

MIRRORS, PORTALS, AND MULTIPLE REALITIES

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Abstract. A biogenetic structural explanation is offered for the cross-culturally common mystical experience called *portalling*, the experience of moving from one reality to another via a tunnel, door, aperture, hole, or the like. The experience may be evoked in shamanistic and meditative practice by concentration upon a portalling device (mirror, mandala, labyrinth, skrying bowl, pool of water, etc.). Realization of the portalling experience is shown to be fundamental to the phenomenology underlying multiple reality cosmologies in traditional cultures and is explained in terms of radical re-entrainment of the neurological systems mediating experience in the brain. Phenomenological experiments with mirror portalling devices from both the Tibetan and the Tsimshian religious traditions are reported.

Keywords: brain and states of consciousness; cosmology; meditation; religious experience; shamanism; symbolism.

How would you like to live in Looking-glass House, Kitty? I wonder if they'd give you milk in there? Perhaps Looking-glass milk isn't good to drink—but oh, Kitty! now we come to the passage. You can just see a little *peep* of the passage in Looking-glass House, if you leave the door of our drawing-room wide open: and it's very like our passage as far as you can see, only you know it may be quite different on beyond. Oh, Kitty, how nice it would be if we could only get through

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[*Zygon*, vol. 24, no. 1 (March 1989).]

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into Looking-glass House! I'm sure its got, oh! such beautiful things in it! Let's pretend there's a way of getting into it, somehow, Kitty. Let's pretend the glass has got all soft like gauze, so that we can get through. Why, its turning into a sort of mist now, I declare! It'll be easy enough to get through. . . .

Lewis Carroll, *Through the Looking-Glass*

This article deals with two categories of material culture—portals (that is, the point at which one enters or leaves a space) and mirrors. At first glance they seem to have little, if anything, in common. However, it will be argued that, first, some mirrors are used psychodynamically as portals, second, their convergence occurs at the junction between ordinary and nonordinary realities (the latter being experienced in alternate states of consciousness), third, portalling-mirrors are used in many mystical traditions to bridge multiple realities, and, fourth, the experiential bridging has theoretical and methodological implications for our understanding of such traditions.

The first stage in developing this argument is conceptual. We must first understand what is meant by the general concept of *portal*. When one thinks of portals, one is mindful of an implied barrier. The distinction between inside and outside bears a number of connotations cross-culturally: known/unknown, safety/danger, sacred/profane. As Victor Turner (1974, 14; 231-32) states, *portals* define thresholds and liminality presenting new possibilities for being. Another characteristic of portals is that they demarcate the qualities of transition (Halifax 1979). Movement through a portal can be in one or two directions, voluntary or involuntary, controlled or uncontrolled.

In contrast to the more obvious and generalized notion of *portal*, mirrors present realities "inside" themselves which reflect what is "outside." The relations between those images and referents are ambiguous. Mirrors minimally are two-dimensional representations of three-dimensional space which reverse what they portray. They may be relatively reflective or opaque, may reveal or hide. They may be reflective of what is presently in front of them, or they may invite projection of that which is sought. Although giving only a partial picture of the outside, what is seen can be altered by shifting mirrors, or one's orientation to them. They may also allow looking at things which are otherwise inaccessible—such as one's own face. The resultant images imitate and mock the viewer's self and immediate situation. They are similar and different to, more and less than, what they purport to reflect.

Similar to locked glass doors, mirrors give a vision of realities in the Schutzian (1945) sense which are beyond reach. Yet, the reflections speak to what is in the here and now. In that respect they are like

rituals. Just as rituals can remove barriers between mythological and everyday worlds (Eliade 1963, 6-14; McManus in d'Aquili et al. 1979), so can mirrors become open doors. In the next section the full range of portalling devices (a range that includes mirrors) will be examined cross-culturally. We will then present a neurocognitive theory to account for the more general portalling phenomenon. We will follow this general treatment with more specific phenomenological explorations pertaining to portalling mirrors from two different cultural traditions: the Tibetan tantric and Tsimshian shamanic traditions.

PORTALS CROSS-CULTURALLY

There exist many forms of portalling devices, only some of which are mirrors in the literal sense we are used to in western culture. The most obvious and dramatic portals found in a material culture system are the architectural ones. Naturally enough, doorways into a house are the most obvious portalling feature. The threshold is very important, not just the jams or the lintels of doorways, but the entire facade of the house. Windows and doors were consciously designed as portalling devices in medieval cathedrals. Among Pacific rim cultures the house itself is distinctive (see Cordy-Collins & Stern 1977, 56-60), for the facade and portal design is variably the visage of ancestral forms, or supernatural beings who give access to the ancestors (see G. MacDonald 1984).

The inside of the house may also represent different conceptual spaces. House designs may therefore incorporate the notions of portals between the profane and the sacred. A major portal theme is often the fire in the lodge, another is the smoke hole. The fire becomes the portal to the underworld and the smoke hole the portal to the upper world. For example, among some North American Indian groups, curing was done around the fire because it was considered a propitious place to draw the requisite curative power (unpublished notes of G. T. Emmons, American Museum of Natural History on Tlingit and Tsimshian shamanism).

The use of house features as cosmological portals may well revert to the use of cave features. The earliest examples of these are to be found in the decorated Paleolithic caves of Spain and France (Leroi-Gourhan 1967). One of the most dramatic examples of such portals is found in the caves at Lascaux (dating to about 19,000 years ago). Although this famous set of paintings has been given numerous interpretations, it seemed to one of the authors (MacDonald) during his visit to the cave that the shaman is depicted as leading the animals through a natural portal in the rock. The best references, however, for the use of caves as portals are ethnographic parallels such as Gerardo Reichel-Dolmatoff's

(1971) description of the shaman entering a cave which is festooned with bundles of animals hanging from the roof. The vagina is seen in many cultures as the ultimate portal between worlds, and the connection between caves and female genitalia is obvious. The womb is often seen as a doorway or source, usually associated with earth, from which all the bounty of nature derives (see Blodgett 1982, 10; Neumann 1963), and in many traditions the act of sexual intercourse is viewed metaphorically as the act of portalling.

