of the right foot by sliding this foot along the ground. Care must be taken to ensure that the left foot does not screw round as the right foot reaches out. Repeat with the other foot.

Posture Correction

(22) Adopt a standing position, back to the wall and feet about 18 inches from the wall. Lean back against the wall and then bend down to touch the toes, bending the knees at the same time. Gradually straighten up so that every part of the back unrolls onto the wall in succession. In particular, care must be taken to ensure that the "small of the back" does not come away from the wall as the shoulders are pushed back.

"Warm up". Part of the "warm up" process consists of mobilising the joints and stretching the muscles to be used in fast walking. Consequently, a "warm up" should include some mobility exercises with the emphasis on hip and ankle joint mobilising and hamstring stretching. Exercises 8, 12, 15, 16 and 19 are recommended for this purpose. Mobility exercises in which the extreme joint position is maintained for some seconds (as it should be) are quite strenuous. In a "warm up" routine, it is probably wise not to hold this position, but just to move the joint smoothly up to this point and back again.

Frequency. A walker should develop the habit of doing mobility exercises as frequently as possible, for only through constant repetition can a high level of joint mobility be obtained. Although some people do appear to be endowed with considerable mobility, it is usually found that they are relatively less mobile in some joints. Good *all-round* joint mobility, as required for race walking, can only be obtained through exercise.

5. Training and Racing Programme

1. **General considerations.** Careful thought should be given to the planning of training and the choice of races during a season. If a walker trains in an organised, purposeful manner and has clear objectives, he is much more likely to make progress than the individual who trains on a day-to-day basis. Such considerations are particularly applicable at present in view of the increasing number of athletes who almost seem to place training achievements ahead of racing results. This attitude is no doubt a result of the great volume of training undertaken by athletes today, and it clearly represents a dangerous trap for many potential top class walkers.

Planning will have to take into account such factors as the athlete's age, experience, ambitions, occupation and mental attitudes. Some athletes like to train by themselves, others enjoy training in a group. Some enjoy track training, others hardly ever use a track. Some athletes do very similar training week after week, others require considerable variety from day to day, and so it goes on. Training and racing must be tailored to suit the individual, and this fact makes discussion of plans and training schedules in general terms very difficult. However, certain guiding principles do seem to be applicable and these will be considered below.

2. **Plan of the season.** The overall training plan must be based on the pattern of races to be undertaken during the year. A certain period will be devoted to major (championship) races in which the walker will hope to achieve his best performances. This is not to say that he will not race all the year round if he desires. However, it would seem desirable to concentrate serious racing into about a six month period if optimum performances are the target. With the present championship programme, international events, etc., this will probably be from April/May to September/October. Subdivision of the year into various periods will not only enable the walker to build up to peak performances but, equally important, it will allow him time to recover from hard racing and training after the end of the racing period. Such a long term plan will, of necessity, have to be quite flexible. The time spent in each phase of training (see next section) can be varied and will depend, to some extent, on the individual's requirements and accidental intrusions like illness, injury, etc.

	SUGGESTED DURATION	IMPORTANCE ATTACHED TO RACE RESULTS
ACTIVE "REST" PERIOD	October/November	—
↓		
BUILD-UP PERIOD	December to March	None
↓		
TRANSITION PERIOD	April	Some
↓		
RACING PERIOD	April/May to September/October	A great deal

Specialisation. At this point it is perhaps wise to consider what distances the walker will race over during the main racing period. In fact, should he specialise? For the purposes of this discussion it is convenient to consider 20 km. and 50 km. as the two racing distances for senior walkers. From a consideration of the world's best walkers, a number of salient facts emerge:

At any particular time, those walkers who are considered world class at 20 km. are not the same as those who are considered world class at 50 km. There are very few exceptions to this observation, and even these walkers usually find it necessary to specialise during a season for top results. However, world class walkers are usually capable of near world class performances over a non-specialist distance when fully fit. A number of conclusions can be drawn from these facts:

(a) If a walker is to achieve top performances during a season then he must specialise in one distance. If he attempts to race seriously at both distances, he will be in danger of not achieving an optimum performance at either distance. He is also likely to find it difficult to adjust his training to the demands of both events. Clearly, the special endurance required in each case is different, and training after the "build-up" period must reflect this fact.

(b) Both 20 and 50 km. walkers should be able to race successfully over a range of distances if they are correctly conditioned. The 20 km. specialist will confine his major efforts to 10 km. (track) and 20 km. races. He should also be able to compete over 30 km. and (eventually) 50 km. without adjusting his specialised training. The 50 km. specialist will confine his major efforts to 50 km. and probably some 30 km. events. He should also be able to compete at shorter distances quite successfully without adjusting his training. Racing at distances in excess of 50 km. does not really seem necessary for success at this distance. However, if one or two such races are undertaken in a season, this will probably require a reduction in the number of 50 km. races.

The changing pattern of training during the year

(a) **"Active" rest period.** Following an extended period of racing and intense training, a walker requires a rest for mental and physical recuperation. However, it would be wrong for the walker to have a complete rest. This would allow his hard earned, high level of fitness to decline too far and make his return to full training more difficult than necessary. Besides which many race walkers, used to heavy training loads, would find inactivity unbearable. After a certain period of training, the body almost seems to demand some form of exercise every day. So the "active" rest period might well include some days of inactivity but the remainder would be occupied by light training. The walking and running will be aimed at general endurance development whilst various games (basketball, squash, volleyball, football, etc.) are ideally suited to this period. They allow the walker to work hard in a new situation and this is excellent for mental recovery. In particular, it would seem desirable for the walker to find new training venues at this time. Spending weekends hiking in the country would be ideal. Some strength and mobility work will be carried out, but only in small amounts.

