The Paleolithic Birth of Geometric Thinking

Ralph Abraham
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Abstract. Following a visit in the Winter of 2007 to the Alhambra — a Moorish palace built around 1300 CE in the South of Spain — I have been digging up the roots of the *Alhambra Theorem*, which says that Moorish craftsmen in the Middle Ages knew that there were exactly 17 crystallographic groups. This fundamental result of modern group theory emerged into the mathematical literature only in 1891. Digging back from the Alhambra, we found an Ur source for the motifs of the Alhambra in the earliest Turkish carpets of Catal Hüyük, around 10 KYA (thousand years ago). Digging deeper led to the cave paintings of Upper Paleolithic Europe, beginning around 35 KYA. In this article we tell the story of the earliest geometric motifs we have found. This reveals the birth of geometric thinking in the ambiance of psychedelic shamanism -- religion, art, and mathematics were born together in the youth of our species.

NOTE: This first draft is written as a self-standing article, MS#131, and will be adjusted later as a chapter in the book, *Motif*. This article is a partner to MS#82 on arithmetic of the Venus of Lespugues, an important piece of Upper Paleolithic mobile art. That article is also the first chapter of my new book, *Bolts from the Blue*.

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1. Introduction

In this article we embark upon an archeological dig into the prehistory of mathematics, seeking its origins. It helps to keep in mind a breakdown of the branches of mathematics, and a convenient guide is the theory of the five mentalities. My parse of the coevolution of mathematics and culture began with an attempt to view world cultural history from the perspective of chaos theory, or complex dynamical systems.[1] It evolved further in joint work with William Irwin Thompson.[2]

1.1 The five mentalities, RGADX

- The aRithmetic mentality, beginning in the deepest past,
- The Geometric mentality, from 6 KYA,
- The Algebraic mentality, from 800 CE,
- The Dynamical Mentality, from 1600 CE, and
- The Chaotic (X) mentality, from 1960.

Each mentality is born from its predecessor through the bifurcation of a complex system. The ultimate root of the aRithmetic precedes humanity, as even birds can count. We will seek the earliest emergence of geometric thinking in the Paleolithic past.

1.2. The big picture

Prehistory is an enormous multi-disciplinary domain with a technical vocabulary, so let us begin with a survey of the largest picture. We will utilize a graphic device called a histomap, in which geographical space is compressed to one dimension, and combined with time as a second dimension. Mathematicians and scientists tend to orient space-time graphics with time on the horizontal axis, increasing to the right. But archeologists are used to digging up prehistory from the top down, so we will display time vertically, progressing downwards into the deep past. A convenient and recent big picture, presented by Colin Renfrew, the eminent prehistorian, in his book, *Prehistory*. is shown in Figure 1.[3] Time descends in units of a million years before the present, or MYA.

On this histomap we might visualize the customary epochs of geologic time, for example, the Pleistocene or Ice Age, from 1.8 MYA.[4] On the other hand, we might visualize the customary epochs of cultural time, for example, the Paleolithic, or Old Stone Age, from the earliest development of stone tools around 2.6 MYA, to the Neolithic with settlements and agriculture from around 12 KYA. The Paleolithic is further divided into the Lower (2.6 MYA - 100 KYA), Middle (300 - 30 KYA), and Upper (50 - 10 KYA), also known as the Epipaleolithic, or Mesolithic. The bifurcations, or boundaries, between the adjacent epochs occur it different times in different places, and thus would be represented by curves in the histomap.