The range of visual (as opposed to sonic) portalling devices extends beyond architectural forms and includes some forms of containers for shiny-surfaced liquids (pottery, tightly woven baskets, rocks with natural or hand-ground depressions; see Eliade 1964, 364), objects with shiny surfaces not produced by contained liquids (polishing, adding oils, crystals, adding mica or abalone shell; see Cammann 1948, 1949) and incised, painted, woven, carved, or ornamented objects depicting portals (rugs, icons, sand paintings, mats, etc. [see various examples in Pericot-Garcia et al. 1969]). Perhaps the most widely used are mirrors (or boards) and skrying (divining) bowls (or baskets).¹ One North American example is the Plains Indian practice of burning wooden boards in fire and burnishing the blackened area to a high gloss.² With European contact, Plains shamans increased the reflectivity of the boards by inserting pieces of mirror. The significance of reflecting as opposed to opaque surfaces will be discussed below when we address more theoretical issues. There is some evidence throughout northeastern North America of different types of skrying bowls being used. For example, the Micmac Waltes game uses a wooden bowl also used extensively in divination and social gambling games.³ This combination of gambling and divination with water containers also occurs among the Pomo (see Coe 1976, 199). Another interesting example of bowls used as portalling symbols is to be found in the archaeological record of the Mimbres peoples of the American southwest. Mortuary remains indicate that pottery bowls were punctured at their bottoms, or "killed," to let the soul out of this world into the next (Pericot-Garcia et al. 1969, 200; Brody 1977, 51-52).

Crystals are another form of portalling device (Eliade 1964, 364) and are found in association with shamans throughout North America (see for example, J. MacDonald 1984, 57). The archaeological evidence for them reverts at least into the Archaic Period (over 6000 years ago) over North America. There are many examples of what would appear to be shamanic paraphernalia in certain burials. A good 2000-year-old example was excavated at Rice Lake by Richard Johnson of Trent University, Peterborough, Ontario. Bird beaks, claws, and other items were found suggesting a shaman kit, and with it was found a crystal.

Some Tsimshian myths (see Barbeau 1958, 67-74) refer to the use of crystals by shamans.

Ted Brassler (1976) has made a persuasive case for the use of pipes as portalling devices. He shows that among a number of Amerindian groups smoking the pipe was a "mental device" used to concentrate the mind. For many peoples the pipe is a passage through which spirit and breath are merged as they enter the body and are then released to ascend upwards, a ritual procedure for purification and transformation (see Kelemen 1956, plates 295-97).

Rugs and conjuring mats are another common form of portable portal. The oriental notion of flying carpets is possibly an artifact of this association and may involve the notion of traveling mentally using portalling symbolism woven into the carpet upon which one ritually sits in order to enter an alternative phase of consciousness (see Cammann 1972). Conjuring mats are used by shamans among many hunting peoples for divinitory purposes. The earliest of these mats known is a Naskapi mat in the Speyer Collection of the Canadian Museum of Civilization, Ottawa that dates to the 1740s (see Brassler 1976) and shows portals, herds of caribou, and the four cardinal directions marked clearly on it. The mat is an orientation device which allows the shaman to situate himself relative to the ordinary world and to define the place at which he entered the other world (see Speck 1977). New World sand paintings are similar to rugs and mats in that they are intended as portals leading into multiple realities (Campbell 1983, 240, 242) and are considered requisite for use in healing ceremonies. The patient is placed in the middle of the painting and the powers for the curing are drawn from the other world via the portal (see Campbell 1983, 248).

Examples of possible portalling devices are rife in the archaeological record of prehistoric peoples. Perhaps one of the oldest and simplest forms of portable portal is the incised pebble or stone pallet (see Marshack 1972, 252; Pericot-Garcia et al. 1969, 88). Literally hundreds of slate pallets (or flat pebbles) were found in a dwelling made of mammoth bones at the site of Gunnersdorf, West Germany (dated to Magdellenian IV, around 11,500 B.P.; Bosinski 1976), that were incised repeatedly with animals and shamanic figures, and that may have been used as portals for enticing game animals from the other world. Pebbles similar to the Upper Paleolithic ones of Europe have been found in the upper Great Lakes region and are incised with thunderbirds and other supernatural figures. An interesting incised pebble dating back to more than 6000 B.P. was unearthed by Roger Marois from the Coteau du Lac site near Ottawa and is now in the collection of the Canadian Museum of Civilization, and may have been a divination device of some sort.

Other examples of divinatory boards abound (Parrinder 1967, 90). Middle Mississippi cultures used a rimmed, ornamented, ground sandstone tablet that may well have been used as a kind of skrying bowl. There are examples of divination boards dating between 1750 and 1850 collected from Ojibwa and now are housed in the British Museum. This pattern continues into Mexico and Peru where one finds both pyrite and obsidian divination mirror mosaics and surfaces (Kelemen 1956, plate 298). The Inca had an interesting compartmentalized version although there is little evidence of how they were actually used. Blocks of stone are found in which many square chambers were cut, occasionally interpreted as floor plans for architectural structures. It seems possible that they were actually mobile meditation vessels.

There are numerous examples of mirrors and mirror-like objects that may have been used as portalling devices (see Eliade 1964, 153-55, 498). Chinese mirrors, first appearing in the late Shang Period, were used in burial ceremonies and were considered to have profound cosmological significance. They were polished, round, cast bronze mirrors, very shiny on one side and featuring a cosmological design on the other side (Schuster n.d.). The design elements depict a portalling symbol, the most famous one being the so-called *TLV pattern*, the geometric features representing the corners of the universe observed through a three-portalled universe system (Cammann 1948, 1949). The *Ts* formed the doorway looking from one level, the *Ls* formed the corners of the Chinese world, and the *Vs* the four cardinal directions of the outer world. Such a mirror was suspended over the head of the deceased, and the soul was supposed to pass into the other world by entering the mirror. Such mirrors diffused to the shamans of Siberia who often had dozens of them suspended on their costumes (Lommel 1981, 123) and seem to have been linked to the polished slate forms in northwestern North America. These mirrors were originally made from copper, derived from earlier copper ancestral figures that were mirror-like. Many of these copper ancestral figures appear on shamans' costumes.

Mirrors were often used in Ancient Egypt for cosmetic purposes, but there were some like the Pallet of Nar-Mer, the uses of which remain obscure (Donadoni 1969, 26). This Old Kingdom rectangular pallet, dated at approximately 6000 B.P., is one of the earliest examples of fully developed Egyptian art, and it is possible that it was used as a divinatory device. Mirrors in Ancient Greece (dating to roughly 600 B.C.) were used for cosmetic purposes, but are also found embossed with cosmological symbols and were possibly used as divinatory devices (Seyffert 1957, 395). The tendency of scholars is to write off the use of

mirrors as cosmetic, when it seems possible that the use of these artifacts in prehistoric times was partially divinatory.