It should be stressed that the change from the racing season to this recovery period should be a gradual one. Similarly, the training load should be progressively increased again to take the walker into the "build-up" period.

(b) **Build-up period.** During this phase of training, the walker builds the foundation for the season's racing. In particular he concentrates on improving his general endurance, strength and mobility. The volume of training will be high, but most of the walking and running sessions will be of moderate intensity. If so inclined, the walker might include races in his programme at this time, but he should not take them too seriously. He should certainly not adjust his training for such races, but keep his long term objectives in view instead. Due to the extensive, rather than intensive, nature of most of the training at this time, the walker can concentrate on technique and attempt to eliminate any faults which he has acquired. This period of training will also find the walker spending considerable time in the gymnasium improving his strength, while mobility exercises will be done almost daily. This period will probably last about four months.

(c) **Transition Period.** This is the time when the walker starts to prepare specifically for racing. Up to this point he has obtained a background of general endurance, strength, mobility and technique. Now he must add special endurance whilst continuing to improve the qualities he has already developed. This implies that the 20 km. walker and the 50 km. walker will now start to go their own ways with regard to many walking sessions. Also, a small amount of speed training will be introduced, but strength training might well be reduced a little at this point. In this way the walker's fitness becomes more specific, and training gradually includes more intensive work in preparation for all-out racing. This transitional period is obviously rather indeterminate, but it will probably last 4–5 weeks and include one or two races to gauge progress. Care must be taken at this stage to ensure that faster walking does not lead to a faulty technique.

(d) **Racing Period.** This period will probably last about six months, during which time the walker will expect to produce peak performances in a number of races. Consequently, training will have to be fairly flexible to allow for these races. Training during this time should see improvement in general endurance and (particularly) special endurance, to which will be added speed as a "final polish". Short distance races (3 or 5 km.) can be used for the latter to good effect. It is important during this period to include some time trials so that the walker learns how to cope with the fatigue that he will meet in races. Such trials must be used judiciously and might even be cut out altogether if the walker is racing frequently. Strength training will be continued but cut to a minimum (one session per week), whilst mobility exercises will continue to be performed as frequently as time permits.

With regard to an overall racing plan, the walker may adopt one of several alternatives:

1. He may try to maintain a high level of performance in every race, i.e. a high plateau. At most levels, this is a reasonable objective provided the walker does not race too frequently. At the top level, it becomes more difficult and races will have to be spaced out thoughtfully. This uncomplicated approach will appeal to the majority of walkers.
2. He may try to maintain a "plateau" of performances just below his full potential but build up to a peak for certain important events—his "races of the year". This approach is the most popular amongst top performers and represents a rational method for any walker who aims for the highest honours. It represents a balance between adequate training in the racing season and sufficient racing to give the walker that vital "edge" in the big events.
3. He may race relatively infrequently and just concentrate on reaching peaks for several important races. In between these peaks, the walker may revert to a build up period and might, therefore, be some way below racing fitness. This presupposes a considerable interval between races and such a régime is not likely to appeal to many. As an example, one could consider a top class walker who aims to make the team for a major international championship in the season. Provided the qualifying races are early enough, he can reach one peak in order to qualify, revert to basic conditioning and reach a second peak for the championship.

The actual plan adopted will depend greatly on the individual and his requirements. It should be remembered, however, that a walker only learns to race through racing. Consequently, most walkers need to race fairly frequently to gain the experience that is essential for success at the top level. Once a walker toes the starting line, he should only think of producing the best performance of which he is capable. This applies even when the walker is building up and some way below full racing fitness. "Taking it easy" in a race could become a bad habit. It is only permissible in a minor event if the walker can win comfortably. In major races, it is a good habit to win "by a street" when the chance presents itself for obvious psychological reasons.

3. Detailed Training Plan

Most athletes plan their training around a weekly cycle of activity although some may use a 10 or 14 day cycle. Whichever they adopt, a number of general principles dictate the day to day work pattern:

(a) A balance between the various factors required for the event. This will vary from one period of training to the next as outlined above.

(b) A balance between hard and easier sessions to allow for recovery.

(c) Sufficient variety so that the athlete's interest is maintained.

(d) A consideration of the facilities and time available for training on various days.

Some athletes like to split their daily training into two sessions—usually one completed in the early morning before work and the other in the early evening after work. If this is done, it must be remembered that the early morning session must be fairly easy and not too prolonged. This is because the body requires some time to reach a state of full readiness for vigorous exercise. In particular, the blood sugar level is low on waking and will fall to even lower levels during training. For this reason, the walker should take some form of sweet drink or cereals, milk and sugar before training.

To illustrate how a week's training may be organised, sample schedules for each period of training are outlined below. It must be emphasised that these are only examples of what *could* be done during a week. Training must always be planned to suit the individual. *Mobility exercises* have not been mentioned below because it has been assumed that the individual will fit these into his schedule as frequently as possible.