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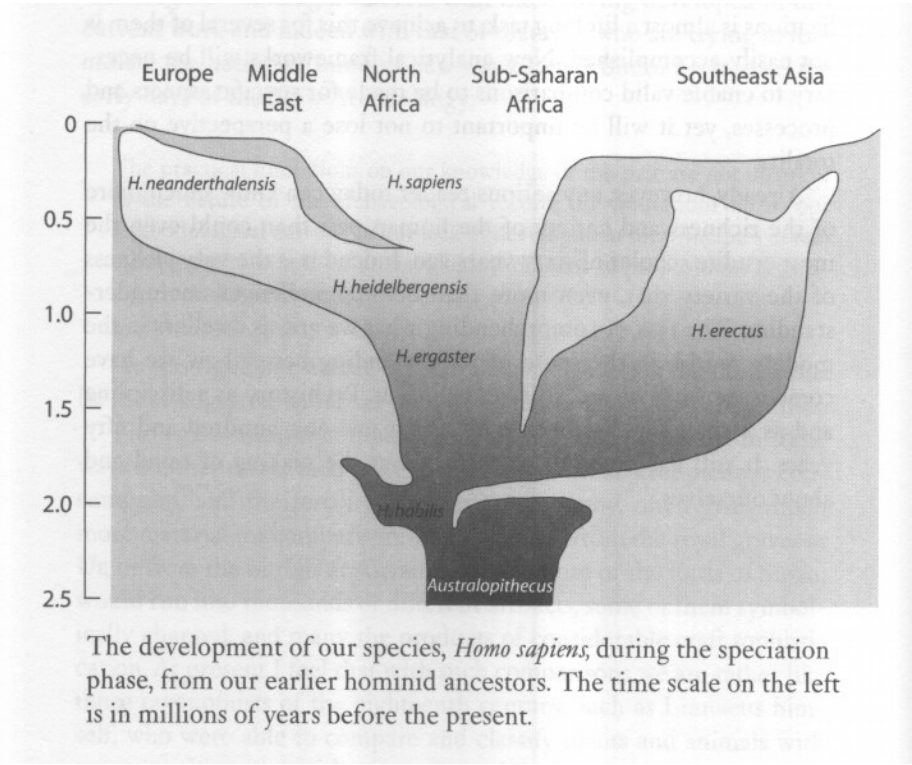
1 (Abraham, 1994)
2 See (Abraham, 2011) and (Thompson, 2004).
3 (Renfrew, 2008; p. 190)
4 (Renfrew, 2008; p. 15)



The development of our species, *Homo sapiens*, during the speciation phase, from our earlier hominid ancestors. The time scale on the left is in millions of years before the present.

Figure 1. Histomap of hominid diffusion "out of Africa".

As we will be interested primarily in the upper left section of this histomap, we show an enlargement in Figure 2. Here the units of time are thousands of years ago, or KYA. The spread of Homo sapiens Northward and Westward into Europe displaced and overlapped the earlier occupation by Homo neanderthalensis. The boundary curve may be regarded roughly as the bifurcation between the Middle and Upper Paleolithic epochs, the *Middle to Upper Transition*. The portion of this histomap in the upper half of the Europe column is the locus for our analysis of the emergence of geometric thinking that developed eventually into the Geometric Mentality in Neolithic times.

1.3 The Franco-Cantabrian region

Cantabrian refers to Cantabria, the part of Spain facing the Bay of Biscay, also known as the Cantabrian Sea. An enlarged histomap for the Franco-Cantabrian region (the Southern half of France and Northern border of Spain, a thin vertical strip of Figure 2) is shown in Figure 3.[5] This also indicates the approximate time-frames of the culture complexes: Mousterian and Chatelperronian (Neanderthal), and Aurignacian, Solutrian, Gravettian, and Magdalenian (H. sapiens). The Middle to Upper Transition, from 45 to 35 KYA, shows the overlap of the Chatelperronian

5 (Lewis-Williams, 2002; p. 72)