Hopewell culture may have used mica sheets as portalling/divination devices. The layering of the mica has much the same visual effect as abalone, giving an illusion of depth of field somewhat like that of water. Hopewell shamans also used silver plates. Gold mirrors were used throughout Central and South America, usually decorated around with the figures of supernatural beings that guard the portals (Abel et al. 1981, 225, 226). Cast bronze mirrors are associated with the Chimu Kingdom (from 1000 A.D. and up to the time of the Inca Empire), as well as with Inca in the north coast of Peru. These were rectangular skrying boards with birds depicted all the way around the periphery. Mirrors of jet are also associated with prehistorical cultures of Peru (Benson 1972, 148).

The use of oracle bones for divination was ubiquitous throughout the Paleolithic period (see Speck 1977). The surface of the scapula of game animals, ranging from raccoon to oxen and caribou, was blackened over a fire and then used to read divinatory events. This is linked clearly to the use of the blackened pallets for divination on the Plains. The link to the Shang Chinese oracle bones is also very well established in the literature (Li Chi 1977; Kwang-Chih Chong 1977). The Shang Chinese broadened this usage to include turtle shells. These were considered to have miraculous powers because the turtle was considered to be the creature upon which the earth was cosmogonically formed.

The use of labyrinths, mazes, and other portalling designs is found in rock art throughout the world (Pericot-Garcia et al. 1969, 102-5) and were often associated with other devices like skrying bowls (see Layard 1936; 1937). There were baskets that have labyrinth-like designs on the outside while the inside was used to hold water. Labyrinth-like designs are also to be found on Australian bark paintings (Carrick 1976), in Medicine Wheel symbolism (Aveni 1977, 50), and in ground drawings (Kern 1974). The labyrinth itself is common to shamanic traditions around the world and may well have been used both as a portalling device and as a symbolic description of the entire spiritual journey (see Campbell 1964). Continuous line drawings in New Guinea are often integral to a ritual process by which one begins in one place and by the time one has traced one's way through the labyrinth, one has perhaps experienced portalling into another reality (Schuster n.d.).

An interesting design feature in depictions of shamanic portalling and journeys between multiple realities is the motif of the guardians of the portal (see Gonzalez in Benson 1979, 141, 163). This relates to the

recognition and symbolic depiction of difficulties and dangers inherent in traveling between realities (see Wang Zi-de 1984, 68). Shamans recognize particular crises or dangerous possibilities of that passage (Eliade 1964), thus, wherever one finds access markers as a feature (doorways, bodily orifices, natural caves, rock fissures), one may also find indicators of the possible dangers of passing through. Art associated with fissures often indicates these as apertures to the other world, guarded by monsters, dragons or frightening animals or birds, but through which game animals may pass. Some decorations actually begin to map features of the other world. The decorations depicting the other world may themselves be a frame about a portal.

In order to become a competent shaman, it was crucial to be able to identify dangers involved in portalling and to protect oneself against them (Eliade 1964). In many groups the dangers included some form of natural threat such as a mountain pass that might collapse or snap together upon the unwary. Or the danger might be mythological as throughout the New World with the appearance of double-headed animals that looked both ways through the portal (see Lommel 1977, 227) and opposed the entry of anyone who did not control the right formula. The latter figures have caused New World prehistorians a lot of trouble because they try to interpret such creatures as being merely a marker of contact, thus missing the experiential aspect of shamanic symbolism (see Campbell 1964, 12).

The portal guardian figures may actually be conceived as the shamans' familiars. The shaman is, after all, repeatedly passing back and forth through the portal. This may be why the guardians are often depicted on some of the paraphernalia used by shamans (combs, mats, painted drum heads, drum sticks). The association of the shamans with their spirit helpers is seen over and over in the iconography of the Northwest Coast (Barbeau 1958). One role of the helper was to help the shaman return from the other world. The shaman also knew many chants, incantations, and songs to aid in this return. The shaman would even take along diagrams to show the way back.

Double-headed animals or birds are one of the more common guardian motifs found in shamanic art (see Pericot-Garcia et al. 1969, 212), and very often the shamans' combs have double-headed animals on them (see Ritchie 1965, 116). Combs are an important implement, for ritual combing of the hair is often necessary preparation for moving into another reality. Among the Inuit, the controlling beings are conceived to be constantly grooming themselves because they get lice in their hair and the lice are representative of the sins of humanity. The ritual act of combing is a purification for the shaman prior to entering the portal. It is the long hair of the shaman that gives them their power

(Eliade 1964, 152), and the combs are often decorated with the same portalling motifs as are found on some of the more obvious portalling devices already discussed. The hair of the shaman is occasionally depicted as standing out, thus forming an aura, a feature linked with attainment of power (sometimes mistakenly interpreted as space helmets or such). It is interesting in this respect that there is a clear connection between grooming behavior and the balancing of autonomic nervous system functions in primates and humans (see Lex in d'Aquili et al. 1979). This fact may well point to a connection between shamanic symbolism, ritual activity, and activation of autonomic structures preparatory to engaging in actual portalling.

Masks are often used as symbols of portalling in ritual dramas (Young-Laughlin & Laughlin 1988). They are frequently designed in such a way as to depict the shaman traveling to another world of experience with the aid of his spirit helper (see Feder 1982, plate 200 for Naskapi; Burland 1973, 50 for Eskimo; and Malin 1978 for northwest coast transformation masks).

Sounds, as well as visual stimuli, may serve as portals. Drums are a common sound portal (Campbell 1983, 171). Mircea Eliade (1964) has presented interesting information about the making of shamans' drums. The shaman initiate is required to seek the primal tree. The initiate is blindfolded and required to touch an appropriate tree, a piece of which is then taken to form the drum hoop. The hoop becomes the portal over which is stretched a membrane. Tambourines and sistrums are also used as portals, and usually form a round, hand-held device that is festooned with jangling objects (puffin beaks, deer hooves, or even metal cymbals in post-contact times). Sometimes the hoop rattle has a cross-member in the middle as a handhold and which is ornamented with a number of objects considered as evocative of spiritual power. Puffin beaks abound among northwest coast cultures (see Miles 1963, 197) where they are linked to attainment of spiritual power because the puffin is the local form of the earth-diver, an animal observed to dive into and disappear into water. Also the hooves of fetal caribou or deer are seen to have primal power.

