

ROWING

Rowing is an excellent activity for developing physical fitness. It conditions the muscles of the back, shoulders, arms, legs, and abdomen, as well as the cardiovascular system. When pursued vigorously, rowing can provide as much exercise for the heart and lungs as can cross-country skiing, running, or swimming. Many people think that rowing requires only upper-body strength, but the proper use of the legs can greatly enhance one's performance.

Few adjustments are required in order to accommodate a lower limb amputation; one can row while wearing a prosthesis or not. However, the exercise is less effective without the use of both legs because their use increases the power and efficiency of rowing strokes.

Rowing is a highly accessible form of exercise. One can row in a boat, or on a stationary rowing machine at a health club or at home.

WATER-ORIENTED ROWING

Although rowing shells are usually lightweight (30-40 pounds), getting a rowboat into the water can be difficult for a person with lower limb loss because good balance is required in order to carry the boat to and from the water. A padded V-shaped cart can be used for transporting the boat, but it also helps to have someone assist, if the need arises. The boat can be steadied with one hand once it is set in the water beside the dock. The rower can then

slide into the boat from a seated position. People who have good balance can easily master the skill of climbing into the boat from a standing position.

In the boat, balance is essential for safety as well as for effective rowing. It is best for beginners to start with a "wherry" (a rowboat with a wide hull) which provides for stability in the water but is not designed for speed. After gaining some experience with the wherry, a narrower, more streamlined model can be used, such as the recreational shell available from the Pocock Company.

A rower sculls or sweep-rows with oars. Sculling uses two oars and is done individually (although it can be done in teams). Sweep-rowing is used in the team sport of rowing, wherein both hands are used to work a single oar. Stationary rowing machines are designed for sculling.

An individual can row without wearing a prosthesis, but body symmetry, as well as leg power, is sacrificed. When sweep-rowing with one oar as part of a team, a rower not wearing a prosthesis should sit with the sound limb on the opposite side of the rigger and oar. This position will provide for better balance and a more powerful stroke.

STATIONARY ROWING MACHINES

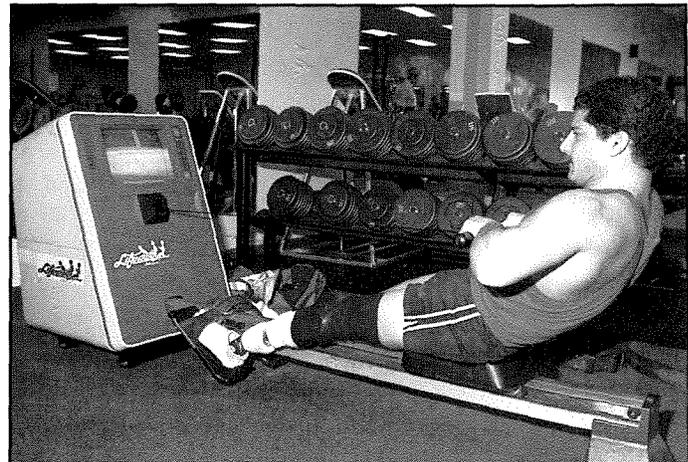
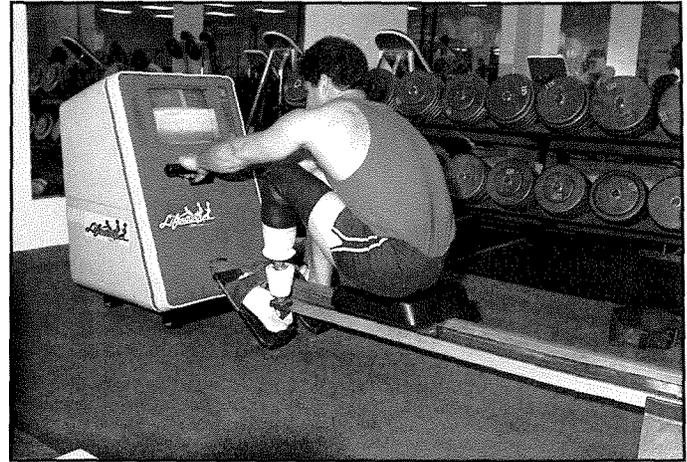
A stationary rowing machine can be the alternative for rowing a boat in water, or it can supplement the outdoor sport throughout the year. The rowing machine does not require any boating experience,



STEVE WILBER, SEATTLE, WA
Craig Rhyne, in a recreational Pocock wherry, prepares for some sculling without wearing his AK prosthetic leg.

swimming skill, or ability to balance a boat in water. Although the machine does not provide the exhilaration of gliding across the water under one's own power, it does allow more people to benefit from the fitness aspects of the sport. Many competitive scullers and sweep-rowers keep in practice by using stationary rowing machines.