SAMPLE TRAINING SCHEDULES:

(a) **Active Rest Period—e.g. a week in October**

DAY	TRAINING METHOD	FACTORS IMPROVED	TIME
Sunday	Long hike across country with pack.	General Endurance	5–6 hours
Monday	Rest (or playing games).	—	—
Tuesday	Run (75% effort) or Walk (75% effort).	General Endurance	1 hour
Wednesday	Rest (or playing games).	—	—
Thursday	Walk (75% effort).	General Endurance	1 hour
Friday	Rest (or playing games).	—	—
Saturday	Mixed running and walking at easy speeds.	General Endurance	1½ hours

In the schedules which follow, an attempt has been made to show how the training load can be graduated to suit individuals of widely varying ability and ambition. The letters A, B and C stand for classes of walkers who may be broadly described as follows:

A. Walkers who have one or two years' walking experience and can no longer be regarded as novices. This class will also include those who do not wish or are unable to spend a great amount of time training.

B. Walkers who aim to reach the top and have passed through Stage A.

C. Walkers of international status who are aiming to reach world class and are willing to spend considerable time training.

(b) **Build-up Period,** e.g. a week in March

DAY	TRAINING METHOD	APPROX. TIME			FACTORS IMPROVED
		A	B	C	
Sunday	Walk at about 75% effort.	2 hr.	3 hr.	5 hr.	General Endurance
Monday	Weight training. Run at about 75% effort, with some faster sections.	1 hr. ½ hr.	1 hr. ¾ hr.	1 hr. 1 hr.	Strength General Endurance
Tuesday	Walk at about 75% effort with sections at racing speed.	1 hr.	1½ hr.	2 hr.	General & Special Endurance
Wednesday	Weight training. Run at about 75% effort.	1 hr. ½ hr.	1 hr. ¾ hr.	1 hr. 1 hr.	Strength General Endurance
Thursday	Walk at about 75% effort.	1½ hr.	2 hr.	3 hr.	General Endurance
Friday	Weight training. Run at about 75% effort.	1 hr. ½ hr.	1 hr. ½ hr	1 hr. ¾ hr.	Strength General Endurance
Saturday	Race OR walk at racing speed over fraction of race distance, e.g. 10 km. for 20 km. walker 20–25 km. for 50 km. walker				Special Endurance

(c) **Transition Period,** e.g. a week in April

DAY	TRAINING METHOD	APPROX. TIME			FACTORS IMPROVED
		A	B	C	
Sunday	Walk at about 75% effort. For 20 km. walker For 50 km. walker	 2 hr. 3 hr.	 3 hr. 4 hr.	 4 hr. 5 hr.	 General Endurance
Monday	Weight Training. Run at about 75% effort.	1 hr. ½ hr.	1 hr. ¾ hr.	1 hr. 1 hr.	Strength General Endurance
Tuesday	Warm up. Interval training, walking at racing speed. Warm down. A. 4×1,000 m OR 5×800 m B. 6×1,000 m OR 8×800 m C. 10×1,000 m OR 12×800 m				Specific Endurance (Pace Judgement)
Wednesday	Walk at about 75% effort.	1½ hr.	2 hr.	3 hr.	General Endurance
Thursday	Walk at about 75% effort with sections at racing speed.	1 hr.	1½ hr.	2 hr.	General & Special Endurance
Friday	Weight Training. Run at about 75% effort.	1 hr. ½ hr.	1 hr. ½ hr.	1 hr. ¾ hr.	Strength General Endurance
Saturday	Race OR walk at racing speed over fraction of race distance. e.g., 10–15 km. for 20 km. walker 20–30 km. for 50 km. walker				Special Endurance

(d) **Racing Period,** e.g. a week in June

DAY	TRAINING METHOD	APPROX. TIME			FACTORS IMPROVED
		A	B	C	
Sunday	Walk at about 75% effort. For 20 km. walker For 50 km. walker	 2 hr. 3 hr.	 3 hr. 4 hr.	 4 hr. 5 hr.	 General Endurance
Monday	Weight Training. Run at about 75% effort.	1 hr. ½ hr.	1 hr. ¾ hr.	1 hr. 1 hr.	Strength General Endurance
Tuesday	Warm up. Interval training, walking at racing speed. Warm down. A. 5×1,000 m OR 6×800 m B. 8×1,000 m OR 10×800 m C. 12×1,000 m OR 15×800 m				Specific Endurance (Pace Judgement)
Wednesday	Walk at about 75% effort.	1½ hr.	2 hr.	3 hr.	General Endurance
Thursday	Warm up. Speed training, walking about 10% faster than racing speed. Warm down. A. 8×400 m B. 12×400 m C. 16×400 m				Speed
Friday	Warm up. (Walk or run at various speeds).	½ hr.	½ hr.	½ hr.	General Endurance
Saturday	Race OR walk at racing speed over fraction of race distance. e.g., 10–15 km. for 20 km. walker 20–30 km. for 50 km. walker				Special Endurance

Before a major event, a walker may modify his training for some days prior to the race to ensure that he is fully recovered but really "tuned up" for a peak performance. The walker will "taper off" his training by reducing the work load gradually. However, a little speed training might be included several days before the event as a final polish. Some walkers may prefer a day's rest before a big race, but it should be remembered that the body becomes adjusted to a cycle of work and recovery, and resting up may have a detrimental effect in some cases. Perhaps the best plan would be to rest on Thursday and train lightly on Friday (in effect an extended warm up) for a Saturday race. Certainly, in all cases, fairly light training is indicated on the day prior to a major race.

