the boat will remain stationary in the water. If the moments are unequal, as in our example where the bow is too low, the water moment is less than the boat moment and we must raise the bow, pivoting the boat about its longitudinal center of gravity. This causes the underwater hull volume to be shifted towards the stern. Again we compute the water moment. Because the distance of the underwater hull volumes' center (called the longitudinal center of buoyancy) is increased, the moment will be greater and after repeated increments, eventually the moments will be equal. At this point the whole system is in static equilibrium. The see/saw is balanced. This assumes, of course, that all parts of the deck or tops of the hull sides are still above water and the boat is floating.

Now we know where the waterline is and can draw it in on a profile drawing of a museum specimen as in figure 1. All this without the boat ever having been out of the storeroom or off the drawing board.

The next question we want to ask is what happens to the waterline when a ton of fish is placed in the cockpit or two dead seals are tied on the after deck? Going back to our example boat, we take it out of the water, place the weights where we want them and again lower it into the tank computing new centers of gravity and buoyancy and moments until the boat is again in perfect trim. The computer program assumes that if excess weight is added such that the bow or stern are under water, the craft is sunk and the trial is aborted. Up to ten different weights per trial and up to twenty trials are accepted by the program for any one boat. The last major question to be solved by the computer concerns the stability characteristics of the boat. Imagine yourself standing on the gunwale of a canoe. The force of your weight trying to capsize the boat is far greater than the buoyancy force trying to keep the canoe upright and you know the result. Quantitatively, we want to know the buoyancy force, called the righting moment (expressed in meter-kilograms), when the boat is heeled over a given number of degrees. The greater the righting moment, the greater the stabilty of the craft. When the righting moment becomes negative, the boat is in a capsize condition.

In the simulation program, the boat is tilted or heeled around a transverse section through the longitudinal center of gravity and it is assumed that the trim previously calculated does not change for different degrees of heel.

Figure 3 shows the stability data for a typical Bering Sea kayak. Column 2 contains the data for the kayak and kayaker heeled over at 1°, 10° and every 10° up to 90°. Looking at the row under each angle of heel labeled "righting moment (m-kg)" we see that this figure is greatest at 20° of heel and that at 50° of heel the righting moment is negative and the kayak is capsizing. Column 4 data is for two people in the cockpit back to back. Since their vertical center of gravity is higher than for one kayaker, they are less stable and reach capsize condition at about 40° of heel. Column 5 data is for one kayaker, one seal inside and forward of the cockpit, and one seal inside and aft of the cockpit. All this low weight tends to put the center of gravity lower than for the kayaker alone and the craft, while also unstable at 50°, has greater righting moments at 10° - 40°.

The waterlines for this kayak are all given in figure 4 along with the specific load conditions. The loads are added by specifying their weight and