Stationary rowing machines are excellent for getting in shape and keeping in shape. The rowing motion is repetitive, which is best for endurance training of the cardiovascular and musculoskeletal systems. The level of resistance on the stationary rower can be adjusted to monitor progress. The muscles of the legs, arms, back, and shoulders are all being worked to provide power for the strokes,



JOHN WOODMANSEE/VAMC SEATTLE, WA
Albert Rappoport monitors his strokes on the computerized Liferower machine. He wears the ActivAnkle and the Symes Carbon Copy II Foot, a combination which allows for unrestricted range of motion in flexing the ankle and for locking while standing.

and the flywheel or hydraulic cylinders produce the resistance against these muscles. Blood is circulated through the heart in large quantities to meet the high demand for the required oxygen.

Although inexpensive hydraulic models can be purchased for use in the home, the more costly nonhydraulic machines offer features that can enhance the enjoyment and safety of the exercise. Some rowers also feel that the nonhydraulic models exert less strain on the lower back. Many health clubs have nonhydraulic, computerized "liferowers" that can be adjusted to any level of physical condition and training goals. Regardless of the user's amputation level, these machines can be used to strengthen muscles and promote overall fitness.

They are a good form of exercise, with or without the use of a prosthesis, for those in early postsurgical rehabilitation, because little stress is placed on the residual limb.

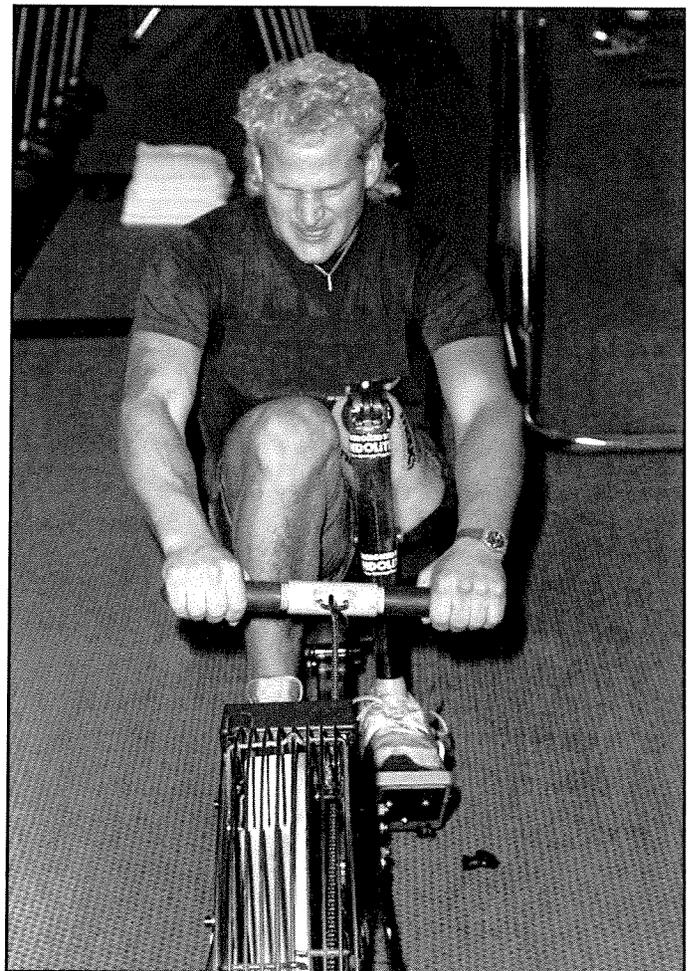
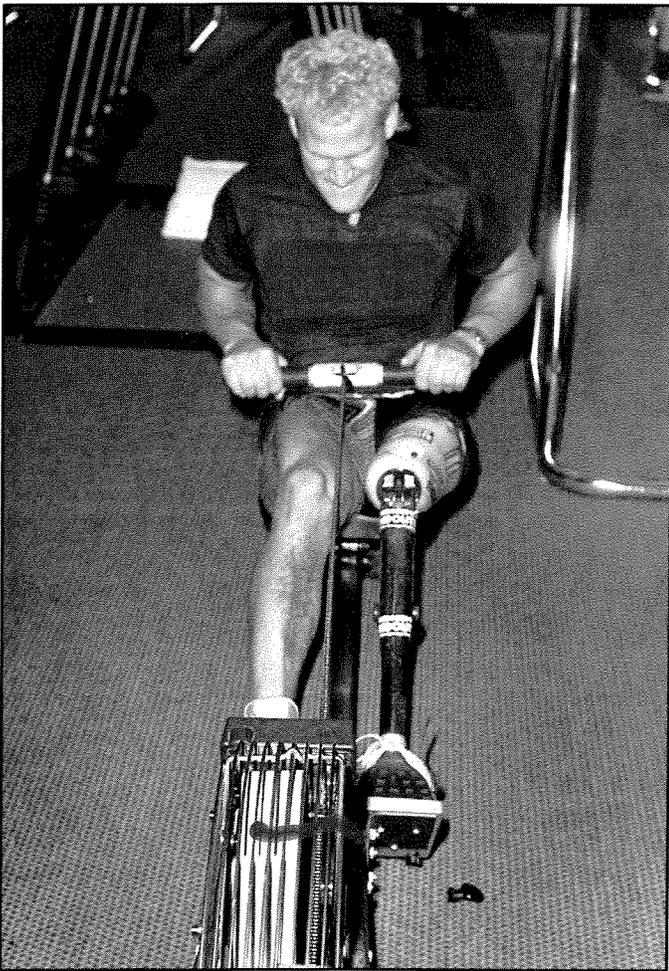
The cost of a rowing machine can vary from as low as sixty dollars to as high as several thousand dollars; therefore, it is wise to research the market carefully and test the machine before purchase.