If possible, training for some weeks before a major race should be carried out at the same time of day as the race will be held. The body has a built-in "physiological clock" which governs its various internal activities during the day. Training alters this clock so that the body is fully prepared for hard physical effort at a certain time of the day. It is also possible to increase an athlete's performance potential in endurance events by altering his diet. This will be considered later in a chapter devoted to nutrition.

Some walkers like to have an under-distance time trial during their build up to an important event. The purpose of this seems to be more psychological than physiological in that a good result will improve the walker's confidence. A time trial over a distance like 3, 5 or 10 km. will certainly improve the walker's "sharpness", but it should be remembered that there is not necessarily a high correlation between performances at these distances and performances at 20 km. or 50 km. Time trials will be quite unsuitable for those walkers who will be upset or worried by a poor result. As with other aspects of training, the individual must find a scheme which suits him best through a process of experimentation.

Following a hard race, it may be several days before a walker feels that he can resume full training again. Recovery depends to a large extent on the walker's fitness, but sometimes a poor result can so depress a walker that although physically recovered, he feels disinclined to train for some time. A good result on the other hand seems to accelerate recovery. In general, however stiff and sore a walker may feel after a race, he should do a little easy walking or some jogging the following day as this will aid his recovery. He may then take a day's rest if he feels that it is necessary before resuming training again.

4. Planning a race—strategy and tactics

At the outset it is perhaps wise to distinguish between strategy and tactics. Strategy is the overall plan for the race envisaged before the race starts, while tactics are minor modifications to the strategy which a walker adopts during the race to beat his opponents. By its very nature, race walking tends to produce strategic rather than tactical races for the majority of the competitors. Any tactical "battles" which do occur, tend to take place in the early stages of the race. After that, the race is more like a time trial for most of the walkers. This state of affairs is brought about by several factors.

(a) In running, a runner who tucks in behind the leader uses less energy because his wind resistance is lowered by the man in front. At the lower speeds involved in race walking, no appreciable benefit can be gained this way.

(b) In race walking, changes of pace are difficult to effect because a slight increase in walking speed requires a big increase in energy output. This is more marked than in running at the speeds involved in distance races, i.e. the graph of energy output against speed is steeper at race walking speeds than it is for running at long distance speeds.

(c) Sudden increases in walking speed increase the chances of being disqualified due to loss of contact. Speed is increased in walking almost entirely by lengthening the stride. Towards the end of a race fatigue tends to reduce stride length, so that any sudden attempt to speed up by increasing stride frequency in compensation will be dangerous for the walker's contact.

Strategy. In a race, only a certain fraction of the field usually has a chance of winning, so it seems wise to divide strategies into two classes:

(a) strategies designed to win the race

(b) strategies designed to achieve the best possible performance.

The first group of strategies might also lead to the best possible performance, but such considerations will be of secondary importance to winning the race.

(a) Strategies designed to win the race

1. The walker could set a fast pace from the start, which he knows he can maintain to the finish but the rest of the field cannot. The walker would expect to have company for perhaps most of the race but gradually his challengers should fall away.
2. The walker could set a very fast pace from the gun and try to "kill off" the opposition early on before settling down to walk his own race.
3. The walker could walk with the leader or leading bunch, hanging on until he has a chance to break away for victory. Tactical considerations will be important here.

(b) Strategies designed to achieve the best possible performance

1. The walker could ignore others in the race and walk to his own time schedule. This would be planned to give him a personal best performance for the distance. This strategy could sometimes lead to victory if other "faster" walkers misjudged their pace or the effect of adverse conditions.
2. The walker could try to hang on to a slightly faster walker than himself for as long as possible.

The strategy actually adopted in a race will depend on such things as the walker's present form, the strength of the opposition, the importance of the race and the prevailing conditions. For example, if the walker has a chance of victory, he must consider whether he is vastly superior to the opposition or not. If he is, then the safest strategy is to set a pace which is within his capabilities but beyond the capabilities of the opposition. If a closer contest is anticipated, he can either take a gamble and try to "kill off" the opposition early on or, in a more important race, go along with the leader's pace until he has a chance to break away for victory. Whatever a walker's ability, he should try out various racing strategies, preferably in minor events in the first instance.

From the above discussion it is clear that a walker should acquire good pace judgement. This is especially important in road races in which intermediate times may be given infrequently or not at all. In general, pace judgement is more critical during 50 km. races than in 20 km. events. All too often, walkers in the longer race walk too fast in the early or middle stages because they are feeling good. Consequently, they slow down and suffer unduly later on. A small error in judgement is greatly magnified by the duration of the race. Pace judgement is acquired primarily through interval training on the track in which the efforts, walked at about racing speed, are accurately timed.

