GEOINFORMATION IN PRE-LITERATE COMMUNITIES

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Abstract

The contemporary concept of geographic information systems is a logical development of human curiosity about the environment. As a necessity for survival, this curiosity must have existed since the emergence of human consciousness.

The map and spatial model making ability of pre-literate human communities is re-examined in the perspective of geographic information content, methodologies, spatial orientational abilities, and, most importantly, the reason and purpose of such activities.

Introduction

Adler, early this century, undertook a comprehensive descriptive study of all known "primitive" mapping. It included an assessment of the mapping of the Aztecs, Incas, Chinese and many African tribes. In the English speaking world his work is known through de Hutorowicz's (1911) abbreviated translation.. Eskimos and Marshall Islander's spatial models have been studied much more extensively, particularly by Davenport (1960) and Spink and Moodie (1972).

In the context of this paper, the terms "maps", "spatial models" "charts" and similar will be used interchangeably as all of these terms refer to products that have one aim - to provide geographic information. Regrettably, most authors of past studies did not concern themselves with the actual names of these geographic information products, except for those describing the Marshall Islander's "stick charts". Early authors terminology describing these products as "primitive" because their creator's lack of literacy and the mode of producing the same, cannot be reconciled with the mapmakers sophistication in terms of ingenuity, logical reasoning, methodology of data gathering and the purpose. Therefore, the differentiation of resulting spatial abstractions as "literate" or "primitive" is arbitrary and irrelevant. No spatial abstraction (or map space) which essentially corresponds with reality (referent space) deserves that description.

Edney (1993) in his re-interpretation of the natural and historical development of maps excluded pre-literate communities although they were contemporary with other developments described in his research.

Spatial Orientation

Bagrow's (1948) generalizations about *primitive* (italics mine) peoples maps are confusing "... the sixth sense often shows him the right of way". However, on Eskimo coastline maps, the distances are based on differential travelling times, therefore logical deduction replaces the "sixth sense". Bagrow thought that a pre-literate individual visualised only an array of local details rather than an extended spatial relationship. If this is true then the explanation of Australian native "walkabouts" becomes very difficult.

Australian Aboriginal people have demonstrated an exceptional orientational ability. In their tribal system they had to maintain a semi-nomadic existence in one of the harshest environments in the world -- hot, dry and sandy desert or semi-desert conditions. To find water, food and shelter in such an environment, the inhabitants, except for relatively short periods, had to be continuously on the move. This process has been translated in English as "walkabout". Aboriginal people could reconstruct their "walkabout" in the sand as an abstract model indicating the sources of water, edible plants, insects and animals. Ultimately, the tribe returned to their place of origin, and some of the tribes travelled hundreds, and in some case, thousands of kilometres. The orientation-survival dichotomy is, therefore, the most plausible explanation of the orientational ability of the Australian Aboriginal people.

Whilst geographers and anthropologists discuss various cultural, racial, spatial and socio-economic attributes of pre-literate communities, even in a comparatively recent study (Howell, 1973), the problem of location and spatial orientation did not receive the attention it deserves. The influence of modern technology may have superseded the orientational ability in the remaining pre-literate communities, although the study and understanding of this ability is an important yardstick in both, anthropological and geographical studies.

Spatial Modelling by Siberian Tribes

Adler's study strongly focuses on Siberian tribes and, therefore, his accounts of these tribes appears to be more competent than his accounts of the mapping of other peoples (de Hutorowicz, 1911).

Chukchi spatial models of the Anadyr Delta (Siberia) are drawn with reindeer blood on wood boards. The meandering watercourses, vegetation, relief, hunting places and a number of islands within the delta are faithfully reproduced (de Hutorowicz, 1911).

Tungus maps were drawn on birch bark early this century apparently in the presence of technologically advanced explorers. De Hutorowicz maintained that none of the natives who drew these maps knew of modern cartographic techniques at that time.

The absence of an unambiguous statement whether or not both Chukchi and Tungus maps were original perceptions of space, or derivatives, confuses the understanding of the functional role of these maps.

De Hutorowicz (1911) saw similarity between the pre-literate mapmakers of Siberian tribes, the Eskimos and the North American Indians with regard to orientation, relative accuracy and the attention paid to essential detail. Subsequent archaeological research (Anderson, 1968) does not exclude the possibility of contacts between these population groups as the dating of human occupancy of areas around Alaska and Greenland (Kalaalit Nunaat) goes back at least 5000-7000 years. Anderson (1968) estimates the age of some archaeological sites to be 15000 years.

Spatial Modelling by Eskimos

Eskimo models have received a great deal of scientific attention.