Training on a Stationary Rowing Machine

Rowing machines closely simulate the sculling stroke with one significant difference. When in the starting position of rowing a boat, the oars are dipped into the water and the stroke begins; this action is called the “catch.” The rower’s body is bent forward, the knees are flexed, and the arms are

outstretched. As the stroke is pulled to the “finish” or “runout” position, the body straightens and bends slightly back, the legs become extended, and the arms are brought in toward the chest or stomach. On a stationary rowing machine, the opposite occurs. The exerciser usually begins in the finish position and pushes the hand bars forward until reaching the catch position.

Aerobic benefits of stationary rowing are best achieved by performing a high number of repetitions at a low-to medium-resistance setting. The usual goal is to build endurance in order to maintain a targeted heart rate for 20 to 30 minutes of exercise 3 to 5 times per week. Once this is achieved, the number of repetitions and level of resistance can be raised to concentrate on muscle strength as well as on increased endurance.



DALE TILLY/VAMC, SEATTLE, WA

Greg Mannino works against high resistance. Newer flywheel machines like this one offer computer-controlled resistance programs so that the rower may vary the workout as strength and endurance are increased.

Efficiency of heart rate is the measure of progress in any aerobic exercise program. The rowing machine, as well as other stationary exercisers (e.g., bikes and cross-country skiing devices), allows the exerciser to monitor the heart rate and progress under controlled conditions. This is done by tracking the resting heart rate, the training heart rate, the number of minutes in exercise, and the number of strokes per minute made with the oars.

The following example of a "reference workout"¹ can be used to test the response of the heart rate to specified exercise periods:

1. 5 minutes at 30 strokes per minute at setting 1 on the rowing machine (5 strokes/10 seconds);
2. 3 minutes at 24 strokes per minute at setting 2 (4 strokes/10 seconds);
3. 2 minutes at 18 strokes per minute at setting 3 (3 strokes/10 seconds).

After each interval, the pulse should be taken and recorded. The rate should be timed for 6 seconds only and the number later multiplied by 10 to establish the rate for 1 minute. The rower should proceed to the next interval without further pause. After about 2 weeks, the reference workout should be performed again to determine if the heart rate is declining during the workout. If it is not, the rower should adjust the routine to work at a higher targeted heart rate, or should exercise for longer periods of time.

A 30-minute session of continuous rowing at a steady rate performed 4 to 6 times a week provides for good aerobic conditioning. Each session should be preceded by a 15-minute period of warm-up exercise and followed by a 15-minute period of cool-down exercise. Interval training or sprinting—mixing high-intensity with low-intensity exercise—is useful for setting up a beginning routine or for working up to longer routines.