Tactics. Although physiological considerations clearly suggest that an even pace will bring the best results in any continuous endurance event, it has been shown above that the adoption of various strategies will cause variations of pace. Similarly, tactical "man to man" battles during the race will also result in variations of pace as each tries to gain a winning advantage. In assessing a tactical situation, a walker might consider trying to break away on an uphill section of the course if he is stronger in this department than his opponent. On the other hand, if a walker has very good basic speed, he could use this to advantage on a downhill stretch. In a 50 km. race, a walker could try to break away when an opponent slows (or even stops) at a feeding station. Whatever situation arises, a walker should always try to make the decisive break before the final couple of kilometres. The longer an opponent hangs on, even if he is struggling, the more confident he becomes as the finish approaches. It is also important to bear in mind that a close "sprint" finish in the last few hundred metres is very dangerous for a walker's contact and could result in his disqualification.

6. Nutrition

Throughout the history of sport, athletes have searched for some 'miracle diet' which would somehow improve their performances out of sight. Despite many novel ideas over the years, no such diet has emerged. As a result, in recent years most coaches have recommended that athletes eat a normal, well-balanced diet and perhaps too little attention has been paid to nutrition. Recent experiments, carried out in Scandinavia, have shown that an athlete's diet can affect his performance in endurance events. Furthermore, the experiments have indicated how a diet can be adjusted before a race to give improved results. Before these important findings are considered, it is worth establishing the role played by various types of food in the body and, in particular, what constitutes a well-balanced diet.

A well balanced diet. From a physiological viewpoint, we eat for two reasons:

(a) To provide energy for internal bodily processes, keeping the body warm and for muscular exercise. This energy is derived from *carbohydrates* and *fats*.

Carbohydrates. These are essentially sugars or starches (complex sugars) which may be obtained from plants or animals. Plant sources of sugar include leaves, fruits and roots from which jams, treacle, syrup, sweets etc., are made. Bread, cakes and cereals are made from plant starch found in grain. Animal sugar is found in meat, milk and honey. In the body, carbohydrates usually end up as glucose (a form of sugar) which it stores in the muscles and liver as glycogen (a form of starch). A certain amount of glucose always remains in the blood stream and this constitutes the blood sugar level.

Fats. Energy from fats can be used in the near future or fats themselves can be stored in the body to form an energy reserve. They store a great deal more energy, weight for weight, than carbohydrates as the latter are always stored with nearly three times their weight of water. Fat deposits can result from a carbohydrate intake in excess of demands. Sources of fats include oils in seeds and nuts (hence cooking fats, peanut butter etc.), milk fats (hence butter, cheese etc.), suet, lard and margarine.

(b) To provide substances essential for living processes in that they enable the body constantly to repair itself (*protein*) and afford protection for the body (*vitamins*).

Proteins. These are the substances which are used to build all the tissues and organs of the body. The sources are the tissues of animals ('first class' protein, as it is most closely related to man's needs) and plants ('second class' protein). Animal sources include meat, poultry, fish, animal products (milk, eggs) and foods derived from animal products (cheese, margarine etc.) Vegetable sources (which are valuable, but incomplete for man's needs) include leaves (cabbage, lettuce etc.), stores made by plants (peas, beans, potatoes, wheat, etc.) and products made from these stores, e.g. flour which is made into bread.

Vitamins. This is a large group of substances, each of which must be present for good health and resistance to infection. It is not intended, here, to list the functions and sources of each vitamin since in a balanced diet, sufficient amounts of each vitamin will be provided for perfect health. It might be noted, however, that vitamin C (especially important for the healthy state of blood vessels) is easily destroyed by over-cooking green vegetables — one of its major sources. As a result, fresh fruit (oranges, grapefruits, etc.) and tomatoes should be eaten to boost the daily intake. In this country, such a wide variety of foods is available all year, that the chance of a person suffering from a deficiency of a particular vitamin is remote.

A balanced diet means in effect a balance between quantity (sufficient calories provided by carbohydrates and fats) and quality (sufficient protein and adequate vitamin intake). Guided by his hunger, a physically active person will eat large quantities of carbohydrates and fats, but should be careful to include plenty of meat, fish, eggs, milk, green vegetables, fresh fruit etc. in a varied manner.

Diet for endurance events. It has been established by experiment that, in a normal diet, protein is not used for fuel during exercise. This leaves carbohydrates and fats to provide the necessary energy.

On a **mixed diet,** moderate aerobic exercise (using about 50% of the maximum oxygen uptake) draws 50–60% of its energy from fat. If the exercise period is extended to over 3 hours, the contribution from fat rises to about 70% of the total. Heavy aerobic exercise, however, draws most of its energy from carbohydrates.

On a **high fat diet,** an individual's endurance is reduced. With 70–99% of the energy being supplied by fat the work load, which could be maintained for 3 hours on a mixed diet, can now only be held for about 1 hour.

On a **very high carbohydrate diet** in which 90% of the food calories are provided by carbohydrates, the period of exercise (with the same work load as above) can be extended to more than 4 hours. As exhaustion approaches, the contribution from fat starts to rise, eventually reaching about 60% of the total.

At **exhaustion,** the blood sugar level is found to be very low and further exercise can only be carried out following the intake of glucose. Experiments show that the glycogen stores in the muscles are far from depletion when exhaustion occurs. It seems that exhaustion is associated with the central nervous system, for this relies on the blood sugar for its functioning as it has no glycogen stores of its own.

It is clear that the walker requires a very high carbohydrate intake for good performances. Glucose, the final product of carbohydrate digestion, is stored in the muscles and liver as glycogen. On a mixed diet, 1.5% of the muscle weight is stored glycogen. This represents about 1,200 calories for an average sized man. The liver's glycogen store (up to one-third the size of the muscles' store) is used to maintain the blood sugar level and supply the central nervous system with energy.