Whistles are another form of sound portal (see Campbell 1983, 225 for use in Plains Indians Sundance ceremony). There are many examples of northwest coast whistles, carved as ancestral figures, in which the mouth is important both as a vent for the creation of sound and as the locus of transformation of breath from one form to another. The mouth as a portal of the human body becomes the portal for souls, beings, and of the ancestor in house decorations and in whistles (Holm & Reid 1975, 206).

THEORY AND METHODOLOGY

The emphasis upon multiple realities and the portals connecting them is explicable in terms of a neurocognitive entrainment theory of consciousness. We will briefly summarize one such theory (see Laughlin et al. 1986 for a more complete version of the theory) and then note some methodological implications for students of symbolic systems.

Multiple realities may be viewed as constructs of the human neurocognitive system. These cognized realities are experienced within the *sensorium* (the total sensory apparatus) of each individual. The sensorium is the functional space within which the moment-by-moment flow of experience simultaneously manifests and passes away.

Reality as it arises within the sensorium is an integration of cognitive and perceptual functions, and is fed in part by information delivered by the various physical senses. Experience is constructed and mediated by the nervous system and unfolds each moment of consciousness. Experience is phasically organized; that is, it unfolds in more or less enduring or continuous "chunks." Because the shifting *entrainment* (cellular organization, or structuralization) of neural networks making up the ever-changing structure of consciousness manifests recurrent temporal patterning, "chunks" of cognized reality seem to recur in a cyclical fashion. Episodes of experience may be as momentary as the rapid shift of sensory focus as the system scans the world for interesting objects, or may be relatively long, lasting minutes or hours.

Awareness of bits of experience is a principal component of consciousness. Because the definitive characteristic of awareness is *recollection*, *remembering*, or *recognition* of patterns in experience, awareness refers to a role played by knowledge in experience. Further, since the recursive quality of experience may be cognized as such, reflexive knowledge about consciousness itself involves knowledge of phases. If an experiential episode is perceived as a salient unit, then it may be cognized as distinct from other experiences, and perhaps lexically coded: for example, I am "awake," "stoned," "depressed," "asleep," "out of my body," and so on. These cognized episodes of experience, and their mediating neurocognitive structures are *phases* of consciousness. The points of experiential and neurocognitive transformation between phases are *warps* (Laughlin et al. 1986).

In the normal range of human consciousness, phases are rarely if ever recognized by their formal properties;⁴ however many of those properties may causally influence the structure of phases. Further, phases are never identified by the full range of ever-shifting information passing through the sensorium at any given moment. Rather, phases are commonly defined upon a small set of recurrent attributes

that are recognized within the far greater range of possible attributes available in the moment. There are innumerable attributes of the experience of sleep and dreaming that might be focused upon as definitive, but people in various cultures tend to focus on only a few of these. For example, in many cultures such as the Pukapuka (Beaglehole & Beaglehole 1938, 307) the dream phase is interpreted as the period of the day during which the soul may move about in the world independent of the body and talk to rocks and spiders and other objects. Tibetan yogis, on the other hand, interpret the dream phase as illusory phenomena reflected in the mirror of mind.

Phase attributes may be comprised of bodily sensations ("I am hungry"), feelings ("I am in love"), various kinds of sensory cues ("I am listening to music") or actions ("I am running"), or they may involve characteristic relations between perceived objects ("I dreamed I was swimming at the bottom of the ocean"). Phases may be defined as well upon qualities of thought: for example, my thoughts are "discursive," "scattered," "profound," "lucid," or "clever."

The important point is that societies typically define a set of possible phases of consciousness for their members, who are then socialized to recognize the appropriate attributes as definitive of their own and others' states of mind (see Tart 1975). This recognition sets boundaries on phases of consciousness typically experienced in a culture through the establishment of conditioned, internalized control of attention. In addition, many of the structural features comprising consciousness are causally entrained by attention. As a consequence, recognition of phase attributes effects powerful control of unconscious, but nonetheless experientially efficacious, formal properties.

In order to understand the role of portals in symbolism and experience, it is necessary further to understand warps. Although a phase is a discrete, cognized strip of unfolding experience dominating (for however long) the sensorium, a warp has a causal influence on the organization of the phase succeeding it, and a causal influence upon the cessation of the phase preceding it. A warp is a minuscule neuro-cognitive version of Victor Turner's *liminal* event: one standing between two cognized strips of experience (see also Gennep 1960). Turner's liminal event may be much more lengthy, being a social activity, but similar to the warp is essentially anti-structural in function—in this case disentraining. For example, if one is "happy" one moment and "sad" the next, then somewhere between these two phases of consciousness is a warp which involves the cessation of the happy phase and which causes the sad phase. The liminal aspect of the warp metaphorically implies a sort of door or threshold through which the stream of consciousness must pass when it "leaves" one phase

behind and “enters” another phase. When a warp occurs in response to an external stimulus (as in the case of an event “causing” the shift from happy to sad), then the warp is treated as an intervening variable.

Three aspects of warps need to be stressed before considering the ritual control of experience. First, warps are often momentary to the point of evanescence despite their causal predominance over the entrainment of phases. In fact they pass so swiftly, that they usually are not perceived. Typically, we are aware only of a sequence of phases and not of the warps intervening between phases. We would caution the reader that we are not merely suggesting a new name for any kind of transformation, but rather are *referring specifically to the period of rapid neural re-entrainment that produces the more enduring structure mediating a phase of consciousness.*

Second, a warp is the intersection of two relatively durable and cognitively salient episodes of experience. Warps have both structural and functional aspects just as do phases. However, most people are not aware of warps. This is because the functional aspect of a warp is typically *not* salient, and hence is not consciously experienced. This is due primarily to the fact that the warp functions to de-structure the enduring episode, whereas awareness in most humans is conditioned to seek the stability of recurrent structures.

Third, a transformation of the neurocognitive structures comprising a warp may be induced by a vast variety of factors, both intrinsic and extrinsic to the being. Such factors include the ingestion of chemicals, events in the external world, events triggered by the biological clock, metabolic changes, and so on. These are *driving factors*, or simply *drivers* (see Lex in d’Aquili et al. 1979). A person may or may not be aware of the driver inducing a warp.