One of the best original examples of Eskimo spatial models (fig. 1), made on tanned sealskin, is described by Bagrow (1964). The Crown Prince Islands, carved from wood, are glued to the skin. Their

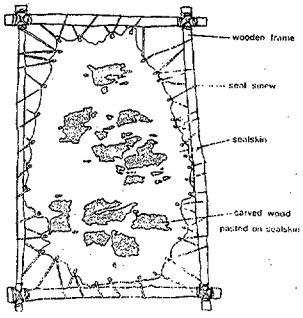

Fig. 1 Eskimo model of the Crown Prince Islands
Source: Bagrow, Eskimo Maps in *Imago Mundi*, (5), 1948

configuration, scale and orientation is described as remarkably good.

Fig. 2 is one of the remarkable examples of Eskimo mapping. This is a reflection of a cognitive map drawn by an Eskimo - Wetalltok with pencil on the reverse side of a lithograph. The resulting mental picture of the

Fig. 2 Eskimo map of Belcher Islands drawn by Wetalltok
Source: Flaherty, The Belcher Islands of Hudson Bay
their Discovery and Exploration in
The Geographical Review (5), 1918

Belcher Islands *(Hudson Bay)* compared favorably with an official map (fig. 3) by Flaherty (1918). Wetalltok's map shows more detail than the official map which was the result of various reconnaissance surveys.

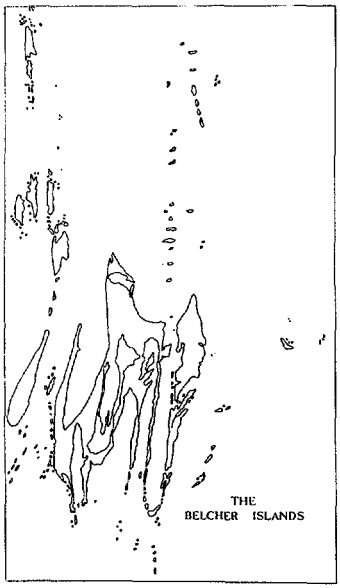

Fig. 3. Surveyed map of Belcher Islands
Source: Flaherty (1918)

Woodcarvings are more common in Greenland areas. They are carved on boards that drifted to their shores. Their functional role has not been established.

Spink and Moodie (1972) recognize the differences between the maps/models produced by the Eskimos alone and those drawn under varying degrees of Occidental (and probably Oriental) influences.

Marshall Islander's Navigational Models

Like Eskimos, the Marshall Islander's ingenious solutions to spatial modelling have also been analysed by researchers. The first description of these models is attributed to an American missionary, Gulick in the 1860's (de Hutorowicz, 1911) and, subsequently, they attracted the attention of anthropologists. Lyons (1928) thought that their spatial orientation abilities were no longer existing at the time of his research.

Because of the secretiveness surrounding the work of the Marshall Islander's, the interpretation of their models was difficult. Lyons (1928) outlined a chronological summary on previous work. Davenport (1960) exposed the intricate relationships and the construction of these models whilst Thrower (1972) summarized their principal functions.

The models were made of the centre ribs of palm leaves and tied with lengths of palm fibre. They were classified in three groups:

(a) mattang (fig. 4) - show the general concepts of wave refraction and served as an instructional aid

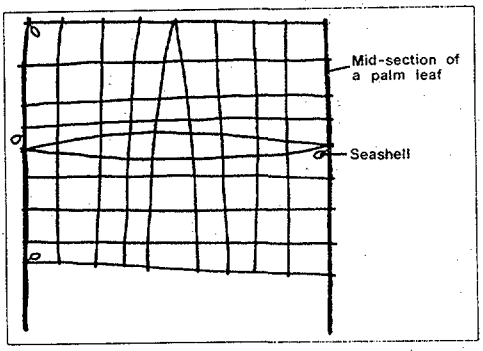

Fig. 4 Mattang
Source: Lyons (1928)

(b) meddo (fig. 5) - show relative locations of specific islands and selective hydrography with an emphasis on wave data.

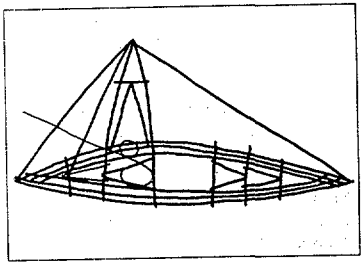

Fig. 5 Meddo
Source: as for Fig. 4

(c) rebbelith (ṛębbelib) (fig. 6) - similar to meddo but include all or most of the islands in the group. Seashells are often used to show islands on meddo or rebbelith.

