# 3 · The Origins of Cartography

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One can argue that man's need to make maps arose during a fairly early stage in the coevolution of brain and culture. While gene mutations created new potentialities, culture would have bestowed advantages on those individuals and groups who could best perform specific mental and mechanical activities.[1] At a certain stage it would have become advantageous for man to structure information about the spatial aspects of his world and to communicate it to others. Unlike temporally structured information such as narratives, which can be transmitted—as speech or music—in a sequential mode, spatial information would not have been easy to transmit by the earliest of man's communication systems. Speech and music were ephemeral as well as sequential, and so were gesture and dance, though those could be two- or at best three-dimensional. However, once graphic forms of communication were developed in the Upper Paleolithic (some forty thousand years ago), they had the advantage of being both more permanent and two- or three-dimensional. Thus it would have been from these graphic forms that the means of expressing and communicating information about the world in spatially structured images first emerged. Although the advantages of such a means of communication would have been accruing from the start, for a long time mapmaking was almost certainly an unconscious, barely differentiable form of graphic expression. Indeed, this is still its status in certain indigenous societies, though in other parts of the world it began to emerge as a distinctive practical art some three thousand or more years ago. Mapmaking appears to have remained undifferentiated in those cultures in which cognitive development, even in adults, terminated at the preoperational stage, which is distinguished by the topological structuring of space. Those societies in which adults first began to manifest operative modes of cognition were the ones that first began to formalize projective and Euclidean geometries, and it was within these that cartography first emerged as a distinctive practical art.

The capacity to transmit information about spatial relationships between phenomena and events and to receive such information in message form was already well developed in many animals long before the emergence of *Homo sapiens*, though their message systems were genetically predetermined and thus unmodifiable either by mental reflection or by group interaction. Since these animals have evolved far less rapidly than man during the past forty thousand years, we can assume that their means of communication were much the same then as now. Studies of animal behavior have revealed examples of mapping procedures. Most involve scent marking of the environment and require the receiver to be in the area.[2] In certain respects such scent marking of territory can be likened to the way man employs markers to indicate boundaries where no maps exist. There are also a few known animal systems for communicating spatially structured information about the environment to receivers outside it, but these are ephemeral, lacking the relative permanence of artifacts. The best known is the round and waggle dance performed by honeybees on returning to the hive, by means of which they indicate to other hive members the direction and distance at which nectar has been found.[3]

Although this example might be dismissed as exceptional, "it is quite possible that we have yet to learn about the specialized languages of many organisms," as John Bonner says, since "each case is rather like cracking a code, and few people have the gift."[4] All the animal systems so far deciphered for transmitting a "map" to others of the species are genetically inherited. In consequence, they are unadaptable and are transmitted in

1. Charles J. Lumsden and Edward O. Wilson, *Promethean Fire: Reflections on the Origin of Mind* (Cambridge: Harvard University Press, 1983), 1–21.

2. For example, wolves in northeastern Minnesota cover their 100 to 300 square kilometer ranges approximately once every three weeks, leaving scent marks at regular intervals along well-established routes and in greater concentration at route junctions and near the edges of their territories. Roger Peters, "Mental Maps in Wolf Territoriality," in *The Behavior and Ecology of Wolves: Proceedings of the Symposium on the Behavior and Ecology of Wolves Held on 23–24 May 1975 in Wilmington, N.C.*, ed. Erich Klinghammer (New York and London: Garland STPM Press, 1979), 122–25.

3. Karl von Frisch, *The Dance Language and Orientation of Bees*, trans. Leigh E. Chadwick (Cambridge: Belknap Press of Harvard University Press, 1967).

4. John T. Bonner, *The Evolution of Culture in Animals* (Princeton: Princeton University Press, 1980), 129.

forms that, though rememberable (at least by higher animals), are otherwise unstorable. It is in these aspects of spatial consciousness and the ability to communicate it that *Homo sapiens* is different.