It is apparent that if control of phases of consciousness is to be exercised, either by the individual or society, it must be especially exercised over warps and driving factors. In other words, control must be oriented towards the aspects of unfolding experience *about which the perceiver is typically least aware.*

The simplest and most direct means of controlling a phase of consciousness is by directing the attention of the perceiver to the warp preceding it (see Beck 1979). Directing and enhancing awareness of a warp by a perceiver, as occurs in many contemplative traditions, results in the warp “opening up” to conscious inquiry (Goleman 1977). If that inquiry is continued with sufficient interest, the warp itself will be transformed into a cognized phase. Without getting into the formal properties of the transformation, cognizing a warp minimally involves discovering and learning a set of phase attributes that then become markers by which the experience of the warp may be recognized.

For example, Tibetan dream yogis are taught to become aware of, open up and control their consciousness in both the warp between the waking phase and the dream phase (the *hypnagogic* warp), and the warp between the dream phase and the waking phase (the *hypnopompic* warp). Ritualization of dream-related warps and “incubation” of dreams is a common theme in cultures that consider incorporating knowledge and “power” derived from dream experience important to life (O’Neill 1976; Halifax 1979; Grunebaum & Caillois 1966). In a considerably more sophisticated way, Tibetan yogis work with their dream experiences as a meditation and learn to control events in the dream cycle by first increasing awareness of warps (see Chang 1963, 88; Evens-Wentz 1958).

Many anthropologists have noted the importance of ritual as a marker and mediator of points of social and psychological change (Turner 1979, 1974; Gennep 1960; Wallace 1966; Eliade 1964; see also McManus in d’Aquili et al. 1979). For example, Eliade (1964) has noted the role of ritual in structuring the experiences of initiate shamans. By learning ritual control of the warp between the normal phase of consciousness and the “transindividual” phase (as Ring 1974 calls it), the young shaman is gradually able to integrate alternative phases of consciousness into a single personality (Halifax 1979). Likewise, by practicing various rituals initiate adepts to Buddhist and Hindu tantrism learn to transform their ego-centered consciousness into phases of consciousness symbolized by the various deities that are the objects of their meditation. Such ritual programs often incorporate a variety of driving factors which operate to evoke particular experiences of value to the practitioner and to his or her society (see Lex in d’Aquili et al. 1979). We are particularly concerned here with one set of driving factors by means of which symbols become transformed into experience.

The very essence of awareness is remembering—seeing and recognizing what one is seeing. Thus, all ritual—certainly all ceremonial ritual—operates by manipulating awareness of symbols. The symbolic process depends upon two subsidiary processes by means of which symbols and awareness become integrated in experience (see Laughlin et al. 1981; 225). One process is *semiosis*, the cognitive development by which the intentionality or “meaning” of a symbol is constructed, usually during a person’s formative years. As will be noted below, it seems probable that most, if not all symbols develop from initial, genetically transmitted, archetypal neural organizations. The other process is the *semiotropic response*, a conditioned orientation response to culturally salient symbols. Thus, the awareness of a participant in a ritual is directed toward salient symbols that for the moment dominate

the sensorium and are experienced as meaningful within the context of the unfolding drama in which they are embedded.

The intriguing question in all of this is how symbols presented in the participant's environment come to evoke experiences within the participant's sensorium. The means by which this "magic" is achieved is the *mechanism of symbolic penetration* (see d'Aquili et al. 1979, 354; Laughlin et al. 1981; Webber et al. 1983). In order to fully grasp it, one must understand that in order for any symbol to be perceived by a person, that object or figure or sound must give rise to a field of neural activity in receptor cells at the various sensory centers; that is, at the retinae of the eyes, the cochlea of the ears, and so on. This initial activity both filters the input along various dimensions, and excites neural activity at higher levels of processing. The higher the level of processing, the more complex is the cognitive structuring of the information being processed (McManus in d'Aquili et al. 1979). If the symbolic stimulus enters awareness, we may suppose that the levels of processing involved in the neurocognitive hierarchy have ranged from the most simple and peripheral to the most complex and central (that is, from the sensory receptors to the highest cortical processing, and all levels in between). This movement inwards from external symbol to activation of the most central processing activated is literally one of penetration, and the symbol as stimulus that produces the penetration is a driver.

It may well be that particular symbols produce a specific field of penetration under appropriate ritual conditions, and may do so universally across cultural boundaries. Carl Jung (1964) has called these *archetypal symbols* and explains their universal field of intentionality by relating them to what he called humanity's "collective unconscious." It has been argued that archetypal symbols operate by penetrating to neurocognitive structures that are archaic and highly genetically predisposed in their organization, and thus function when activated much the same way for all human beings, regardless of cultural background (see Webber, Stephens & Laughlin 1983; Laughlin, McManus & Webber 1986; Young-Laughlin and Laughlin 1988). This is not to say that cultural conditioning does not, or cannot influence the experience of such archetypal material. The incubation of archetypal experiences is almost always highly controlled and interpreted by agents of culture (often shamans). It is quite common to find symbols of high archetypal salience (e.g., streams of water, gems, spheres, angelic figures, paths, etc.) embedded within more variant cultural materials (taro, pigs, crosses, water buffalo, puffins, etc.).

PORTALS AND PENETRATION

We consider the set of symbolic objects and practices we have termed *portals* to be heavily archetypal in nature, and as such we may expect them: first, to be universal, or nearly so, in the mythopoea of cultures valuing experience of multiple realities, second, to be utilized cross-culturally in a similar manner within the context of ritual practice, and third, to evoke under proper conditions structurally similar experiences cross-culturally. In particular we hypothesize that portal symbols will penetrate to the neurocognitive structures controlling the entrainment of phases of consciousness, and will produce (often profound) re-entrainment of those systems. In other words, portal symbols produce warps in consciousness by penetrating to mechanisms (such as septo-hippocampal centers) that are internal to the nervous system and that control the transformation of consciousness. Among other things, we are offering a mechanism that might account for one category of what might be called a culture's *core symbols* (Geertz 1973).

Metaphorically speaking, portal symbols are precisely like doors between rooms, or perhaps keys to the doors between rooms. If we conceive of the rooms as relatively durable phases of consciousness, then the doors are warps. Much of the symbolism in multiple reality cosmologies pertains to elements and relations occurring within discrete rooms, but additional symbolism pertains to the relationships that occur between rooms, and to just how one goes about moving between rooms. We are suggesting that transformational symbols (such as portals, mirrors, etc.) will have predictable forms cross-culturally because of their efficacy in penetrating to the mechanisms that produce re-entrainment of neurocognitive systems mediating the play of experience unfolding in the sensorium. Furthermore, by directing attention to the warp between phases of consciousness, they result in opening up the warp to awareness and thereby to cognitive restructuring as a phase. The practitioner thus becomes aware of the process of transformation from one reality to another by focusing awareness upon the portal between realities.