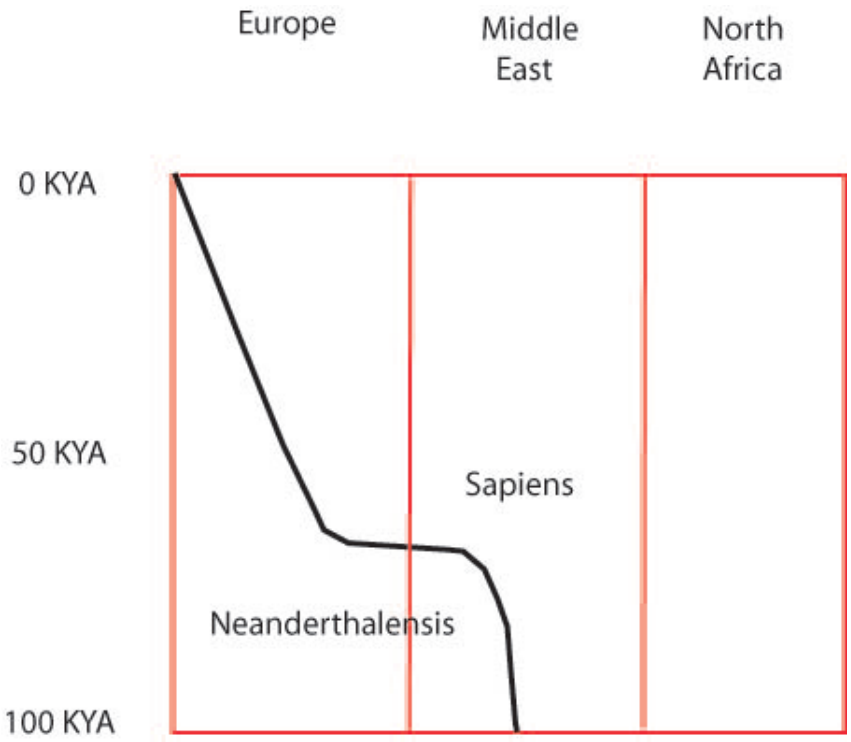


Figure 2. Histomap of hominid diffusion, enlargement.

(H. neanderthalensis) and Aurignacian (modern human) cultures. The Upper Paleolithic period in the Franco-Cantabrian region is the site of the "creative explosion" of Cave Art, 35 to 8 KYA, in which we will discover the birth of geometric thinking. A geographical map of the Franco-Cantabrian region is shown in Figure 4,[6] showing the sites of the main caves in which pre-geometry "documents" have been found.

1.4 The Franco-Cantabrian people

Modern humans (H. sapiens) arrived in Europe from Africa around 45 KYA (in the latter part of the last glaciation) already divided into four races: Cro-Magnon, Combe-Capelle, Grimaldi, and Chancelade.[7] The Cro-Magnon (meaning Big Cave), dated from 35 KYA, are credited for the Cave Art phenomenon of Upper Paleolithic Europe.

1.5 The plan for this article

To appreciate the geometry of the Franco-Cantabrian culture, we will begin, in the next section,