In the late 1960's, experiments carried out in Scandinavia (Bergstrom, Hermansen, Hultman and Saltin, 1967) have shown how an athlete can greatly increase the glycogen stores of his muscles. After clearly establishing that the initial glycogen level in the

muscles was of decisive importance in endurance events, the experimenters tested the effects of various diets on performance. If a subject switched from a normal diet to a high fat diet, his muscle glycogen fell to 0.6%. A further switch to a high carbohydrate diet raised this level to 3.5% with a correspondingly improved endurance performance. Further research showed that if the glycogen stores are first emptied by exhausting exercise before the above dietry sequence, the glycogen level could exceed 4%.

Summary. If a walker is competing in an event lasting for more than one hour, it is beneficial for him to raise his initial glycogen level as follows:

1. About six days before the race, he should exhaust his body of glycogen by training very hard.
2. During that day and the two that follow, he should consume fat and protein, eating as little carbohydrate as possible. Training during this period will be difficult (due to the lack of glycogen) and will probably have to be reduced some-what.
3. In the couple of days before the race, he should switch to a very high carbohydrate diet and aid the storage of glycogen by only carrying out easy training sessions.

Some other aspects of diet. Can the intake of additional quantities of other foodstuffs improve performance?

Proteins. A high protein intake does not improve endurance performance. Protein intake has only to be adequate for growth and repair of tissue. However, if an athlete is trying to make strength gains, extra protein should aid muscular growth. Experiments have shown that several cups of 'Complan' (a specially balanced, milk based food for invalids!) taken daily are effective in this respect.

Vitamins. Despite claims at various times for increased vitamin B and E intake, there is no conclusive evidence that increased vitamin levels in the body will aid performance or recovery.

Iron. Some athletes take iron tablets in the belief that they can increase the haemoglobin content of their blood and hence its ability to absorb oxygen. Whilst this would be highly desirable, it will only occur if the athlete is suffering from iron deficiency anaemia in the first place. It is found, however, that some athletes in endurance events do have a tendency to become anaemic. In view of this, it is advisable for any athlete engaged in strenuous training to have the haemoglobin content of his blood measured from time to time. Such tests are carried out in the pathology laboratories of hospitals and an athlete should be able to arrange for such a test through his doctor.

Fat. The importance of fat in a balanced diet has already been mentioned. The walker must not lose sight of this when he switches to a very high carbohydrate diet. If *only* carbohydrates are consumed, the body becomes adapted to using them all the time. The body's internal processes and exercise up to moderate intensity, which normally utilise large proportions of fat, begin to use carbohydrates for fuel. As a consequence, the athlete's glycogen stores are run down.

Fluids. Training in a temperate climate, a walker will require about 5 litres or 10 pints of fluid per day. It is very important to have sufficient fluid, especially on the day preceding a race. Too much is better than too little, as any excess will always be eliminated. The walker's thirst will be a good guide to his needs, but replacement should follow the lines of a little fluid (250 ml or $\frac{1}{2}$ pint) taken frequently.

Salt. Sweat consists of proportionately less salt than the fluids inside the body. This implies that sweating is in fact tending to concentrate the salt level in the body and extra salt is not required. Only in exceptionally hot and humid weather (as encountered in the tropics) does extra salt have to be added to the diet.

Meals. Experiments indicate that an athlete should eat at least three meals per day, whilst some research workers advocate five equally spaced but smaller meals. Breakfast appears to be an important meal for its absence tends to lower endurance. A walker should eat about 2–3 hours before training. The actual time depends on the intensity of the training (a longer time interval before fast walking) and the individual's reaction. The process of digestion requires a good blood supply to the stomach, and blood is shunted there from other parts of the body. If a walker trains when digestion is taking place in his stomach, there is obviously a 'competition' for blood between the working muscles and the stomach. Clearly the athlete's performance will suffer and he will feel discomfort from the partly digested food in his stomach.

A pre-race meal should consist of easily digested food with a fairly high but not excessive carbohydrate content. Cereals with milk and sugar followed by lightly poached eggs on toast is fairly typical, but each walker must experiment to find what suits him best. It should be remembered that pre-race 'nerves' can slow up digestion, so the walker should eat at least 3 hours before the race to ensure fairly complete emptying of the stomach by the time of the start. Those who have real difficulties in this direction could try foods specially designed for easy digestion such as 'Complan' (see above) or 'Nutrament'.

Nutrition during the race. This will not concern the 20 km. walker as he is not allowed to take any refreshments during the race. In 50 km. events, the first feeding station is at 10 km. and, thereafter, there is one every 5 km. Drinks can only be taken in the feeding station zone. Whatever the walker decides he is taking during the race, he must have his bottles prepared beforehand, clearly labelled, and ensure that they go to the correct feeding stations. Nothing should be left to chance as correct feeding could decide the outcome of the race.

Basically, a walker needs to drink in a race to replace fluid and to maintain his blood sugar level as near to normal as possible. A solution of glucose in water (probably fruit flavoured) is required*. The strength of the solution will vary between 10 and 40% glucose since individuals vary greatly in their tolerance to the concentration. This is due to the fact that concentrated glucose solution draws water into the stomach, causing discomfort and delaying absorption into the blood stream. These facts make it imperative for the walker to experiment with feeding during training. A drink will usually consist of about 120 ml. or 4 fluid ounces of glucose solution, which will probably require washing down with a little water due to its stickiness. If the drink is cold it should be held in the mouth for a short time so that it warms up. If this is not done, the cold liquid could upset the stomach.

