

NOTE

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REFERENCES CITED

- ADCOCK, C. J.
1951 A factorial approach to Rorschach interpretations. *J. Gen. Psychol.* 44:261-262.
1954 Factor analysis for non-mathematicians. Melbourne University Press.
- ADCOCK, C. J., J. R. MCCREARY, J. E. RITCHIE, and H. C. A. SOMERSET
1957 Personality and physique: a Rorschach study with Maori and European subjects. *Austral. J. of Psychol.* 9:158-188.
- BEAGLEHOLE, E., J. E. RITCHIE, et al.
1956 Effects of technological change on four New Zealand Maori Communities. Progress report No. 3. Department of Psychology. The Victoria University of Wellington.
- BEAGLEHOLE, E.
1957 Social change in the South Pacific. London, Allen and Unwin.
- BILLIG, OTTO, JOHN GILLIN and WILLIAM DAVIDSON
1947-48 Aspects of personality and culture in a Guatemalan community: ethnological Rorschach approaches. *Journal of Personality* 16:153-187, 326-368.
- CATTELL, R. B., H. BREUL and H. PARKER HARTMAN
1952 An attempt at more refined definition of the cultural dimensions of syntality in modern nations. *Amer. Social. Rev.* 17:408-421.
- DRIVER, HAROLD E.
1953 Statistics in anthropology. *American Anthropologist* 55:42-59.
- EYSENCK, H. J.
1953 The structure of human personality. London, Methuen.
- GLADWIN, T., and SEYMOUR B. SARASON
1953 Truk: man in paradise. Viking Fund Publication in Anthropology No. 20. New York.
- HONIGMANN, J. J.
1949 Culture and ethos of Kaska society. Yale University Publications in Anthropology No. 40. New Haven.
1955 Symposium on projective testing in ethnography. *American Anthropologist* 57:253-256.
- KLOFFER, BRUNO et al.
1954 Developments in the Rorschach technique. Vol. 1. New York, World Books.
- MONS, W.
1947 Principles and practice of the Rorschach personality test. London, Faber and Faber.
- RITCHIE, JAMES E.
1956 Basic personality in Rakau. Department of Psychology Publications, No. 8 (Monographs on Maori Social Life and Personality No. 1). The Victoria University of Wellington.
- SPINDLER, G. and W. GOLDSCHMIDT
1952 Experimental design in the study of culture change. *Southwestern Journal of Anthropology* 8:68-83.
- THURSTONE, L. L.
1947 Multiple factor analysis. Chicago, University of Chicago Press.

Canoe Travel in the Truk Area: Technology and Its Psychological Correlates

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ALTHOUGH canoe travel in the open ocean between islands has been characteristic of all cultures in Oceania, and indeed was necessary for the population of the islands, only in Micronesia were long voyages made in sailing canoes. In Polynesia, for example, such trips required large crews of paddlers; the wind was used only to help the craft along when it blew in an appropriate direction. Long journeys were therefore feasibly organized only by persons able to command the services of a substantial number of people. In Micronesia, in contrast, four or five men could readily man a sailing canoe and travel where or when they wished.

At the present time, sailing canoes suitable for long trips remain in use only in the small islands of the Caroline group scattered widely over the ocean from Truk westward. The language and culture found on these islands relate them clearly to Truk, whereas most of them fell historically under the hegemony of Yap to the west—a tie which Lessa (1956) has demonstrated is by no means completely extinct. Both Truk and Yap possess volcanic soils which can support crops impossible of cultivation on the sandy coral islets which lie between. Trade therefore provided the impetus for travel to and from the high islands, and there was in addition considerable social visiting back and forth between all the islands. Some voyages, apparently of exploration, have also been recorded extending over hundreds of miles to Guam and even remoter islands. Trips of up to 200 miles or so are still made, although with reduced frequency. Canoes are also used on a few islands other than those mentioned above for interisland, but essentially local, travel to Truk and Ponape.

It is my intention here to discuss briefly the combination of factors, none of them unique in themselves, without which this type of travel would probably not be possible. We shall consider canoe design, navigation, personality structure, and social organization. It is my thesis that we cannot fully understand the development of this or probably many other forms of travel without taking into account the combined effect of all of these aspects of the problem.