Like all animals, but far more so than most, early *Homo sapiens*, of forty thousand or more years ago, was mobile. People moved in an essentially two-dimensional space for a variety of reasons, either searching out or avoiding a diverse range of objects, conditions, processes, and events. Consciousness of the world involved monitoring it for novelty—for both unanticipated events in time and unexpected objects and conditions in space, which might constitute hazards or, alternatively, afford opportunities. In either case they compelled attention. More than in other primates and far more than in other animals, the well developed eyesight of *Homo sapiens* provided the necessary sensory basis for developing a spatial mental schema against which to relate these hazards or opportunities. In contrast to the forest habitats of most primates, the grassland habitat of *Homo sapiens* afforded a more extensive visual world. Survival involved developing strategies for achieving at the same time prospect through vision and refuge through self-concealment.[5] Not surprisingly, therefore, "spatialization" was probably the "first and most primitive aspect of consciousness," so much so that attributes of space such as distance, location, networks, and area continue to pervade many other areas of human thought and language.[6]

Unlike modern scientific awareness, with its search for order and regularity, the awareness of early *Homo sapiens* focused on irregularities in the world and on uncertainties rather than certainties.[7] Consciousness would have constituted "a form of re-presentation of the current perceptual input on a mental screen," thus maintaining a continuous state of alertness for the unanticipated and unexpected.[8] However, survival and success were not dependent only on consciousness and on response in individuals. They also depended on cooperation between individuals and within the society and on the ability to communicate between individuals and within the group, to store and transmit information, and to decode it in message form. Hence the development of the several forms of language—including those for communicating spatial information—which ensured the emergence of society and the handing on of its accumulated culture to later generations.

As early as 400,000 B.P., *Homo erectus* (i.e., Peking man) was capable of group pursuit and a degree of coordinated action in capturing and slaughtering large animals. These activities involved sporadic forays, systematic searches, and occasional migrations away from established territories (as distinct from the cyclical migrations of many other species). Such abilities were in part the cause and in part the consequence of intellectual and social developments. Success in hunting was to increase further with growth in the ability to adapt behavior to particular circumstances and to communicate and collaborate with others.

Both involved tremendous increases in intelligence and learning ability. *Homo sapiens* developed four important mental capacities that may also be regarded as necessary conditions for the eventual acquisition of mapping skills. First, there was the ability to delay an instinctive response in favor of a pause for exploration; second, the facility of storing acquired information; third, the ability to abstract and generalize; and fourth, the capacity to carry out the required responses to information thus processed. Collaborative effort in hunting, in particular, involved coding information and a capacity to transmit it rapidly and effectively between individuals. Language (gestural and graphic as well as spoken) was the enabling device that ensured this. Unlike the "here and now" language of the other higher primates, human language began to bind "events in space and time within a web of logical relations governed by grammar and metaphor."[9] Wittgenstein's proposition that "the limits of my language mean the limits of my world" remains valid.[10] One could go further and say that the origins of language and the growth of spatial consciousness in man are closely interrelated. The cognitive schema that underlay primitive speech must have had a strong spatial component. Not all messages were spatial in content or manifestation, but many would have been, and these

5. Jay Appleton, *The Experience of Landscape* (New York: John Wiley, 1975), 73.

6. Julian Jaynes, *The Origins of Consciousness in the Breakdown of the Bicameral Mind* (Boston: Houghton Mifflin, 1976), 59–61. Time is, and long has been, described in the terminology of space. Unconsciously, and without giving rise to confusion, we talk, albeit metaphorically, of the *distant* past, *points* in time, and the *way* ahead. Our lives *meander*, *diverge* along different *paths* from those of others, and have *turning points*. We *locate* problems and have different *areas* of interest. Our minds have their *regions* and *frontiers*, and our lives are *circumscribed*. Much less frequently, we reverse the metaphorical process by describing aspects of space in terms of time. Journeys take *minutes*, *hours*, or *days*. Yet for most people, and perhaps from the beginning of human consciousness, "what fails to exist *now* has seemed less real than what merely fails to exist here": Alan Robert Lacey, *A Dictionary of Philosophy* (London: Routledge and Kegan Paul, 1976), 204. Hence we *chart* our progress to date, *plan* our careers, and *map* out our lives.

7. Interestingly, forty thousand years or so later, the idea that in order to constitute a message, information must contain a degree of surprise for the receiver has been used by mathematicians in defining it as a precisely measurable commodity.