Portalling symbols and devices may be found to take advantage of qualities varying along certain dimensions. For example, mirrors may have surfaces that range along a continuum from extremely opaque to extremely reflective. In modern western society we are generally used to the practicality of highly reflective mirrors. There are, however, many societies among whom such highly reflective surfaces were unknown or rare prior to contact with western society (for example, pre-contact Tsimshian). Furthermore, the difference in reflectability of a surface may determine the type of penetration evoked by concentration upon the mirror. Highly reflective surfaces (*mirrors* in the proper sense)

may allow concentration upon reflected images (clouds in the sky, fire, a face) that may penetrate, whereas an opaque surface (*mirrors* only in a metaphoric sense) may operate to invite projection by the mind upon the surface, thus perhaps symbolically penetrating to mechanisms mediating the so-called dark light background luminescence of the visual system apparent in the total absence of external light stimuli (Barlow & Mollon 1982, 129). As with the case of the Tsimshian mirror described below, the quality of reflectivity/opacity may actually be varied to produce combined effects. We will continue to call all such surfaces mirrors, although it may be strictly speaking improper to do so in English.

The clarity of definition provided by portalling surfaces, whether mirrors or symbols, may have a determining effect upon the experience obtained by the participant. The experience would be, to some extent, constrained by the properties of the portals. Mirrors, as we said, can range from the highly defined image of a clear glass surface, through the moderately determined image of a copper surface, to the complete opaqueness of a slate mirror. Symbols as well can vary along a similar dimension from the sparse abstractness of a cross or a labyrinth to the highly articulated image of a Tibetan tanka or a Christian cathedral window.

Mirrors as portals depend upon the human proclivity for projection of unconscious images and affects, internal phenomena projected on and through an external surface. Various symbols differentially penetrate and trigger activation of internal neurological processes. Differential interaction between individual projections and the surface of a portalling mirror would variably grant determination of experience either to operations in the individual's unconscious, or to features represented by the portalling surface itself. An opaque surface supplies fewer degrees of constraint allowing greater individual variation in experience to occur. Clear surfaces may contribute to a greater similarity of experiences among practitioners.

The experience obtained from use of a portal device would likely be the result of a three-way interaction among the characteristics of the participant, the constraints inherent in the portalling device, and the surrounding mythic context and training procedures. The latter would include cosmological systems and their symbolic accoutrements. A highly defined portal combined with intensive training of expectancies and technique and a highly articulated mythic system should combine to produce the most predictable experiences and the most uniformity among participants. Opaque mirrors in the hands of individual or minimally trained explorers in a loose or pluralistic mythic context should produce the greatest variability in experience.

The universal and archetypal potency of portal symbols points the way toward an effective transpersonal methodology for interacting with and studying such symbols. Very simply, one may meditate upon them in a disciplined way (produce a willful semiotropism) and explore the experiences that arise as a result of concentration. The experiences that arise may then be treated reflexively as data concerning the "meaning" or intentionality of the portal symbols (semiosis). This does not mean that the experiences arising for the anthropologist are going to necessarily be precisely the same as for the native practitioner. The anthropologist and the native usually carry into the exploration divergent cultural baggage. Cognized phases of consciousness will differ from culture to culture, and from individual to individual within a single culture—the furnishings in the various rooms of consciousness will perhaps differ from house to house. However, if the portal symbols are indeed archetypal in nature, then there should occur a fundamental similarity of experience, if only at a structural level—all houses of consciousness will have rooms, however furnished.

The anthropologist must be mindful of the warnings that come with the various meditative traditions: The initiate shaman must learn to find his or her way back to "normal" reality. Various safety measures are built-in to techniques of portalling. In terms of the present theory we may interpret this common admonition to mean that one must learn to re-entrain the phase of consciousness from which one began the exploration. This is usually automatic due to the lifelong conditioning to operate in that phase of consciousness. Yet certain measures are commonly taken to avert the danger of fearful reaction to novel experiences that may easily arise doing this type of spiritual work.

We have demonstrated the notable incidence of the use of mirrors and other material objects as symbolic replicas of the portalling experience, and we have offered a theory to account for the widespread use of these symbols and a methodology for testing their efficacy in evoking portalling experiences. We would now like to present our findings from actual participant observation within two religious traditions, the Tibetan and the Tsimshian. Charles Laughlin's work with the Tibetan tradition preceded the theory just described, while John Cove's with the Tsimshian mirror occurred as a test of the theory. Finally, we will draw what generalizations are possible from this preliminary work.

TIBETAN MANDALA OFFERING

One of the preliminary meditations (*ngon-dro*) carried out by practitioners of Tibetan Tantric Buddhism is termed *dkyil-'khor*, or "mandala offering" (Beyer 1973, 437-40). The root *dkyil* refers to the middle or center, and the root *'khor* to a wheel or circle. There are variations on

the practice, but they all involve repetitively constructing a mandalic form with rice on a round metallic surface and then wiping the surface clean. The practitioner concentrates intensely on the operation of constructing and disassembling the mandalic form and repeating a mantra, or chant (*gzuns*, *snags*; Govinda 1960, 92), that speaks of the construction of the mystical cosmos surrounding the mythical Mount Sumeru. The beginning practitioner is expected to repeat this operation at least a hundred thousand times during the process of foundation work. An additional hundred thousand repetitions may be required of a practitioner (usually a monk) who has entered the traditional three-year retreat. The mandala offering is found in abbreviated form as an element in most ceremonies carried out in temples. The mirror-rice mandala may also be represented using a ritual hand gesture, or *mudra* (*phyag-rgya*). Yet performing the mudra during rituals probably has no actual transformative effect upon consciousness unless the basic foundation practice using the mirror and rice has been carried out. Once the experience of transformation has been realized, however, the mudra may symbolically penetrate in the same way as does the actual mirror meditation.

The base upon which the rice mandala is constructed is a circular bowl made of silver or copper, often with symbolic engraving and occasionally gold inlay around the rim. It is called *sa-gzhi* in Tibetan, the root *sa* meaning earth or ground and the root *gzhi* meaning foundation. The bowl is used upside down and has a flat, matte-finished surface upon which the rice-mandala is constructed.