For sailing across the open ocean a small craft must possess two crucial design characteristics. First, it must have a minimum, and predictable, tendency to slip or drift sideways with the wind; in other words, it must be inherently capable of countering the sideways push of the wind by a counter-pressure generated by the travel of the hull through the water. Otherwise it would only sail a straight course when the wind happened to be astern. This counter-pressure generated by the hull must also increase automatically when the wind pressure increases, so that the helmsman does not have to guess at a

change in course with every gust of wind. Second, the craft must have sufficient stability to ride out a storm—and the islands of which we are talking lie in the typhoon area.

Despite the obvious difficulty of these requirements, the sailing canoes in the Truk area, and to the best of my knowledge all of the Western Carolines, meet them with extraordinary efficiency. They are roughly 20 to 30 feet in length, with the familiar geometry of the single-outrigger canoe. They use a lateen sail which can be shifted to either end of the hull in order always to sail with the outrigger on the windward side, thus causing the tilt of the boat from wind pressure to lift the outrigger in the water and reduce its drag to a minimum. There is also a platform mounted opposite to the outrigger on which the crew can sit as necessary to balance the outrigger and keep it riding suitably high in the water. The spectacle of one of these boats reversing direction to a new tack is a miracle of organized confusion. On the order of the skipper the mast is lifted from its socket and descends in a mass of sticks, ropes, cloth, and shouting men who are leaping all over the frail canoe. As one is forming a picture of the hours necessary to unscramble this mess, the sail incredibly rises at the opposite end of the canoe and it glides off effortlessly on a new course.

The secret of this canoe's sailing performance lies in its hull. It is narrow, tapers to a point at either end, and is a deep V in cross-section. It is built up of planks hewn from breadfruit and beautifully fitted to a keel-piece carved from the trunk of an extra large breadfruit tree; the planks are secured with lashings which are countersunk and caulked to produce a smooth exterior. The hull rides fairly deep in the water, although not nearly as deep as the centerboard or keel of a European-type sailboat, most of which could not negotiate the passes available through the coral reefs. This keelless V-shaped hull also has a minimum of wetted surface under the water, an important factor in reducing the drag of the water on the hull. Viewed from above, the hull thus travels through the water as a long, narrow, symmetrical shape, sharply pointed at either end—a shape which is becoming increasingly familiar as the cross-section of the ideal supersonic aircraft wing. This is not a coincidence, for the dynamics of supersonic airflow, when the air becomes incompressible like water, are very similar to those of hydrodynamics. The airplane wing when traveling through the air at a very slight upward angle develops a distribution of pressures above and below sufficient to sustain not only itself but the entire weight of the airplane. Similarly, the canoe hull, traveling through the water on a heading only slightly upwind of its true course, is able to counteract adequately the downwind pressure on the sail. (It should be noted that the wings of supersonic airplanes are generally not symmetrical in both planes only because of the compromises necessary for subsonic flight on takeoff and landing.)

To continue the airplane wing analogy, if the angle of the wing is increased a little, a marked increase in its lifting force results. This is also true of the sailing canoe hull. Here we find operating an additional relationship between sail and hull, between wind pressure and water pressure. Although the mast is

stepped forward of the midpoint of the hull, the sail angles backward far enough so that the tendency is for the wind to push the aft end of the canoe downwind, pointing the bow into the wind. The helmsman counters this with a little pressure on his steering paddle. If, however, the wind increases in force and the helmsman does not move his paddle, the stern falls off a little, pointing the bow up at a slightly sharper angle toward the wind. But this is precisely the change in attitude which we noted above would be expected to increase the lift, as it were, of the hull, and counter the increased pressure of the wind. If the boat is properly rigged it will thus continue to sail a true course irrespective of small changes in wind velocity without any attention from the helmsman, each change in the wind altering slightly the angle of the hull as it goes through the water and thereby increasing or decreasing the resistance of the hull to slippage.

Some canoe builders further elaborate on this already efficient balance of forces by introducing a little curve in the hull, curving away from the outrigger at either end. This creates a slight tendency to turn downwind, counteracting in part the upwind tendency created both by the angle of the sail and by the drag of the outrigger (which operates in the same direction as the wind forces). In this fashion the work of the helmsman is materially reduced and such canoes will sail "hands off" under favorable conditions, maintaining any course they are trimmed for.

Little need be said about the second requirement, stability in a heavy storm. The solution is simply to remove mast and sail, lash them down to the hull, and ride it out. The hull and outrigger are now spread out crabwise over the water with nothing sticking up for the wind to catch and tip over. Although some lashings may loosen, necessitating dangerous emergency repairs, the boat is not likely to be overturned by the waves. Even in a storm the long swells of the open ocean do not have the steep pitch and rapid cycles of waves in an enclosed body of water and a small boat can ride up and over the crests without too much difficulty. It is worth noting that the crews of sailing canoes en route to Truk loll about and sleep when at sea, but once they enter the enclosed lagoon every man is awake and at his station, ready to take corrective action if a squall creates choppy water or a shift in the wind changes the angle of the waves.