8. John Hurrell Crook, *The Evolution of Human Consciousness* (Oxford: Clarendon Press, 1980), 35.

9. Crook, *Evolution*, 148 (note 8).

10. Ludwig Wittgenstein, *Tractatus Logico-Philosophicus*, trans. D. F. Pears and B. F. McGuinness (London: Routledge and Kegan Paul, 1961), para. 5.6.

would have helped to provide the structural as well as the functional foundations of language. It has been argued that these foundations helped to promote

> the ability to construct with ease sequences of representations of routes and location. . . . Once hominids had developed names (or other symbols) for places, individuals, and actions, cognitive maps and strategies would provide a basis for production and comprehension of sequences of these symbols. . . . Shared network-like or hierarchical structures, when externalized by sequences of vocalizations or gestures, may thus have provided the structural foundations of language. . . . In this way, cognitive maps may have been a major factor in the intellectual evolution of hominids . . . cognitive maps provided the structure necessary to form complex sequences of utterances. Names and plans for their combination then allowed the transmission of symbolic information not only from individual to individual, but also from generation to generation.[11]

A related way forward is through modern studies of spatial cognition in humans. This has been well researched, and the spatial consciousness of modern indigenous peoples can be used to help unravel prehistoric mapping and hence the origins of cartography. For instance, researchers such as Christopher Hallpike, following the Piagetian school of developmental psychology, have identified a list of spatial concepts dominating aboriginal spatial thought.[12] This is composed of opposites such as inner and outer, center and periphery, left and right, high and low, closed and open, and symmetrical and asymmetrical order. "Boundary" is another important spatial concept. Orderings are "basically topological, as opposed to Euclidean or projective, and are associated with concrete physical features of the natural environment."[13] Here too we have evidence of the cognitive maps that underlay the emergence of maps in material form.

It is in the development of language in its broader sense that the origins of mapping are to be found. Crucial to this development would have been the emergence of teaching beyond the level of mere imitation and of communication systems capable of expressing relationships. Of the latter, aural systems (speech and music) were ephemeral and limited to the temporal dimension.[14] They were therefore least effective as means of communicating spatial messages. Of the visual systems for communication, gesture and dance, though also ephemeral, were themselves spatially three-dimensional forms and therefore would have been more effective in conveying a "map" to members of the group who were present and within range at the time of transmission. Drawings, models, pictographs, and notations were, potentially at least, three-dimensional but had the additional advantage of combining immediacy with a greater degree of permanence. It was from this visual group of systems for communicating that cartography, along with other graphic images, eventually emerged as a specialist form of language.

Neither the sequence of emergence nor the relative rates of development of these human systems of communication is recorded. A possible key stage, however, linking mental maps to their specialized expression as graphic representation, may be found in the use of gesture. Gesture, says Gordon Hewes, probably "reached the limits of its capacity to cope with cultural phenomena by the end of the Lower Paleolithic" but "gained a new lease of life in the Upper Paleolithic and thereafter, with the birth of drawing, painting and sculpture."[15] Gesture and ephemeral graphics are still used in bridging the gap between different linguistic groups, and they are sometimes preferred or used as an adjunct to speech, especially as a means of communicating locative messages. The literatures of anthropology and of European exploration and discovery from the fifteenth century onward are rich in examples of the way gesture was used in communicating with native peoples, many of whom were still following an essentially Upper Paleolithic way of life.[16] Gesture is frequently described as having been used to solicit or to communicate information about terra incognita. In such cases both European interrogators and native respondents tended to use sketch maps, and occasionally dance, in conjunction with gesture.

A link between gesture and simple mapping is also to be found in pictography. Unlike syllabic alphabetic writing, pictography was not unilinear and was readily adaptable to represent the spatial distribution of things and events.[17] Most early peoples used some form of

11. Roger Peters, "Communication, Cognitive Mapping, and Strategy in Wolves and Hominids," in *Wolf and Man: Evolution in Parallel*, ed. Roberta L. Hall and Henry S. Sharp (New York and London: Academic Press, 1978), 95–107, esp. 106.