6 From Wikipedia entry, Franco-Cantabrian region.
7 (Graziosi, 1960; p. 11)

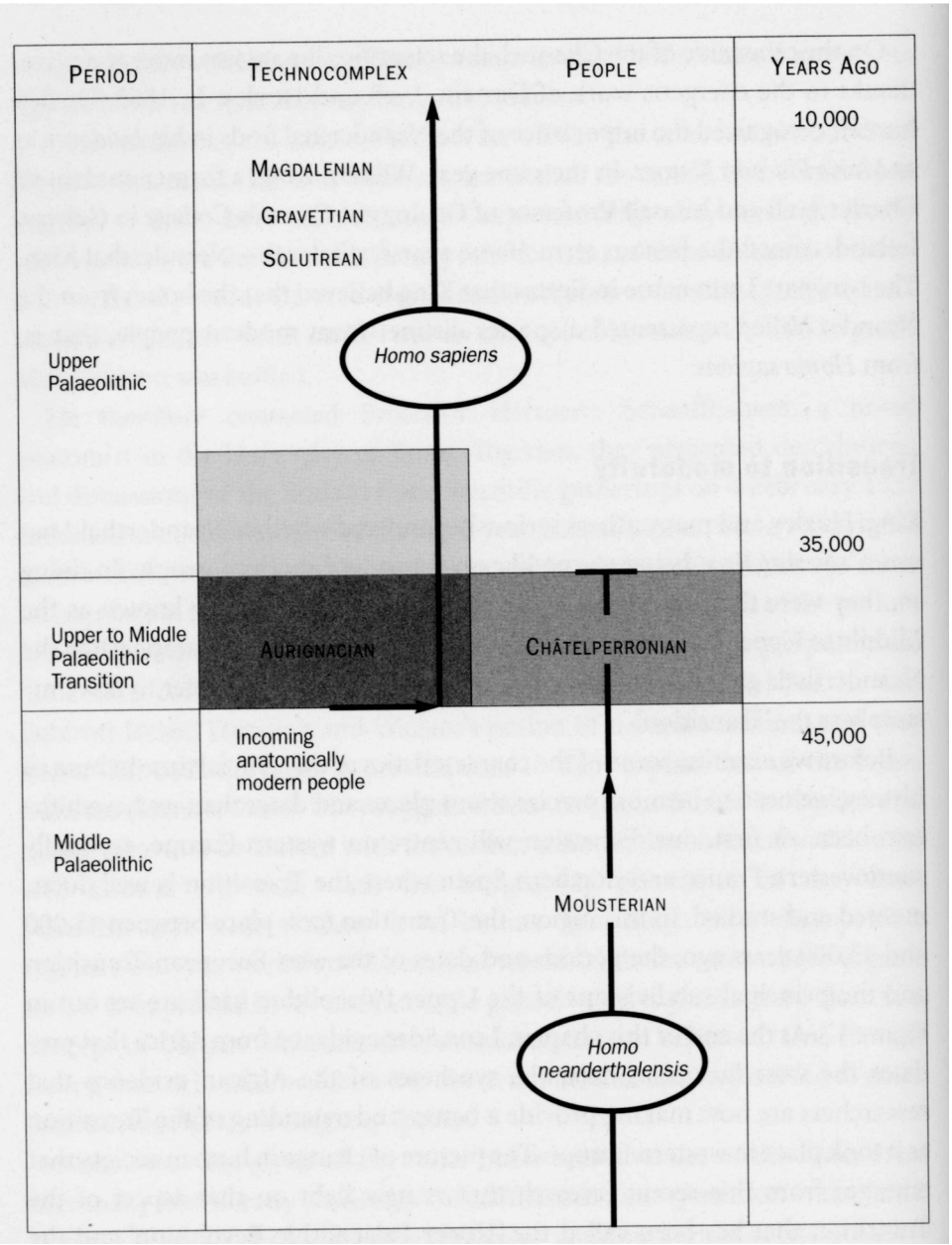


Figure 3. The Middle to Upper Transition in the Cave (Franco-Cantabrian) Region, placed within the time-span, 70 to 10 KYA.