Laughlin completed his hundred thousand repetitions during two retreats, a one month retreat in Canada in 1979, and a two month retreat in Scotland in 1982. During the first of these retreats he completed approximately 85,000 repetitions while combining the mandala offering work with meditation on the breath (Skt.: *ānāpānasati*). He worked on the mandala offering meditation during five one-hour sessions a day. The mirror used was the glass taken from a standard, round five inch shaving mirror which was glued to the bottom of a tea saucer. The saucer provided a handle by which to hold the mirror in the left hand while the mandalic form was constructed with the right hand. Five pounds of long grained rice was used, dyed yellow using common food coloring, and laying in a plastic bowl in the lap. A handful of rice was taken up, the mandala completed using the prescribed gesture, the mirror and rice offered-up to the guru, and then the mirror swept clean with the right hand, the rice falling back into the plastic bowl, all the while repeating the appropriate mantra.

A journal was kept describing meditation experiences and dreams occurring during the retreat. A number of experiences and insights

arose during the course of that retreat that may flesh-out our understanding of the use of the shamanic slate discussed in the next section. As an example, most experiences obviously evoked by or related to the mirror work occurred during sleep. Laughlin, who is a lucid dreamer, had mandalic lucid dreams virtually every night, once the retreat was under way. A common feature of these episodes was the appearance of a circular, opaque disk upon which a variety of symbolic forms arose. These usually arose as lucid phases immediately after a more ordinary dream. On one occasion, "the disk was back, consisting of two concentric circles, the inner more opaque than the outer and there developed for several moments a rapidly transforming series of abstract characters flowing from a central vertical diagonal toward the periphery in a horizontal flow. Not all characters were symmetrical. . . . I was staring through this mandala at scenes beyond . . . (scenes being common hypnopompic imagery)" (Laughlin 1979 Journal).

On another occasion, there arose "a brief mandala episode during which a field of bright yellow flowers sprang out of a circular mirror and emitted great energy and, as it were, spit a blob of black something out of its center which then paused a moment and then melted into black drops and fell away. This occurred, as usual, several times" (Laughlin 1979 Journal).

Relevant motifs often arose in the normal dream state as well: "I am in the ocean in a very sunny clime, flying a round, yellow-orange kite which pulls me out into the ocean and up to some interesting rock formations that seem to be made of piles of yellow rice. I have gotten deeper in the water, but just as I am about to go under, I note that the rock formations begin to take on an ominous quality with eye sockets, etc. I lock my concentration onto one such and it transforms into a face and into a "real" dark profile of a male driving the car I'm in. I can't seem to make out the face clearly. Then I am aware of the lights increasing in intensity from above (I am fully aware at this point and am entering lucid phase) and concentrate on the lights and that brings on a full-blown mandala experience" (Laughlin 1979 Journal).

By full-blown mandala experience is meant an intense, internally generated light-show during which the entire visual screen is filled with brilliant lights usually emitted at the center in waves that radiate outward to the periphery in a continuous flow. As constantly shifting and changing patterns, sometimes incorporating human and other forms, sometimes remaining amorphous, the experience is associated with intense absorption, bliss and ecstasy and an extremely keen awareness and intense concentration. When these lucid dream experiences first arose many years prior to the mirror exercises being described, they would last only a few minutes. During this retreat Laughlin was able to

hold the experiences for thirty minutes or more at a time through maintaining intense concentration on the center of the ever-unfolding mandala.

Associations were frequently made in dream-state between mirror, opaque disk, and bodies of clear water. All seemed to be equivalent metaphors for the reflexive quality of mind. This association is hardly surprising considering that in the Buddhist tradition generally the most commonly mentioned symbols signifying the illusory nature of phenomena as they arise in mind are such motifs as images reflected in a mirror, the moon reflected in a pool of water, and a continuously moving stream, as well as an echo, a rainbow, and a soap bubble.

Lucid mandala phases commonly involved a three-dimensional effect of traveling down tunnels into radiant light, or into space—the sort of phenomena often associated with shamans' journeys to alternative worlds. Sometimes in dream and in meditative vision a tunnel would become a "space door" or portal into vast spaces and alien landscapes. These portals would usually constitute a *limen* signifying the point of transformation between one state of consciousness and another. Over time, the range of states became increasingly varied and differed ever more subtly one from another. Sometimes there was fear of passing through the portal, sometimes the awareness would pass through and shoot down a passage at great speed into brighter and brighter light, or into expansive, crystal clear awareness of boundless space. The mind grew to understand that it could either resist passage out of fear, or let go into whatever experience lay ahead. The consciousness often seemed to be polarized relative to the mirror, a part that wished to "pass over" and a part that wished to remain behind, and depending upon which part was strongest in the moment, the experience would go the one way or the other.

The mirror and yellow, rice-like energy particles became core symbols in dream and meditation vision thereafter. Laughlin recalls an occasion two years or so after the initial retreat when he was visiting the monastery of one of his teachers in Nepal. It was late at night and frightening apparitions were appearing before him in lucid dream phase. In despair, he finally called out mentally to his teacher for help, and the teacher appeared in a vision sitting on a throne and concentrating upon a gilt-edged mirror hanging on the wall. The vision changed to a close-up of the mirror and then a ray of yellow light comprised of distinct particles beamed down onto the mirror and was reflected away. Laughlin was simultaneously aware that all of the apparitions that had been so frightening were but transient piles of rice grains on the mirror of mind—in other words, transient, impermanent, insubstantial. The sense of despair immediately lifted and although apparitions con-

tinued to arise, the knowledge of their illusory nature was always present thereafter.

Mirror surface motifs seem to be of two types: mirror surfaces of a reflective kind we in the west commonly associate with the concept *mirror*, and surfaces of an opaque kind that resemble the matte surfaces of Tibetan, Chinese and shamanic ritual mirrors. It is interesting that of the two types the opaque surface proved to be the most common in Laughlin's phenomenology, even though he used a modern reflective mirror unlike the matte ones used by Tibetan yogis. We suspect that the intent of the traditional Tibetan paraphernalia is to combine the "dark light" penetrating opacity of the mirror with the mandalic forms created by the rice in order to represent the object-field tension so fundamental in the physiology of visual perception.

