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Mr. Don Evans, Director
Clark University News Bureau

Dear Don:

I promised you last week that I would write a brief description of my new scheme or invention for rigging a rowing shell so as to gain certain increases of efficiency by improved application of certain physical principles. Let me first express my sincere thanks for your cooperation in getting some photographs which show in pictorial form the major features of my scheme. I have been anxious to get a record of what I have done and your photographs are excellent for that function. Here goes!

Rowing as a method of propelling a boat is perhaps one of the oldest techniques of human power application for transportation. The basic principle involved is that of the lever (oar) and fulcrum (oarlock), with the oarsman pulling on the handle of his oar, to drag the fulcrum (oarlock) past the point in the water where the other end or blade of the oar is momentarily fixed in the water. Since the oarlock is fixed to the gunwale of the boat, the movement of the oarlock (fulcrum) in a given direction also moves the boat in the same direction. This is the whole basic explanation of rowing.

As the art of rowing has developed, however, two basic innovations have been added to increase the speed of the boat by improving the application of the oarsman's energy to the propulsion of the boat. These are:

1. The use of an outrigger, extending outward from the boat's gunwale to hold the oarlock. The outrigger made possible narrower, more streamlined boats while maintaining or increasing the oarsman's leverage, and thus contributed to increasing the oarsman's potential speed from a given exertion of energy at the oar handle.

2. The sliding or rolling seat for the oarsman. The moving seat utilized the oarsman's legs as well as his arms and back, both to increase the length of the "reach" or distance the oarsman could exert his energy on each stroke of the oar and to enable him to use his leg muscles, the most powerful muscles of the human body to propel the oar through

the water by virtually "lifting" the oar handle in a horizontal plane from the shoes or "stretchers" where the oarsman's feet are placed to push himself backward, hands on oar handle, as if he were lifting a heavy weight vertically from a floor.

However, despite many refinements, which are too numerous to recount in brief space, two basic sources of the loss of energy still prevail, so that for a given number of foot-pounds of energy applied to the oar handle a somewhat smaller number are actually available to move the boat in the desired direction of progress. These are:

1. The moving weight of the oarsmen in the boat which for approximately one half of the duration of each stroke is either checking the boat by the friction of motion of the several oarsmen as their seats roll approximately 20 inches in about one second of time or checking the progress of the boat by the counter-momentum of the weight of the oarsmen as they stop their seats at the end of the seat tracks when their legs are fully bent preparatory to application of their oars to the water for a new power stroke.

2. The direction of the application of the oarsman's power toward moving the boat changes throughout a "stroke" as the angle of the oar to the boat changes during its swing through an arc of 50^0 or so. Only when the oar is at an angle of 90^0 to the boat is the oarsman's energy being applied at a maximum level of efficiency.

In the early part of the stroke, the oarsman is applying his force to partially "squeeze" the boat and as the oar passed the 90^0 angle to the boat, his force is partially applied to "spread" the boat. Since the boat is rather rigid, it does not squeeze nor spread, and furthermore whatever energy was exerted in those directions is wasted, so far as propulsion of the boat forward is concerned.

I began to wonder about these energy losses some thirty years ago as a college oarsman. However, I was not able to arrive at any solutions that offered promise until about five years ago when I experimented with an oar, the blade of which was linked to the boat so as to remain always at 90^0 to the boat. The idea proved to be impractical. Then I sought to solve the problems by modification of the rigging and in 1953, finally came to the theory of the system I am now engaged in applying.

My system consists of reversing the relations of the seats, shoes and outriggers of traditional racing shells by having the oarsmen's seats fixed to the boat and attaching the shoes and outriggers to a moving frame which can be propelled by the oarsmen exerting pressure against the backs of the fixed seats. This scheme tends to reduce the loss of energy from both of the present sources of enefficiency, namely the friction and momentum of the weight of the oarsman, and the "squeezing" and "spreading" of the boat. It accomplishes these economies of energy first by reducing the moving weight by 80 to 85 per cent. Since only the outriggers, oars, and shoes and frame plus the oarsman's lower legs will move in my plan as opposed to the motion of almost the entire body weight of the oarsmen, in the traditional rig of racing boats. Second, the use of moving outriggers and fixed seats reduces the arc or angle through which the oar moves during a given length of stroke, thus tending to apply the power exerted by the oarsman at something closer to the 90° position to the line of progress of the boat than can be accomplished in the traditional system.

The shoes, outriggers and oarlocks are fixed to a rigid frame which may be moved freely some 20 inches to and fro within the restricted distance of the cockpit of the rowing shell. The frame is equipped with a number of ball bearing wheels which operate on "tracks" to carry the weight of the movable rigging. Alignment of the frame within the cockpit is maintained by another series of ball bearing wheels, which roll against the gunwales of the shell, to take care of any horizontal side thrust which may be exerted by the inequality of the pulls of oarsmen between port (left) and starboard (right) sides of the boat. The tracks which carry the wieght of the movable frame and rigging are provided with "risers" of 5/8" as the frame is pushed from the "bow" end to the "stern" end of the tracks. This "riser" enables the oarsman to accomplish a "recovery" between strokes without the exertion of energy to pull the frame and rigging back toward the bow for the next power stroke.

The present model is an experimental one, and weight somewhat more than a traditional rowing shell. If it shows the increased efficiency in practice that it promises in theory, weight reductions can be made by use of lighter materials, to bring the weight close to the weight of present shells as experience is gained in solving construction problems.

I hope this statement will clarify the differences between the traditional rigging on racing shells and my "invention."

Again, thank you for the excellent pictures.

Cordially yours,

F. Eugene Melder

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