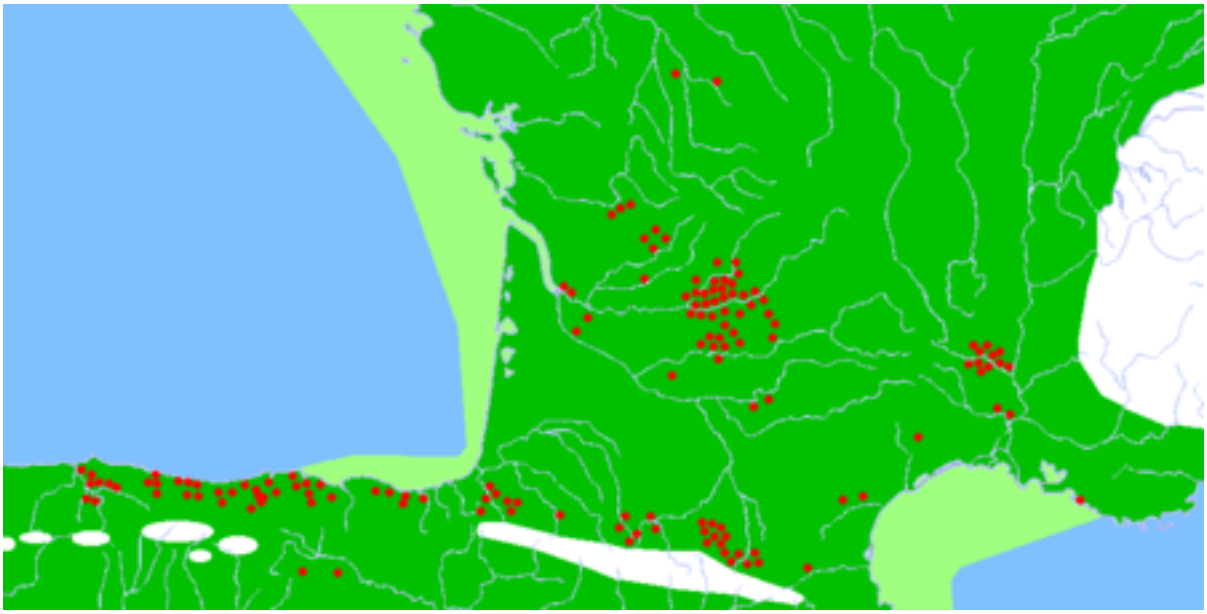


Figure 4. The Franco-Cantabrian region, showing the location of the many caves participating in the "creative explosion" of Cave Art, 35 to 8 KYA.

with shamanism, the religion of the Upper Paleolithic people, and its relation with psychedelic substances. Then we will go on to an examination of the mobiliary (portable) and parietal (rock wall) arts. Finally, we will bring together the religion, the psychedelics, and the art documents into an appreciation of the proto-geometry of the culture. The emergence of geometric thinking, or proto-geometry, in the shamanistic rites of Upper Paleolithic religion paved the way for the R/G (aRithmetic/Geometric)bifurcation of early Neolithic times.`

2. Paleolithic Religion (after Mircea Eliade)

We must now delve into the culture of the Paleolithic people. This involves the early evolution of religion. A convenient approach to this extensive material is to follow the works of a leading scholar, and we have chosen Mircea Eliade for this purpose.

2.1 Bibliography

The 2009 edition of Eliade's book, *Yoga: Immortality and Freedom* (published originally in-French in 1954) begins with a 14-page introduction by David Gordon White, from which we have extracted this skeleton biography.[8]

> Eliade was born in Romania in 1907. His interest in Yoga, developed in his college years in Bucharest, led him to India in 1928. He studied with Surendranath Dasgupta, Profes-

8 For further reading, see his autobiography. (Eliade, 1981)

> sor of Indian Philosophy at Calcutta University, living in his house during the first half of 1930. He fell in love with the professor's daughter Maitreyi. He first practiced the Yoga of Patanjali, then adopted tantric yoga, practicing (he claimed, but she denied) with Maitreya. When their affair was discovered, Eliade was banished from the Dasgupta home. He moved to the ashram of Swami Shivananda near Rishikesh, where he continued his study of yoga and tantric practice. Early in 1931 he returned to Calcutta, where he continued his studies and wrote the thesis which earned him the Ph.D. in 1933, became his first book, *Yoga*, in 1936, and established him as a leading authority in the field. After sitting out the war in London and Lisbon, he settled in Paris, where his book was revised and republished in French in 1948, and then again in 1954. In 1956 he moved to Chicago, where he taught the history of religion until his death in 1986.

The English edition of his magisterial book on yoga appeared in 1958. In its table of contents one may recognize his broader interest in the history of religion. See for example, Chapter 7, Yoga and Alchemy, and a section of Chapter 8 entitled, Yoga and Shamanism. These topics foreshadow his subsequent books pertaining to our subject, Paleolithic religion. We are interested in these works:

- *Yoga: Immortality and Freedom* (1948/2009)
- *Patterns in Comparative Religions* (1949/1996)
- *The Myth of the Eternal Return* (1949/2005)
- *Shamanism: Archaic Techniques of Ecstasy* (1951/2004)
- *The Forge and the Crucible: The Origins and Structures of Alchemy* (1956/1978)

We now extract some topics of interest from these five books.

2.2 Yoga, 1948

This book had a long gestation, from Eliade's thesis of 1931 until first publication in 1948. In Chapter 3, Yoga and Bramanism (p. 102) Eliade identifies these activities of the heros of the Rg-Veda as shamanizing techniques: intoxication of ecstasy, flying through the air, knowing thoughts, drinking poison. Similarly (p. 105): asceticism, mastering fire, silent meditation, drinking soma. And in Chapter 8, Yoga and Aboriginal India (p. 312): commanding rain, leaving the body, working miracles, descending into hell, and so on. This interest in aboriginal religion becomes explicit in the section, Yoga and Shamanism (p. 318). Here we find defining characteristics of shamanism:

1. initiation, decent into hell, ascent to heaven, trance
2. ecstatic journeys to recapture a sick man's soul,
3. mastering fire, walking on coals,
4. assuming animal forms, becoming invisible.