The split-image motif was very common in the mandala offering work, and has proved a common feature of other types of meditation, both in Laughlin's own phenomenology and in the phenomenology of other meditators he has interviewed. This lateral asymmetry may take diverse form, including for example the left side murky or dark and the right side clear or bright, a flow of energy streaming left and right from a central vertical seam, and different human figures appearing on the left and right sides. In true mandalic form, the center of the visual field was often the locus of symbolic significance, with or without lateral asymmetry of form. Central focus symbolism included gemstones, spheres, tunnels, geometrical figures of various sorts, eyes, and nexes of crosses. It will be remembered that the classic definition of a mandala is a quartered circle with a center.

THE SHAMAN'S MIRROR

The mirrors to be discussed in this section come from the Tsimshian. They are part of the Northwest Coast complex, and consist of three distinct cultures: the Gitksan of the upper Skeena River valley, the Nishga of the Nass River valley, and the Tsimshian proper of the lower Skeena valley and adjacent coast.

While investigating shamanism in these cultures, our interest was drawn to the traditional slate mirror. Although conclusive ethnographic evidence was not available, we concluded that this artifact was shamanic and used as a meditation object (Cove et al. 1984). We decided that the only way we could come to understand the significance of the mirror was to try using it ourselves. In deciding to use it for replication of shamanic experiences, this lack of data meant a purely trial and error participatory approach had to be employed.

The first set of explorations were concerned with the variety of ways the mirror might be used. Wetting the surface and hand holding it

were the sole bits of positive information known. It was discovered that keeping a replica of the original artifact horizontal or vertical produced different effects when meditating on it. In the latter position, a kind of dynamic Rorschach occurred due to random patterns generated by water evaporation. Although flight experiences did arise, these became less interesting than those arising while using the mirror horizontally. In that position, evaporation quickly created a circle which slowly decreased in diameter because of the mirror's slight concavity. The shift from a reflection of one's face to circle happened without conscious recognition. The circle itself focused the mind, and almost automatically cleared it of internal and external noise. A tunneling effect drew one's attention into the circle. After evaporation was completed, the feeling was of being "on" the blank slate. After about fifty sessions, the experience was of poising at a threshold; able to cross the warp into another state of consciousness or re-enter ordinary consciousness. The mirror acted therefore as a driver.

A second set of procedures were performed to validate these conclusions which were based on one person's (Cove's) trials. Another of the investigators (Laughlin), along with four other practiced meditators, meditated on the slate. The only instructions they were given was how to hold and wet it. After sessions, they immediately recorded their experiences, and in some cases made drawings. Although differences did occur, the focussing and tunneling effects were noted in every instance.

Once this technique had been intersubjectively validated, a final set of explorations were undertaken. These consisted of using Tsimshian shamanic texts and firsthand accounts (Barbeau & Beynon 1915-56; Emmons 1912-13) to provide the content and structure of experiences on the other side of the mirror/warp. The intent was to use Tsimshian shamanic symbols for penetration to see if their experiences could be duplicated personally.

The results were mixed. In meditation, complete replication of a textual report did not occur. Once into an altered phase, divergences happened which are explicable in terms of the meditators' mind-states. However, intensive sessions of three to four days duration gave an important side effect. Dreams during sleep-phase spontaneously began to be based on the texts, and experienced directly with little alteration. There is some experimental evidence for the penetration of alterations in waking perception into dream experiences. Roffwarg et al. (1978) report an experiment in which subjects were required to wear red lens goggles during the day and then were awakened during REM sleep at night. Subjects reported that they dreamed in red from the very first night and throughout the course of the study. Once the goggle wearing stopped, dreams returned to normal coloration.

We feel that the slate mirror explorations do demonstrate the possibility of participant observation in alternative phases of consciousness. It should be noted that the slate mirror did not produce the experiences, only facilitated having them. One can meditate on anything or nothing with perhaps similar results. The more important factor was using Tsimshian symbols and texts to enter and structure those experiences. If the mirror served any purpose, it was that Tsimshian shamans probably used them in a parallel way which created an initial kind of affinity to them.

CONCLUSIONS

A number of conclusions and hypotheses are apparent from this study. First, the use of mirrors, bowls of water, crystals, "bull's-eye" concentric circles, mandalas, crystal spheres, and the like as symbolic portals seems to be extremely widespread among the world's cultures. Second, we suspect that the incidence of such objects is associated with cultures in which the universe of phenomena is conceived to be a cosmos comprised of multiple realities, some of which may be directly experienced in alternative phases of consciousness. Third, we suggest that the widespread incidence of portalling symbols is not due solely to symbolic expression of portalling experiences, but is also due to their use as drivers of portalling experiences.⁵

Fourth, there are features common to the use of these artifacts as objects of contemplation: They concentrate attention upon the center of the object, a procedure that is known to have a calming and centering effect upon meditators. The center typically "opens up" to become a threshold phenomenon of some sort: for example, a doorway, tunnel, cave, womb entrance, and so on. If the mediator is receptive (fear is absent and consciousness is sufficiently calm), the awareness may "pass through" the portal to experience another phenomenal reality. If meditators are fearful, or otherwise nonreceptive, they may instead experience apparitions coming at them out of the portal; for example, faces, animals, forbidding shades, and so on.

Fifth, use of such artifacts as objects of contemplation may operate to incubate (set the prior conditions for) portal experiences in a later phase of consciousness, most commonly in the dream phase. These artifacts may operate much as the so-called triggering stimuli that are described by ethologists as evoking "fixed action patterns" (see Hinde 1982, 44). As such, mirrors and other portal objects belong to a much broader symbolic field—a field that includes various sorts of mythopoea, regalia, theatrical drama, dance and tableau—which is used in many cultures to incubate experiences of multiple realities in alternative phases of consciousness.

NOTES

1. See note by G. T. Emmons (1921) on Tsimshian mirrors, and Willey (1966, 225) for skrying bowls.
2. A number of Plains Indian mirrors, as well as descriptions of how they were used, may be found in the Glenbow Museum, Calgary, Alberta.
3. Personal communication from Harold McGee of St. Mary's University, Halifax, Nova Scotia; see also Whitehead (1980, 48).
4. Examples are the level of structural organization in Piagetian psychology, or the full compliment of constituent cognitive functions described in Buddhist psychology.
5. Readers who have knowledge of artifacts used for this purpose in other cultures are invited to communicate with the authors via John Cove, Department of Sociology-Anthropology, Carleton University, Ottawa, Ontario, Canada K1S 5B6.

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