MARSHALL ISLANDS CARTOGRAPHY

By WILLIAM DAVENPORT

Cartography is an invention that is seldom encountered among primitive, that is non-literate, peoples, for it seems to be a development closely allied with writing systems. One of the rare occurrences of map making in a primitive culture—and certainly the most sophisticated of them—is in the Marshall Islands of eastern Micronesia, Pacific Ocean. Before their first contact with European civilization in the 16th century the Marshallese had perfected both ocean-going canoes that were as maneuverable and swift as any small craft ever devised, even by an industrialized society, and a unique system of piloting that was graphically represented on a kind of chart.

The hulls of their canoes, constructed of hard-axed planks that were tightly fitted and stitched together with coconut fiber cord, were knife-thin and kept afloat in the water by a canted-keel outrigger float on one side. Driven by a lateen sail, the canoe could be easily tacked and sailed up very close to the wind, without making undue leeway, as well as sailed down wind with minimum drag in the water. With such seaworthy and manageable craft as these, regular communication among the 34 coral atolls of the Marshall Islands was possible, even though the tiny islands of this group are widely scattered and all are so low that none can be seen from more than a few miles at sea.

By acute observation of the sea, the Marshallse had accumulated a rich fund of accurate knowledge about the action of ocean swells, what happens to them as they approach and pass by land, and the characteristics of two or more swell patterns interacting with each other in the presence of an island. Much of this empirical knowledge was not so well known by scientific oceanographers of our society as it was by Marshallese seafarers until aerial photographs were available for studying wave and swell action. When oceanographers began to study ocean swells it was found that their action conformed to the laws of wave theory in the same ways as do light and sound. For example, when an ocean swell strikes a shore, part of it—its energy, that is—is reflected at an angle equal to the angle of its incidence. And when a swell approaches, strikes, and part of it moves past a small island, such as one of the Marshall Islands atolls, its line of movement is changed according to the angle of shoreline toward which it is advancing. The crestline of a swell approaching the shore of an island is bent and curved toward conformity with the shoreline. This occurs because the inshore portion of the wave is slowed down as it encounters shallow water, its energy is expended by breaking or peaking up the wave, thus slowing down the forward motion while the offshore portion in deep water continues advancing at a constant rate of speed. This is swell refraction. Finally, a turbulent shadow of a special kind, resembling a penumbra, is to be found extending out from the lee side of an island for several miles.

Refection, refraction, the shadow phenomen and several other ancillary wave actions were well understood by the Marshallese who studied them, not from the vantage point of aerial photographs where they can be observed with ease, but from the surface of the sea in their canoes and from the shores of their atolls which offer elevations never more than a few feet above sea level. They not only recognized these complex swell and wave patterns, they put this empirical science to practical use by developing a system of piloting and navigation from it. It is this oceanographic phenomena that are depicted on their charts. The charts are used by sailing masters to teach the principles of wave action and the use of them in fixing a canoe's position when it is near to but out of sight of land.

Marshallse charts are not drawn flat sheets; they are models constructed of sticks. There are two types: the mutting, constructions that illustrate the abstract general concepts of swell movements and interactions in the vicinity of one or more small islands; and the meddo ("sea") constructions depicting particular islands in the Marshall group and their distinguishing wave characteristics. The former are, in effect, science models; the latter, piloting instructions. Neither kind was carried on board a voyaging canoe, for all the oceanographic erudition was stored inside the Marshallse navigator's head. And these navigators, even today, guard this information carefully and pass it on only to others who have been specially selected for the training. Only when the information is to be conveyed to an apprentice are the best charts—that is, those with complete information—constructed. One of the finest meddo type charts in any museum collection is the model collected by Robert Louis Stevenson and his wife when they were in the Marshall Islands in 1890. It is displayed in the Oceania Hall of the University Museum.

Another fine example of the mutting type was given to the writer by James Milne, a fully
A muttagg-type chart on which the principles of piloting by ocean swells are illustrated. The cardinal point is the side on which the two small sticks are not crossed. It is the sunrise or easterly quarter out of which the northeast trades and sly, bringing the dominant system of swells. The other swell systems depicted are those that are generated by winds in other parts of the Pacific Ocean and reach the Marshall Islands in different latitudes at the year after traveling thousands of miles of sea, 34 by 35 inches.

The odd end that has two uncrossed sticks represents the direction of sunrise, the cardinal direction for the Marshallese, from which come the tradewind and the dominant swell. All elements of the model are arranged into an octagonal composition. The eight marginal sticks forming the sides of the octagon and the undecorated straight sticks that connect the corners constitute the supporting frame only and represent nothing.

In reading this training model, the center can represent an island, and the bent sticks illustrate refractions of waves approaching it from many directions. The corvia (Cyprina sp.) shells tied at the center point of each side can also represent islands, and the crossed sticks by them illustrate either interactions of other refracted waves or the turbulence that is found in the lee of an island as a swell is bent around it. In other words, some elements of the construction can be used to represent more than one principle of swell action.

Combinations of island representations, either central and side or side and side, can be selected by the instructor to represent almost any pair of islands in the Marshalls in a variety of wave conditions.

The problem for the Marshallese pilot is to be able to sail up and down the whole chain out of sight of land and to know his position relative to the nearest islands all the time; knowing this he can correct his headings as needed in order to make accurate landfalls when currents, which cannot be observed, affect his traversed course. To do this he must know the relative geographic positions of all the islands in the group, the expected sailing distances between them under varying conditions of wind, and must be able to read the configurations of swells that identify each unseen island as he passes it. By lying on his back in the bilge of his canoe and sensing the motion of the canoe, the skilled pilot can "fix" his position at night even without looking at the sea, for the movement of the canoe alone will tell him what kinds of swells are acting on it.

Obviously, a certain amount of aesthetic license is to be found on some charts, and an instance of this can be seen on the muttagg described here. Wave patterns rarely, if ever, occur in such perfectly symmetrical relationships as shown on this chart. And an added bit of appropriate symbolism is contained in the notched figures of the straight sticks laid between the curved pairs, for they are appropriately shaped in the same form as were masthead decorations on the old Marshallese sailing canoes. These creative liberties hardly can be attributed to the scientific naiveté of a tribal people; the trained technicians who constructed the colored ball and wire models of the atom in order to illustrate principles of nuclear physics also seem to sacrifice some scientific accuracy for visual appeal.

SUGGESTED READING