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Streamlined Athlete

The effect of winds on walking or running is familiar to all of us. It can be specially important to people who are old, or enfeebled, or exhausted in rough country. But quantitative assessment of the effect is far from easy. L. G. C. E. Pugh¹ has now described the results of measurements made on persons running and walking on a treadmill against winds of various speeds, and has compared these with the effects of going uphill at different elevations of the treadmill.

The aerodynamic problems present some difficulty, as do the experimental aspects of the subject. But the results are of some practical importance to athletes. Pugh has shown that a considerable advantage is to be gained by an athlete running in the shadow of a competitor. As he points out, "The effect of shielding is of course well known to athletes and team managers, but they have regarded it as a subjective effect. The observation that it has a physiological basis may enable them to use it with greater tactical understanding than before." His results are also of interest to hill walkers. Their oxygen consumption can increase from 0.77 to 2.1 l./min when walking at a speed of 1.25 m/sec (2.8 mph) when the wind increases from calm conditions to a gale at 18.5 m/sec (40 mph). Such a rise in oxygen consumption can easily lead to exhaustion in a short time, and explains the relative frequency of collapse and hypothermia if the weather is cold and wet as well as windy. Patients suffering from angina commonly complain that they suffer pain and distress walking against the wind a distance they can comfortably accomplish on a calm day. The results reported by Pugh indicate that this can be explained on the basis of the increased energy expenditure required.

The effects of air resistance and air movement were studied by A. V. Hill² in a paper on "The Air-resistance to a Runner." He developed an equation based on experiments with a model in a wind tunnel, but the mechanical efficiency of the runner or walker in combating the pressure of the wind could not be calculated from such experiments. Pugh³ calculated the energy required to run against the wind by measuring the oxygen consumption of trained athletes on a treadmill in a wind tunnel. The intake of oxygen measured on one athlete running at constant speed but at different wind velocities increased as the wind increased, and the extra intake was related to the square of the wind speed. From his results it appeared that in middle distance running (5,000 to 10,000 m) about 8% of the energy spent running on the track was in overcoming air resistance.

In a further series of measurements Pugh¹ tried to estimate the mechanical efficiency of work against wind. The cal-

culation was based on the measured difference of oxygen consumption running in still air and against wind, together with measurements of the surface area of the person's body and the pressure exerted by the wind against it. Hill² and R. Margaria⁴ had expressed the air pressure in terms of an equivalent gradient, as though the runner were going uphill. Margaria considered that the mechanical efficiency of lifting work—that is, of lifting the body up a hill—was about 25% and that the mechanical efficiency of work to overcome air resistance would be the same. B. B. Lloyd⁵ examined world records on different running events and calculated the various limiting factors, using the figure of 25% for mechanical efficiency related to air resistance. However, he found a more satisfactory agreement between calculated and observed results if he used a figure of 50%. Pugh's results now show that the mechanical efficiency of walking or running against wind is considerably higher than going up a gradient and justify Lloyd's use of 50% in his equations.

A number of questions remain to be answered, particularly why there should be this difference between wind and gradient. Athletes and their coaches may have to study the niceties of aerodynamics. As Pugh points out, at the highest running speeds variations in the shape of trunk and limbs (and of clothing) can affect resistance. We may perhaps look forward to the streamlined athlete.

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⁴ Margaria, R., *Internationale Zeitschrift für angewandte Physiologie einschließlich Arbeitsphysiologie*, 1968, 25, 352.

⁵ Lloyd, B. B., *Circulation Research*, 1967, 20 and 21, suppl. No. 1, p. 218.

Blue Valve Syndrome

One of the less well known disorders of the heart valves is mucoid degeneration, a condition in which the leaflets are thin and diaphanous and have a blue colour owing to a replacement of their substance by mucoid material. This mucoid change may also affect the annulus of the valve and the chordae tendineae, but there is no fibrosis, and the chordae are delicate and of normal length. Histologically there is no accompanying inflammation or fibrosis, and the mucoid material gives the histochemical stains of an acid mucopolysaccharide.

The weakening of the valve structure consequent on its loss of substance causes the leaflets to prolapse in the associated chamber of the heart, and this leads to severe, progressive incompetence without stenosis. R. C. Read and his colleagues reported nine cases in 1965, and they called the condition the floppy valve syndrome.¹ The mitral valve is most often affected, and rheumatic valvulitis is closely mimicked. When the aortic valve is affected alone, syphilitic disease must be ruled out by serological tests. Occasionally there is a combined mitral and aortic lesion, and in one case the mitral and tricuspid valves were affected.² The sexes are affected about equally, and most cases have been reported in young and middle-aged adults. The condition proceeds to intractable heart failure.

In some cases the valve has been replaced with a prosthesis. While the immediate result is often satisfactory, there is a tendency for the prosthesis to break loose from the annulus at a later date. P. L. Wolf and R. C. Read encountered this