The walker should keep in mind that it takes a little time for the ingested glucose to appear in the blood stream. This again underlines the need for pre-race planning for it is no good if the walker goes without a drink until he really feels that he is weakening. By then it is too late and he will be forced to slow down until the glucose is absorbed.

*Drinks which are designed for this purpose are now commercially available e.g. 'Accolade', 'Dynamo'. As well as glucose, these drinks contain small, balanced amounts of the various salts which are lost by the body in prolonged exercise.

7. Injuries

Injuries specific to race walking

(a) **Foot strain.** This usually makes its presence felt as a dull ache under the arch of the foot. Sometimes the ache develops into a sharp pain and the foot stiffens up during or after exercise. Foot strain usually results from walking or running in a splay footed manner or from increasing the training load too quickly.

(b) **Tendinitis of the anterior tibials.** The anterior tibial is the tendon at the front of the shin just above the ankle which pulls the foot up towards the shin. The tendon moves inside a sheath and, due to prolonged exercise, friction may be set up between these two parts. This causes inflammation and soreness, which may vary from a dull ache to a very sharp pain apparently spreading up the shin. This condition can be caused by a walker trying to increase his training distances too rapidly, by insufficient warm up before fast walking or by wearing shoes with heels which are too high or too low. This condition is often called 'shin soreness' by walkers, but this term is more correctly used for another injury — periostitis of the tibia (shin bone). In real shin soreness, pain is felt along the inside edge of the lower part of the tibia, swelling usually occurs and the shin is sore to touch. This is a more serious condition which is usually caused by fast running on hard surfaces.

(c) **Capsulitis of the hip joint.** This is inflammation of the capsule surrounding the hip joint. It appears and disappears mysteriously. It might simply be caused by over-working the hip joint, but more probably an unbalanced stress on the hip joints caused by the camber of the road could be the cause.

Treatment of injuries. This is a job for a specialist. A walker should try to obtain the best advice he can as soon as he becomes injured. Unfortunately, this can be rather difficult. Perhaps the best line of approach is to see a qualified physiotherapist. Some physiotherapists know a lot more about athletic injuries than others, and gradually their reputation spreads amongst athletes. A family doctor will often advise an injured athlete to rest rather than obtain treatment which would accelerate recovery and perhaps allow the athlete to keep training. Few G.P's have the time or specialist knowledge to treat athletic injuries, but some will be sympathetic to the athlete's needs and might be able to arrange for physiotherapy at a local hospital.

Even when an athlete is not injured, regular massage might prove useful if only for psychological reasons. Massage is a skillful operation and although it can rarely do harm, it is wise to employ a qualified person. It can aid recovery after racing or training as massage increases the blood supply to the muscles, thus assisting the removal of the waste products of exercise. Massage before training or racing is of far more doubtful value as it does have a local anaesthetic effect on the muscles.

Prevention of Injuries. Although anyone involved in athletics runs a risk of injury, some simple precautions can minimise the danger:

(a) Progress in training should always be made gradually. Many injuries are the result of athletes trying to reach racing fitness too rapidly. The body can only adapt at a certain rate to the demands that training places on it. If this safe rate is exceeded, the body rebels

by breaking down. In this way the body protects itself from further damage which may be more serious. The walker should take note of persistent soreness in his joints or muscles. This is a sign of failing adaptation on the part of the body; a kind of warning signal to ease off training before injury occurs. This is not to say that the walker should not start a session because his muscles feel fatigued from a previous session. Nor should he discontinue a session because his muscles begin to ache. Only if these symptoms are persistent should he take preventive action. Athletes soon learn from experience which aches are serious and which are just an integral part of training. It should perhaps be mentioned here that a session of mobility exercises can often help to relieve muscular soreness.

(b) When running on the road, the individual would be well advised to wear shoes which have a small, microcellular heel attached. This will help to prevent inflammation of the achilles tendon. Running on soft surfaces is also a wise precaution, but this is not always possible.

(c) If the walker has a cold, then it is probably wise to cut down the quantity and intensity of training for a few days. The body has only so much 'adaptation energy', and trying to cope with the stresses of training and infection could prove to be too much for the athlete. Also, when an athlete is tired after training, his resistance to infection is lowered. It is far better to ease off than to run the risk of something more serious occuring.

(d) When weight training, correct lifting movements must always be observed, otherwise back injuries can occur. This has already been emphasised (page 32).