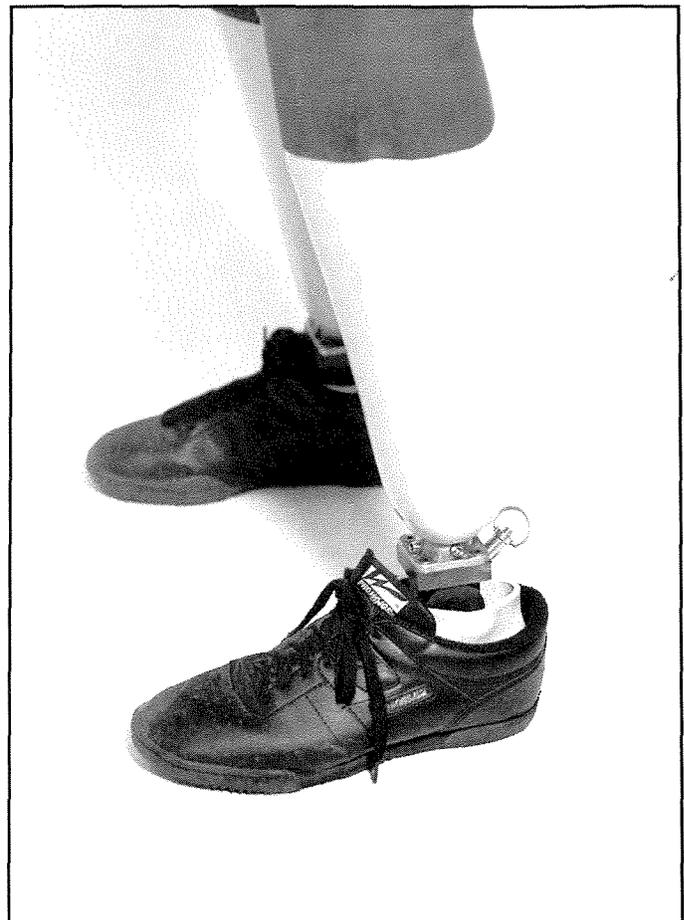
PROSTHETIC MODIFICATIONS FOR RANGE OF MOTION

Rowing is relatively nontraumatic to the residual limb because there is little vertical impact. If irritation does occur, it will most likely be from the trim lines of the socket as the rower goes through a full range of motion to complete a stroke. If hamstring impingement is a problem for those with

a BK amputation, the posterior trim lines can be modified. A lowered medial wall or a diagonal trim line that also lowers the medial side will work in many cases. When rowing in a boat, one can also sit on a cushion so that knee flexion is lessened.

The prosthetic ankle does not have as wide a range of motion as does a sound ankle. To compensate for this on a stationary rowing machine, the heel of the prosthetic foot can be placed higher off the foot board. For that reason, it is best to make the foot strap slightly loose on the prosthetic side.

When the prosthesis is used only for rowing, a removable posterior wall can be fabricated by using a clip with a supracondylar removable wedge. A proximal strap that runs circumferentially around the proximal socket can be used to help hold the removable wall in place. The entire posterior wall



SUSAN BROWN/VAMC, SAN DIEGO, CA
The ActivAnkle can be used for rowing as well as walking. The locking pin shown on the back of the ankle unit can be removed when rowing to allow for dorsi- and plantarflexion.

can be lowered for someone with an especially long residual limb. Those with AK amputation have impingement flexing at the hip from the socket; those with BK amputation have impingement flexing at the knee. Both AK and BK sockets can be fabricated with a flexible brim made from either thermoplastics or flexible resins in order to increase comfort and range of motion while rowing.

Although training and motivation are needed for competency, the rower using a BK prosthesis adaptable for rowing has a significant advantage over the rower with an AK adaptable prosthesis. This advantage is due to the knee action required for flexion and extension in rowing. There are, however, adaptations that will assist the AK-level rower. A flexible brim socket is best for obtaining full range of motion and a nonfriction knee device allows for the greatest freedom when rowing. Since suction may be lost with increased hip flexion, a TES belt or Silesian belt attached to the socket will provide for better suspension to help prevent loss of suction. Avid rowers often use a special leg designed specifically for rowing.