The second factor to consider is that of navigation. This depends primarily upon a vast and minute knowledge of the rising and setting positions of stars through the seasons. For every island to which one might sail there is a star or stars, particular for the time of year, upon which one sets one's course, steering a little to the right or to the left as appropriate. In addition, there are observations of wind and waves, of the flight paths of birds, and other devices which permit one to hold a course when the stars are not visible, and to tell when land is near. The essentials of star navigation, as far as they are known, have been described by Goodenough (1951) and the remainder of the system is too complex to attempt to describe here, except to emphasize two points. One is that, under normal conditions, the system works extraordinarily well and

experienced navigators can make their landfalls with amazing precision. The other is that this is basically a system of dead reckoning. By this I mean that it permits the navigator to set and maintain a sailing course, and allow for changes in course, as long as he keeps sailing. However, if for any reason he stops sailing and drifts in an uncontrolled and unknown direction, once he starts sailing again he cannot find out from this navigational system where he is or what direction he should sail in order to reach land.

This situation can develop either when riding out the circulating winds of a typhoon, or when drifting for several days in a flat calm. The currents in the latter case are often unpredictable because in this latitude lies the shifting boundary between the westward-flowing North Equatorial Current and the eastward Equatorial Countercurrent. The exact location of the boundary is unpredictable, and the navigator may set his course when the wind rises again on the assumption that he had been drifting westward when he had actually been doing just the opposite, thus missing his landfall and sailing off to die of hunger or thirst in the empty expanses of the Pacific. This hazard is very real. During my four years on Truk one canoe was lost after being becalmed with some ten persons aboard, while at least two canoes disappeared in storms. Several others reached land after riding out storms only by random cruising and pure good fortune; one of these desperate voyages is described by Father Rively (1953), a Jesuit missionary, in his book *The Story of the Romance*. This account provides graphic testimony of the helplessness of the native navigator once he is lost.

It would be difficult for us to contemplate with equanimity such voyages with their ever-present dangers, and probably even more difficult for us to withstand the psychological stresses imposed upon those crews who become lost and drift. They suffer isolation and physical privation and the inability to plan any course of action which will assure their survival. Lilly (1956), in the course of a larger study at the National Institute of Mental Health, has collected all the accounts he could find of persons, most of them European in origin or ancestry, who have been isolated in the polar regions and on small boats at sea. With few exceptions they experienced hallucinations and other schizophrenic-like symptoms of varying severity, often leading to delusions which forced them to self-destruction. Yet to the best of my knowledge no such reactions, with the exception of some probably toxic hallucinations, have been reported for the natives of these islands even when they have been lost for long periods.

If we attempt to account for their ability to treat as almost routine such obviously hazardous voyages, and to avoid personality disorganization when the dangers materialize, we are forced into speculation. However, we can cite some differences between Western personality and that of the Trukese (Gladwin and Sarason 1953) which may be suggestive of the psychological equipment which makes such canoe voyages possible. We may make the assumption that the personality structure described by Burrows and Spiro 1953,

Lessa and Spiegelman, 1954, and others for the islands west of Truk is sufficiently similar to permit generalization in this context.

Emotionally, the Trukese are characteristically shallow. They are not more than minimally sensitive to the feelings of others, and are not given to introspection about themselves or their futures. They do not appear to share our concern with the integrity and importance of the self, and find it difficult even when asked to formulate any particular life goals. In other words, they seem to conform to the popular stereotype of the happy-go-lucky native, living from day to day and taking good fortune and misfortune as they come. They respond appropriately to things which happen, but do not inquire too deeply into what the future may hold. Briefly, we believe this sort of personality results from the rather extreme inconsistency of the parents' behavior toward their children, which prevents the latter from identifying successfully with the parents and makes it difficult to develop and internalize a substantial self-image. At the same time, the society of children and of adults is so structured that all strong feeling is best suppressed lest the all-important support of the kin group be lost. Lacking a strong concept of the self, they are naturally little concerned with projecting it into the future.