12. Jean Piaget and Bärbel Inhelder, *The Child's Conception of Space*, trans. F. J. Langdon and J. L. Lunzer (London: Routledge and Kegan Paul, 1956). Christopher R. Hallpike, *The Foundations of Primitive Thought* (New York: Oxford University Press; Oxford: Clarendon Press, 1979), 285. See also James M. Blaut, George S. McCleary, and America S. Blaut, "Environmental Mapping in Young Children," *Environment and Behavior* 2 (1970): 335–49.

13. Hallpike, *Foundations*, 285 (note 12).

14. The spatial and temporal dimensions of messages are discussed in Abraham Moles, *Information Theory and Esthetic Perception*, trans. Joel E. Cohen (Urbana: University of Illinois Press, 1966), 7–9.

15. Gordon W. Hewes, "Primate Communication and the Gestural Origin of Language," *Current Anthropology* 14, nos. 1–2 (1973): 5–24, quotation on 11.

16. Hewes, "Primate Communication," 11, especially n. 7 (note 15).

17. In written Chinese, the character for map (and diagram) is itself a highly stylized map. This suggests that mapping and maps had

pictography, with signs derived in part from the objects being represented and in part from related gestures. Moreover, in surviving maps made by indigenous peoples of historical times, gesture is frequently an important part of the iconography. For example, a hand with the index finger outstretched is used to indicate direction. In other cases, a line of hoofprints or human footprints is used to show both the route and the direction of movement along it.[18]

Such modern analogies are clearly suggestive, but they are not conclusive indicators of the way permanent material maps might have originated. The researcher is brought up against the barrier that the evidence of gesture and ephemeral graphics—by its very nature—has not survived from the Upper Paleolithic. Thus it is in the more permanent art forms—especially in the rock art and mobiliary art of Upper Paleolithic societies in the midlatitude belt of Eurasia—that one might expect to find the earliest evidence of maps. However, just as in ethology one has to be cautious about translating animal signals into human language, so with prehistoric art forms one has to be careful before ascribing specific meaning or function to patterns, textures, symbols, or colors. Furthermore, the mapping of topographical information per se was almost certainly not of practical importance (in the modern sense) to early man. Mapping may, however, have served to achieve what in modern behavioral therapy is known as desensitization: lessening fear by the repeated representation of what is feared.[19] Representing supposedly dangerous terrae incognitae in map form as an extension of familiar territory may well have served to lessen fear of the peripheral world. Similarly, from the Upper Paleolithic onward, man was greatly concerned with his fate after death, and cosmological maps may well have lessened fear of the afterlife. Since early cosmology and religion were also associated with a rather more empirical astronomy, it is reasonable to suppose, too, that celestial maps may have been developed early. For historians of cartography, the difficulty lies not so much in accommodating such ideas as in finding unambiguous evidence to support them and thereby being able to move away from speculation and assumption to firmer intellectual ground.

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emerged as distinctive activities and products before the final development of writing, which in China is generally supposed to have attained essentially its present form by 2800 B.P. Joseph Needham, *Science and Civilisation in China* (Cambridge: Cambridge University Press, 1954–), vol. 3, *Mathematics and the Sciences of the Heavens and the Earth* (1959), 498.

18. Footprints also feature, in pairs or singly, among the Scandinavian petroglyphs of Bronze Age date, but it is possible that they have a quite different meaning here; see H. R. Ellis Davidson, *Pagan Scandinavia* (London: Thames and Hudson, 1967), 54–55. In the Mixtec picture writing of ancient southern Mexico, human footprints or a band containing footprints usually signified a road: see Mary Elizabeth Smith, *Picture Writing from Ancient Southern Mexico: Mixtec Place Signs and Maps* (Norman: University of Oklahoma Press, 1973), 32–33. Australian aborigines distinguish on their pictographic maps between the tracks of men and those of different types of animals: see Norman B. Tindale, *Aboriginal Tribes of Australia: Their Terrain, Environmental Controls, Distribution, Limits and Proper Names* (Berkeley, Los Angeles, and London: University of California Press, 1974), fig. 33.

19. Julian Jaynes, "The Evolution of Language in the Late Pleistocene," *Annals of the New York Academy of Sciences* 280 (1976): 322.