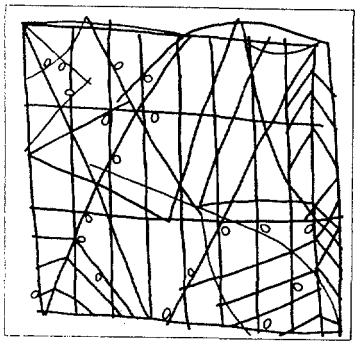

Fig. 6 Rebbelith
Source: as for Fig. 4

The Marshall Islands extend in a general northwest to southeast direction over 1000 km. They consist mainly of low atolls, therefore their visibility from a floating canoe would be limited to a few nautical miles. To maintain course, the navigator referred to the key stars at night - Polaris and Southern Cross, which are visible in most parts of the archipelago. Lyons (1928) and Davenport (1960) noted that the navigational skills of Marshall Islanders were developed independently of other navigators at that time.

Relatively consistent winds (northeasterlies) and their accompanying swell were used fore directional reference. Dead reckoning and elapsed time were the major methods for the determination of position outside land visibility range. Sailing chants were sung continuously to measure time intervals which were correlated with the estimated speed and observed natural phenomena (fish shoals, current convergence, water discolourations) for the purposes of orientation (Davenport, 1960)).

The most important of these phenomena were the combined actions of wave refraction, reflection and diffraction which were interpreted effectively as a navigational aid.

The navigational models, therefore, refer to wave phenomena. They are well conceived and generalized and whilst Davenport (1960) accepted them as products of true cartography, a better term would be navigational models.

The concepts of distance and direction appeared to be of much lesser importance to Marshall Island's navigators than the actual positions and orientation of islands relative to wave actions. Consequently, the cartographic accuracy of both, meddo and rebbelith, in relation to distance and direction, is not high.

Materials Used

Northern Siberian tribes used birch bark. The Chukchi produced very exacting work using reindeer blood on wooden boards. Woodcarvings were utilised by East Greenland Eskimos. Northern Canadian Eskimos

used sealskins. Woodcarving and birch bark drawings have also been used by American Indians (Adler, 1911).

Locally available materials were also used by the Marshall Islanders - palm leaves, palm fibre, coconut fibre and shells from marine animals..

Spink and Moodie (1972) noted the general absence of colour in pre-literate spatial model making although natural colours were available. This contrasts with pre-literate art in which colour is an essential ingredient. One explanation of this lack of colour is that both Northern tribes and Marshall Islanders experienced colour monotony (snow, tundra in North; the surrounding ocean in the archipelago) which may have been reflected in their attitude towards modelmaking.

The representations are realistic and essentially utilitarian in reflecting observed geographic phenomena. Northern Siberians emphasised high vantage points (black smudge or reindeer blood) and accessibility to hunting and fishing places. Rivers are marked with one line whilst a double line indicates an accessible shore. Eskimos indicated the hunting and fishing grounds with dots, crosses or discolourations.

Marshall Islanders on their models stressed the features of most importance to them - wavefronts- as curved lines in relation to islands.

There has been no explicit suggestion that the original models could be effectively used without an explanation. The level of abstraction and the appearance of the models would not permit their practical application without an explanation.

Discussion

Ingenious solutions to their spatial problems were demonstrated by many pre-literate communities but particularly those of Eskimos and Marshall Islanders. Whilst Eskimos selected elevated vantage points for the orientation and observation and used daily travelling time as distance criterion, Marshall Islanders observed more dynamic phenomena - wave action associated with astronomical and marine life observations.

Pre-literate spatial modelling was deeply rooted in the socio-economic life of both Eskimos and Marshall Islanders. It is highly likely that most of the Eskimo tribes converged for winter to share their experiences and to be close to seal hunting areas because the seal meant food, fuel, shelter and clothing. This was also the time to discuss their spatial models. During the summer they dispersed over the land to find the best hunting and fishing grounds (Flaherty, 1918)

With respect to the Marshall Islands, the political ambitions of local chiefs have been argued to be the principal reason for the secrecy surrounding their geographic and navigational models. Invasion forces were sent from island to island in order to gain supremacy (Davenport, 1960).

De Hutorowicz (1911), referring to Adler's work, implicated that cognitive non-graphical images enabled the orientation of many *primitive* (italics mine) peoples. The author observed the orientational abilities of an isolated group of Australian Aboriginal people in 1960. A member of the group on a "walkabout" was shown an aerial photograph close to the Rawlinson Ranges (Gibson Desert), Western Australia. As communications proceeded in sign language, a particular section of the nearby ranges was indicated to the Aboriginal person and then the same section was shown to him on an aerial photograph. The process was then repeated, drawing attention to some of the prominent trees, a dry stream bed and some sand dunes. After a relatively short time he realized that he was dealing with a reduced image of his country upon which he became quite agitated and started to point out other features. He indicated that his agitation was *related* to the fact that the country extended further than the aerial photograph revealed. His appreciation was clear when a series of overlapping photographs were shown to him.

As this person had had very little contact with outsiders and certainly no experience with aerial photography, it can be assumed that his behaviour was an example of his ability to carry a mental spatial image of the area.