If one accepts this description of Trukese personality, it becomes easier to understand why they are not unduly concerned with the possible disasters which may befall them on a voyage. When asked they will admit that the dangers exist, but when pressed to explain their willingness to face them, they shrug the question off almost as if it were irrelevant. Instead of saying, as we (or Father Rively) might, that the goals were sufficiently important to justify the risk, they appear, like American automobile drivers, to disregard the possibility that it might be they who would die. This response is made in spite of the fact that the objective risk is far greater, and the factor of personal skill less important, than in automobile travel.

This same lack of clearly formulated concern over the self or the future undoubtedly also helps them withstand the despair of being lost. In effect, they do not perceive that they have as much to lose as would we in such circumstances. Also, as we might expect, they are not as frightened over the possibility of death. A dying Trukese is usually quite calm, although his relatives, particularly after he has died, react violently.

Another factor apparently of psychological importance in some cases of isolation of Caucasians is the time dimension. For some reason, many people appear to cling with desperation to some ingeniously contrived means of estimating the time of day and the date, a last contact with reality or basis for hope which, when lost, marks their real breakdown. For the Trukese this is a matter of little or no concern. Aboriginally they were equipped to reckon the seasons, and to divide the day into morning, daytime, afternoon, evening, and night, but these were means for relating oneself to the realities of nature, not an arbitrary system for bounding one's activities. In response to the demands of foreigners they have learned to tell time and the date, but when not

in a foreign context they pay little attention to either. A man who has acquired a watch and wears it as a sign of status is concerned if it does not run, but may not even bother to set it if he discovers it is an hour or two off. We may therefore conclude that losing track of the time, which so dismays Western castaways, matters little or not at all to the Trukese.

These are probably not the only, nor necessarily the correct, factors which account for the ability of these natives to undertake and withstand long canoe voyages. However, the contrast with our own society does make it appear that psychological variables cannot be ignored when considering why some people do and others do not travel in this fashion.

The final requirement necessary to make a long and lonely voyage acceptable, and often desirable, is that one find a welcome and a place to stay at one's destination. Here we find social organization abetting the travelers. Throughout these islands, one of the key relationships with regard to feeling tone as well as interaction is that between brothers. Brothers are not merely own brothers, but extend out in a classificatory sense and beyond into artificial relationships. Paradoxically, probably due largely to sibling hostility, the more remote the relationship the more likely a strong bond will develop. This device provides a natural framework for hospitality toward the voyager. If the voyager knows no one on an island but finds his sib is represented there, he will seek out a congenial man with whom to confirm the nominal brother relationship. Even if there is no corresponding sib, he will create an artificial brother tie with someone. The bond becomes ramified throughout the host's kin group, extends back to the voyager's kin on his own island, and will often last down through the generations. A relationship is thus established which will encourage other voyages. It also reinforces the tendency, rooted in more general patterns of solidarity and cooperation within kin groups, to form the nucleus of boat crews around close relatives. This aids in the assignment of roles in routine operations, and also contributes to the control of disruptive emotional forces in time of crisis.

In conclusion we need add only that most of the islands between which trips are still being made in sailing canoes are linked by fairly regular trips of passenger-carrying ships operated for the Civil Administration, with fares quite within reach of the islanders' resources. The fact that they no longer have to make canoe trips and yet still do is ample testimony to the effectiveness of technological, psychological, and social factors in making these journeys not only possible but, in the eyes of the natives, reasonable, fairly routine, and desirable.

REFERENCES CITED

- BURROWS, EDWIN G. and MELFORD E. SPIRO
1953 An atoll culture: ethnography of Ifaluk in the Central Carolines. Behavior Science Monographs, Human Relations Area Files, New Haven.
- GLADWIN, THOMAS and SEYMOUR B. SARASON
1953 Truk: man in paradise. Viking Fund Publications in Anthropology No. 20. New York.

GOODENOUGH, WARD H.

- 1951 Native astronomy in Micronesia: a rudimentary science. Scientific Monthly 73:105-10.

LESSA, WILLIAM A.

- 1956 Myth and blackmail in the Western Carolines. Journal of the Polynesian Society 65:66-74.

LESSA, WILLIAM A. and MARVIN SPIEGELMAN

- 1954 Ulithian personality as seen through ethnological materials and thematic test analysis. University of California Publications in Culture and Society Vol. 2, No. 5.

LILLY, JOHN C.

- 1956 Mental effects of reduction of ordinary levels of physical stimuli on intact, healthy persons. Psychiatric Research Reports 5:1-28.

RIVELY, WILLIAM E., S.J.

- 1953 The story of the Romance. New York, Rinehart.