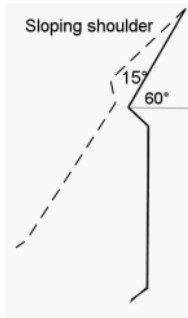
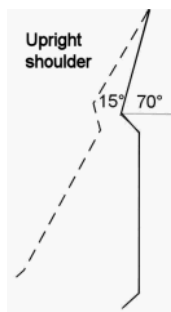


## ON THE MOTION OF THE FORELEG



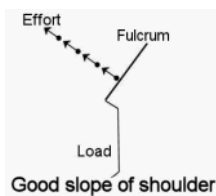
In a previous Newsletter we had a look at the importance of the length of rein in racehorse performance mainly from the view of the physics of levers involved in the locomotion process. No mention was made of the slope of the shoulder and how it functions in the physical processes.

The schematic at the side depicts the foreleg of a horse whose shoulder is at  $60^\circ$  to the horizontal, The solid line shows the position of the limb when standing. The dotted line represents the position of the limb when extended forward. The deviation angle of  $15^\circ$  was chosen by way of illustration.



The schematic at the left now shows an upright shoulder, in this case a shoulder that is  $70^\circ$  from the horizontal. We have kept the same angular deviation of  $15^\circ$  as in the case above.

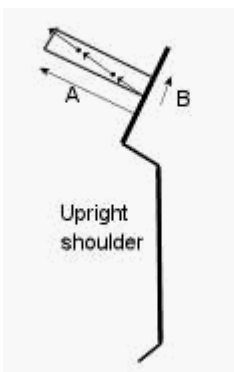
Notice the stride of the upright shouldered horse is shorter than the stride of the horse with a good shoulder.



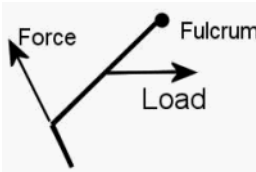
There is another disadvantage of an upright shoulder in efficient locomotion. Remember in the previous article, the most efficient use of the force applied to the shoulder as a lever is when the force is at a right angle to the shoulder as shown on the left.

The schematic at the side represents a horse with an upright shoulder. Notice that the force applied by the muscle is not at right angles to the shoulder but slightly off. The muscle is not only pulling the shoulder forward but also slightly upwards.

A rectangle has been drawn around the muscle with the muscle acting as the diagonal. This is what is known as a parallelogram of forces. What that means is that the original force is split into two components, in this case A and B. Notice that the force pulling the shoulder forward, A, is smaller than the original force (the diagonal is longer than the side). The other element of the force, B, acts up along the shoulder tending to move the shoulder fulcrum upwards. This force even though small is a wasted effort.



There are other advantages of a good sloping shoulder. The shoulder together with the humerus and the pastern provide a shock absorber effect when the leg hits the ground. The concussion force is applied to the shoulder by the humerus tending to rotate the shoulder forward and push upwards as shown on the left. The load are the muscles that pull the shoulder back. In this case the shoulder movement is stretching those muscles.



The more upright the slope the more force is applied pushing the whole shoulder upwards as in the case above. This action is countered by the muscles that keep the top of the shoulder in place. Overuse of these muscles can lead to a sore shoulder.

Another case where there is a decrease in performance of the shoulder motion is when the horse goes off the bit by raising the head and neck.

So a horse with a good shoulder mimics one with an upright shoulder in as much as the muscle is not pulling at a right angle. This will shorten the stride.

In the next and final article we will look at another physical property known as the Moment of Inertia and how it affects the foreleg motion.

*Peter James*