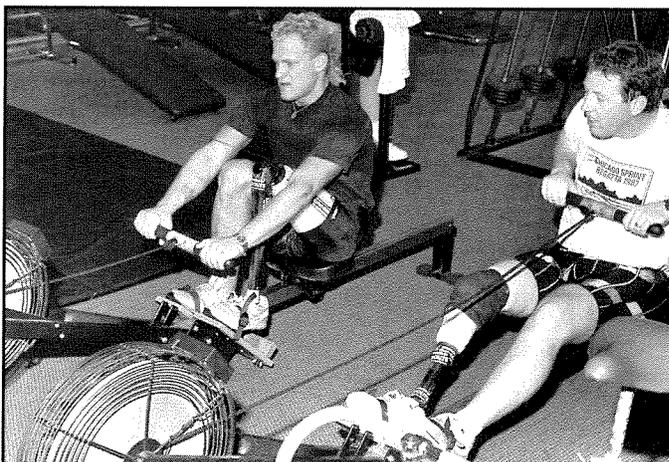
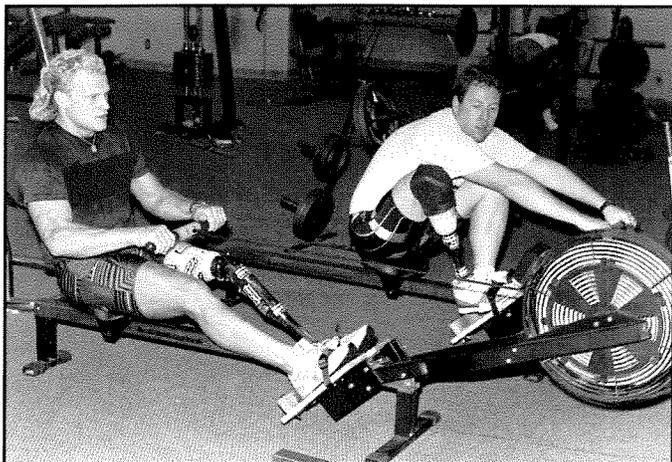
ADAPTING TO SLIDING SEATS

Most rowboats and stationary rowing machines are equipped with sliding seats. A seat that slides

enables the rower to perform powerful extended strokes by integrating both the abdominal and leg muscles into the action. However, beginners sometimes start with a nonsliding seat in order to concentrate on other aspects of the technique.

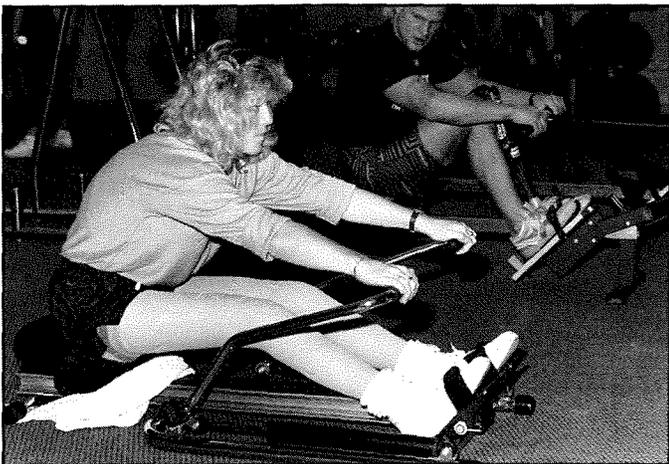
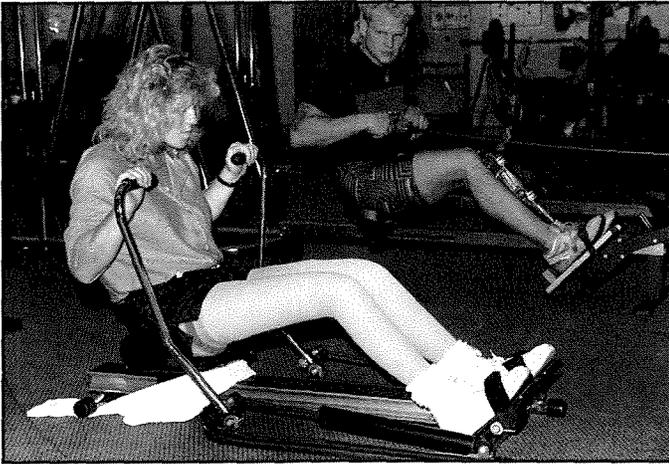
It is difficult to row a boat or stationary machine from a sliding seat if there is no movement at the ankle. The rowing prosthesis should have an ankle or foot combination that allows for a range of unrestricted motion in both dorsiflexion and plantarflexion. Over the years, various prototype ankles have been fabricated to accommodate the need for full range of motion in the ankle. The ActivAnkle is one such design and is very effective for use in sports such as rowing. It can be unlocked for complete dorsi- and plantarflexion during rowing, then locked, after rowing, into a vertical position for standing and walking. The ActivAnkle can be used on endoskeletal BK and AK systems and may also be modified for exoskeletal systems.