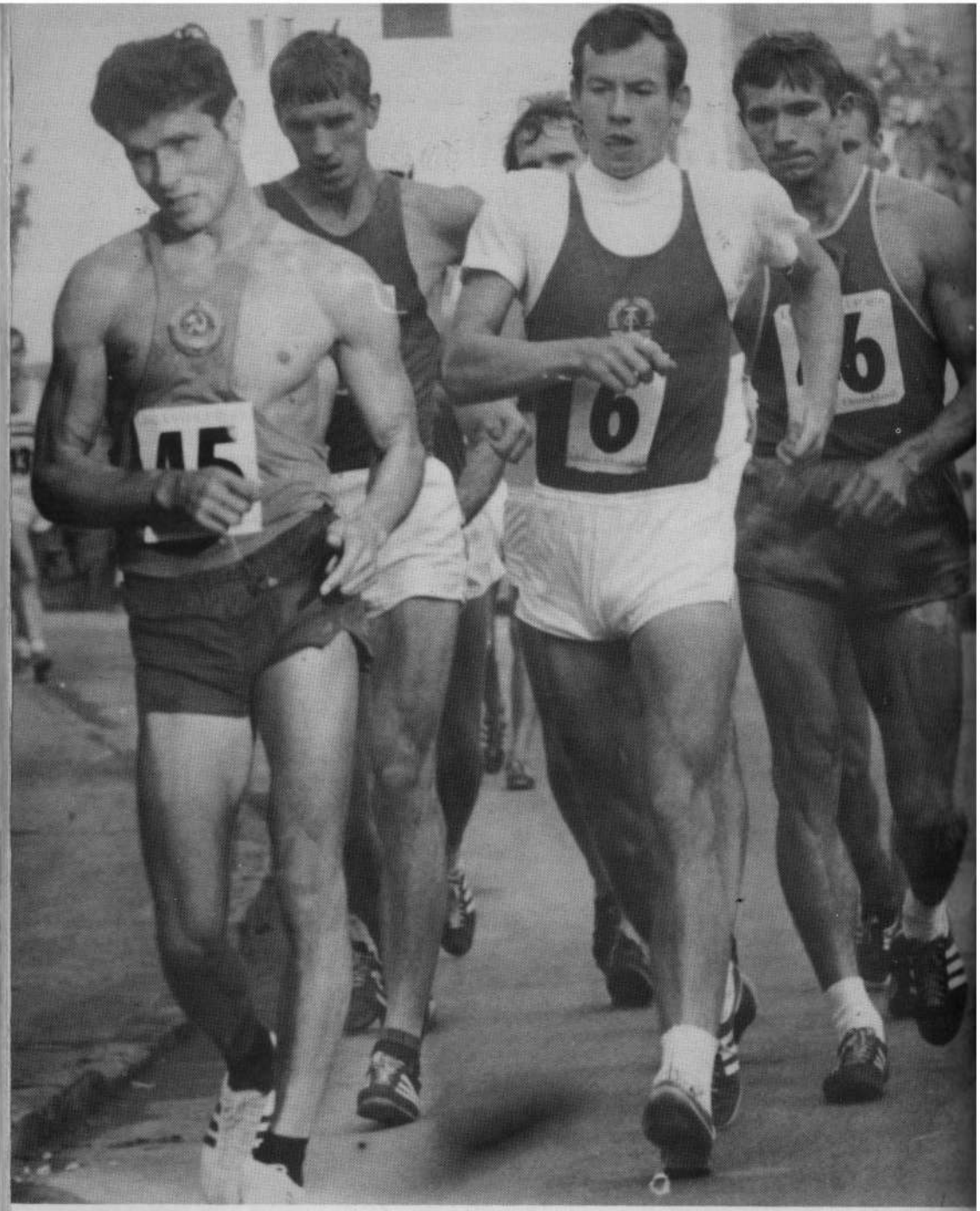
(e) Unnecessary muscular tension can cause injury. For any movement to occur, certain muscle groups (agonists) must contract to produce a force, whilst other groups (antagonists) must relax. If the walker does not learn to relax the antagonists fully, injury to muscles and tendons is likely to occur. In general, the walker must endeavour to relax *all* muscles which are not required to contract at a particular moment.

(f) Walking with a bad posture throws unnecessary stress on certain joints and this can result in injury. Improvement of the faulty walking action and use of the posture correction exercise (see page 34) will help to prevent injuries of this type.

(g) All too often the walker takes his feet for granted. When things go wrong with them, however, he becomes painfully aware of the fact. For their own protection, the feet develop hard skin (callus) on the soles and round the heels. This should not be allowed to become excessive or too hard. Small files can be purchased to remove excess hard skin (cutting is *not* recommended), while lanolin rubbed into the feet will help to keep the callus pliable. If blisters occur, those right at the surface can usually be emptied with the help of a sterilised needle. Deeper blisters under hard skin are better left to specialist treatment. Blisters should not be looked upon as an 'occupational hazard'. They are the result of excessive friction usually set up by some fault in the walker's shoes (too large, too small, rough ridges, etc.) or socks (rough stitching, ridges caused by the sock slipping, etc). With good footwear in a good state of repair, and a little attention to the feet, blisters should never bother the walker.

(h) Inadequate warm up can increase the chance of injury as can the wrong kind of warm up, i.e. one which does not mobilise all the joints to be used in walking.

(i) Attempting to walk at high speed when already fatigued is a good way for the walker to lay himself open to injury. As noted on page 20, speed training in particular should not be carried out when the walker is already tired.



Some of the world's leading 50 km. walkers battle for the 1970 Lugano Trophy. Left to right, Soldatenko (U.S.S.R.—1971 Champion), Selzer (G.D.R.—former world record holder) and Barch (U.S.S.R.—1974 European silver medallist). Directly behind Soldatenko is Lyungin (U.S.S.R.), the winner of the 1975 Lugano Trophy Final.