The essential and defining element is ecstasy. The shaman is a specialist of the sacred.

Based on my own experience of yoga in India in the 1970s, I would guess that the enormous contrast between the Abrahamic religions of Eliade's childhood in Romania and his gnostic experience of shamanic techniques in India provided him with a basis of understanding and the motiva-

tion to pursue his lifelong career into the history and philosophy of religion, and his participation in the creation of cognitive archeology as a field.

2.3 Patterns, 1949

In Chapter 1 on the Sacred, Eliade identifies some hierophanies, or universal sacred structures — myths, rites, gods, superstitions, etc. For example, the axis mundi, or cosmic tree, is found "everywhere among ancient civilizations." (p. 3) He says, "almost all the religious attitudes man has, he has had from the most primitive times." (p. 463) We are to look for continuities from Paleolithic to modern times, including global shamanism (p. 2), and the shaman's flights to the sky. (p. 61) His emphasis on the gap between the sacred and the profane (p. 1) also brings to mind his tantric experiences in India. This book is devoted to the principles of archaic ontology (ancient and primitive world views). (Myth, p. xxiv)

2.4 Myth, 1949

In this book, begun in 1945 and published in 1949, Eliade remarks in his foreword of 1952 that he had considered the subtitle, *Introduction to a Philosophy of History,* for this book. (p. xxiii) Further, in his preceding book, *Patterns*, he attempted to give the principles of archaic ontology, which he defines as *the conceptions of being and reality that can be read from the behavior of the man of the premodern society*. (p. 3) Archaic includes contemporary primitive (uncivilized) as well as ancient ways of thought. (p. 24) The essential theme of this book is the connection to the Cosmos and cosmic rhythms and cycles felt by archaic and traditional people, in contrast to the disintegration of the Judeo-Christian world view. (p. xxvii)

Among the features of this archaic ontology are the belief in the celestial archetypes of cities and temples, and the symbolism of the Center - the sacred city or temple as a sacred mountain, or axis mundi, connecting the three levels of the tiered universe (heaven, earth, and hell). (p. 12)[9]

2.5 Shamanism, 1951

This work remains one of Eliade's most interesting, important, and influential books.[10] Here he brings together his evolving view of archaic ontology and his religious experience in India, in a book which *is the first to cover the entire phenomenon of shamanism and at the same time to situate it in the general history or religions*.[11] In his Foreword, as an example of the global history of shamanism, he cites the practice of a present-day Altaic shaman ritually climbing a birch tree. This exhibits the continuity of the World Tree image of the cosmology of the ancient Near East. Global shamanism is an archaic technique of ecstasy, again suggesting his gnostic understanding or the ritual, based on his tantric experience in India in his youth.

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9 See also (Eliade, 1952/1991; Ch. I).

10 Foreword to the 2004 edition by Wendy Doniger. (Eliade, 2004; p. xiii)

11 Foreword in the 2004 edition by Eliade dated 1946-1951. See also (Eliade, 1978; pp. 18, 24) and (Eliade, 2004; p. xvii).

Among the fourteen chapters we may single out two for our purposes here, the appreciation of the cave art of the Upper Paleolithic. In Chapter 6 we find detailed accounts of the shaman's ritual functions of ascent to the sky and descent to the underworld. And in Chapter 8, the shamanic cosmology of the three cosmic zones and the world tree is explained. The central axis provides openings for trans-cosmic travel, a shamanic specialty. Gods descent the tree to visit us, the dead descend to the underworld to stay, and the soul of the shaman flies up and down at will. In addition to the Cosmic Tree as the center of the universe, there is a Cosmic Mountain in many cosmologies. The ziggurat of Babylonia, for example, is a cosmic mountain.