For the person with bilateral AK amputation, the sliding seat feature of most rowing machines (and boats) creates a problem of instability. Due to the lack of muscular knee control, one can easily fall backward when pulling the bars or oars toward the chest because the seat tends to slide forward at the same time. To prevent the seat from sliding, a towel may be wrapped around the seat and anchored underneath the rear feet of the machine. Another



DALE TILLY/VAMC SEATTLE, WA

Greg Mannino (unilateral AK), on the left, and Richard Hughes (unilateral BK), on the right, exercise on a flywheel machine. In the left photo, Mannino is beginning his stroke from the finish position, while Hughes is in the catch position. In the right photo, Mannino has moved to the catch position and Hughes is pulling toward the finish position. Notice that when each is in the catch position, the shins are almost in a vertical position and the knees are brought up close against the chest.



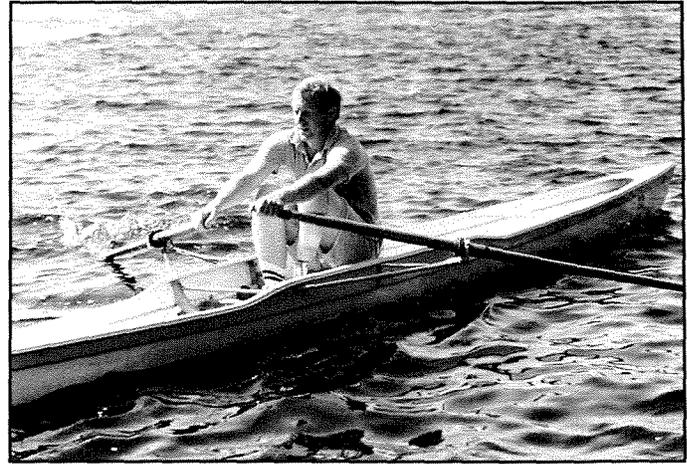
DALE TILLY/VAMC SEATTLE, WA

In the foreground, Samantha Ellis (bilateral AK) works out on an Avita 950 Hydraulic Rower. She wears Endolite prostheses which are not locked in knee extension. A towel is used to prevent the seat from sliding. Greg Mannino, exercising on the Flywheel Stationary Rower, is seen in the background. Note the difference in arm movement in each rower. The design of the Hydraulic Rower requires arm movement which is unlike the flywheel design and from sculling on water.

way to remedy the problem is to lock the knees of the prostheses in an extended position. However, for those who will use the machine on a regular basis, installation of mechanical stops is usually the best way to prevent the seat from sliding.

COMPETITIVE PURSUITS

Traditionally, athletes with lower limb loss have competed in rowing events on the same level as nondisabled athletes. As a result, organized compet-



PROSTHETICS RESEARCH STUDY, SEATTLE, WA
Jim Clark is shown in a Pocock recreational wherry.

itive events that are exclusively among rowers with disabilities have been virtually nonexistent until recently. In 1988, the first international rowing regatta for athletes with disabilities was held in Sidney, Australia.

Jim Clark, PhD, a professor of Business Administration at the University of Washington, began rowing over 20 years ago. Even after losing his leg below the knee, he crewed as a member of the University of Washington team. He rows with a prototype flexing ankle he helped develop, and currently competes in Master's-class events. Clark says that rowing is excellent for the athlete with a limb loss because one can compete with the nondisabled athlete without any compromise in the rules, equipment, or technique. He has found it to be such a positive force in his own life that he is working to involve others in the sport by instructing them. He teaches a beginner's course at The Rowing School on Lake Union in Seattle, WA.

NOTES

1. B. Kirch, W.H. Reed and J. Fithian, *Row for Your Life*. New York: Simon and Schuster, Inc., 1985, pp. 58-59.