Further proof of the implementation of accumulated topographic knowledge is described by Haddon (1908) in his expedition to Torres Strait (separating Australia and Papua New Guinea). At the site of youth initiation ceremonies, he observed a configuration of stones resembling a topographic model of the islands. The story of a tribal hero was told to youths who repeated their hero's journey from island to island by moving from stone to stone..

An experiment by author lends additional strength to the argument that human orientation and mapmaking ability is a function of accumulated collective spatial knowledge.

The first year surveying and cartography students at the Curtin University of Technology (then Western Australian Institute of Technology) were provided with an outline map of Australia on which they were requested to draw several regional features. The geographical boundaries of the features selected appeared in school texts, atlases and other relevant publications and were relatively recognisable to most of the students. The students were asked to draw the boundaries on the outline map from memory only. The experiment extended over the period of several years (1976-1982). The principal observation emerging from this experiment was that the mean position of regional feature outlines became increasingly closer to the mean "established" or "accepted" boundaries of the feature. The mean boundaries from the publications appeared to correlate very closely with the mean boundaries as drawn by the students. This, in itself, could be explained as a statistically obvious result. However, at the same time it provides a rational explanation of the principal methodology of pre-literate spatial problem-solving-a pictorial representation of accumulated collective spatial knowledge by heuristic methods based on a mental, or cognitive, map.

One can argue that, in the case of pre-literate mapping, the "surrogate space" (spatial model) had to be abstracted from direct observations in the field whilst the student test groups prepared their maps from their memory of other mapped surfaces. However, because in both cases, the spatial reconstruction is based on a mental map, the original source of the mental map appears to be immaterial. Otherwise, the Eskimos ability to draw maps on paper or in the snow, and the Australian Aboriginal peoples spatial models made in sand and other available objects, cannot be rationally explained. In each case, the subjects must be able to visualise a diminutive picture of their environment before being able to draw it on whatever media or by whatever means.

Therefore, it is immaterial to draw boundaries between the literate and pre-literate maps, and the methodologies of their conception. One important conclusion, however, prevails. All maps and models were needed in order to understand, represent and appreciate geographic and environmental information without literacy or other constraints.

Summary

The general trend of spatial orientation and modelling by pre-literate communities aims for the communication of geographic knowledge of their specific territories. Such territories range from relatively restricted areas (Northern Siberians, Eskimos) to large areas (Marshall Islanders) and to extensive areas (Australian Aboriginal people).

Pre-literate spatial modelling in some form or another has been restricted mainly to the nomadic peoples whose knowledge of their geographic surroundings was essential for physical and/or economic survival.

Research into pre-literate geographic information gathering and representation has been concentrated on those groups of people who have produced visual manifestations of their spatial knowledge with some degree of permanency.

As pre-literate spatial orientation and modelmaking has practically disappeared, a summary research programme in pre-literate spatial communications could not only be of some anthropological and geographical value but also should clarify a range of psychophysical aspects of human spatial perception.

References

Anderson, Douglas, D. (1951-1958) A Stone Age Campsite at the Gateway to American in Pre-Columbian Archaeology. *Readings from Scientific American*, introd. by Willey & Sabloff, W.H. Freeman & Co., San Francisco, pp. 26-34.

Bagrow, Leo (1948) Eskimo Maps.. Imago Mundi (5)

Bagrow, Leo (1964) *History of Cartography*. Revised and enlarged by R>A> Skelton, Harvard University Press, Cambridge, MA, pp 25-28.

Davenport, William (1960) Marshall Islands Navigational Charts. *Imago Mundi* (15), pp. 19-26.

de Hutorowicz, H. (1911) Maps of Primitive Peoples. Translated and abridged from the Russian original by B.F. Adler, *Bulletin American Geographical Society* (43), pp. 669-679.

Edney, Matthew, H. (1993) Cartography Without 'Progress': Reinterpreting the Nature and Historical Development of Mapmaking. *Cartographica* (20), pp. 54-68.

Flaherty, R.J. (1918) The Belcher Islands of Hudson Bay: their Discovery and Exploration. *The Geographical Review* (5), pp. 433-435.

Haddon, A.C. (1908) *Reports on the Cambridge Archaeological Expedition to Torres Straits* (6) Cambridge, p. 304.

Howell, William (1973) *The Pacific Islanders*, Charles Sribner's Sons, London.

Lyons, H. (1928) The Sailing Charts of Marshall Islanders, *Geographical Journal* (72), pp. 325-326.

Spink, John and Moodie, D.W. (1972) Eskimo Maps from the Canadian Eastern Arctic. *Cartographica*, Monograph No 5, Department of Geography York University, Toronto, pp. 4-8.

Thrower, Norman, J.W. (1972) *Maps & Man*, Prentice Hall, Englewood Cliffs NJ., pp. 4-8.