THE WAY WE WALK

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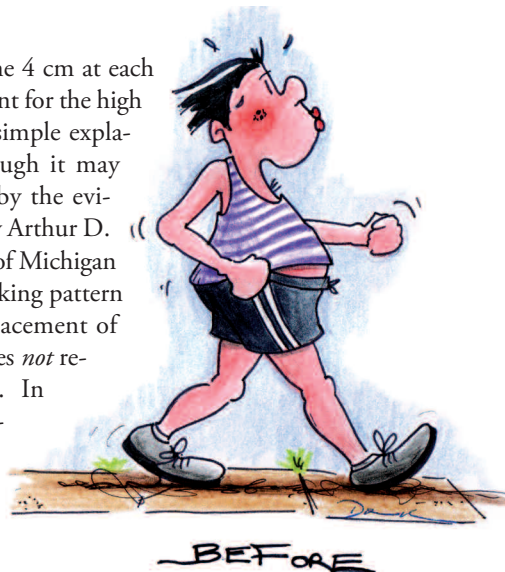
Centuries of evolution have given mankind plenty of time to learn how to walk. Walking is a reasonably efficient way of getting around, although not nearly as efficient as riding a bicycle. A few obvious features help us to walk efficiently: we move our arms and legs in antiphase, thus keeping the total angular momentum more or less zero. And we swing our legs at almost the natural pendulum frequency, which is around 1 Hz for adults. Indeed, traditional military marches proceed at 120 steps per minute: exactly 1 Hz. Given a standard step length of 83 cm, the corresponding marching speed is almost exactly 100 m per minute. Beautiful! This fact does not serve to illustrate the superiority of the metric system, but it sure is handy to know when hiking.

Energetically speaking, walking on a horizontal surface is a special case. We have no external force to overcome, in contrast to climbing the stairs, for example, where we have to fight gravity to increase potential energy; or to rowing and cycling, where we have to overcome drag from water or air. Walking is different: even aerodynamic drag is negligible (remember that it is proportional to the square of the speed). All energy that we produce is dissipated by our own body.

One may wonder why walking costs any energy at all. In fact, experiments show that the metabolic cost of walking, derived from oxygen consumption and carbon dioxide production, is about 2,5 W per kg of body mass. This is roughly 200 W for an adult. Why is that still so much? It is because human walking is mechanically complex. It involves the activity of numerous muscles, and various theories are being developed to arrive at a comprehensive description.

As innocent physicists we may offer an obvious clue: the effective displacement may be horizontal, but our centre of mass must be raised by some 4 cm at each step. Could that account for the high metabolic cost? This simple explanation, tempting though it may be, is not supported by the evidence. Experiments by Arthur D. Kuo at the University of Michigan have shown that a walking pattern that reduces the displacement of the centre of mass, does *not* reduce metabolic cost. In fact, it makes the metabolic cost go up. Also when the step length is varied beyond our natural step length, the cost goes up. In other words: the way we normally walk is also the most efficient one.



The conclusion seems to be inevitable. If we really want to walk more efficiently, we should not try to improve on our steps by thinking physics. We shouldn't even think at all, just walk. And if we are still not satisfied with the result, there is only one alternative: go home and pick up our bicycle… ■