In his Conclusion, Eliade makes an explicit connection between shamanism and European prehistory, referring to a 1959 work of archeologist Karl J. Narr for support.[12] This article of Narr is among the earliest to make this connection. Horst Kirchner was another early theorist of this link in 1954.[13] Gordon Wasson suggested in *Soma: Divine Mushroom of Immortality* (1971) that religion evolved from the contact of humans with psychoactive plants. Even earlier:

> I do not recall which of us, my wife or I, first dared to put into words, back in the '40s, the surmise that our remote ancestors, perhaps 6000 years ago, worshiped a divine mushroom.[14]

Eliade refers to this as *narcotic shamanism*,[15] and gives several examples throughout this book of 1951.[16] In fact, he wrote, *Ecstasy through intoxication by mushrooms is known throughout Siberia*.[17] This suggests the triple connection: psychedelics, origin of religion (shamanism), and origin of art. We are going to refer to this idea as the *psychedelic hypothesis*. We will also have occasion to refer to a weaker version, the *shamanic hypothesis*, meaning the triple connection: ecstasy, origin of religion (shamanism), and origin of art.

> Ecstasy! The mind harks back to the origin of that word. For the Greeks *ekstasis* meant the flight of the soul from the body. Can a better word than that be found to describe the bemushroomed state?[18]

Recall that for the shaman, there are multiple paths to ecstasy, of which psychedelics was but one.
So the psychedelic hypothesis is a special case of the shamanic hypothesis. The suggestion of the

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12 See the later work, (Narr, 1964). Aslo see (Eliade, 1978; p. 4). The earliest I have found is (Hoffman, 1888), which was known to Kandinsky by 1890 (Weiss, 1995; p. 87).
13 See (Grim, 1987; p. 19) and (Lommel, 1966a; p. 17), also (Lommel, 1966b) and (Eliade, 1978; p. 18).
14 (Wasson, 1972; p. 187)
15 (Eliade, 1951; p. 24)
16 We thank Terence McKenna for pointing this out. (McKenna, 1991; p. 144). McKenna strongly disagreed with Eliade on his negative view of psychedelics, So also did Gordon Wasson, (Wasson, 1971; p. 327)
17 (Eliade, 1951; p. 221)
18 (Wasson, 1972; p. 198)

double connection, psychedelics and shamanism, goes back centuries.[19]

2.6 Forge, 1956

This book, published in French in 1956, is devoted primarily to the religion of the metalworker, including alchemy. In it, Eliade frequently makes a connection with shamanism, as the mastery of fire is one of the characteristics of the shaman listed above. This whole story, of course, is Iron Age, hence dating from 4 KYA or so. This may be seen, then, as a later stage in the prehistory of shamanism.

3. Paleolithic Drugs (after Terence McKenna)

The appreciation for the role of naturally occurring psychoactive substances in our cultural evolution has been greatly liberalized since the psychedelic revolution of the 1960s. By now, knowledge of the use of peyote, various mushrooms, yage, ibogaine, and many other psychoactive plants is widespread, and also their ritual use by present-day shamans. A leading voice in this growing awareness, and supporter of the psychedelic hypothesis, is that of the late Terence McKenna.

3.1 Bibliography

When I met McKenna in 1972, he had just returned from an expedition to the Amazon with his brother Dennis, during which they had extensive experience with psilocybin mushrooms. The brothers were then working on the domestication of these mushrooms, a project that led to two joint books, *The Invisible Landscape* in 1975, and *Psilocybin: The Mushroom Growers Guide* in 1976. These were followed by several works by Terence, including *The Archaic Revival* in 1991, *Food of the Gods* in 1992, and *True Hallucinations* in 1993. Also relevant are two volumes of recorded conversations with Rupert Sheldrake and me, *Chaos, Creativity, and Cosmic Consciousness* in 1992/2001, and *The Evolutionary Mind* in 1998/2005. We are interested in these works:

- *The Invisible Landscape* (1975)
- *Psilocybin: The Mushroom Growers Guide* (1976)
- *The Archaic Revival* (1991)
- *Food of the Gods* (1992)
- *True Hallucinations* (1993)

3.2 The Invisible Landscape, 1975

This book has two parts. The first is an account of their expedition in the Spring of 1971 to La Chorerra, a Witito village in the Upper Amazon Basin, in search of "liberation" following *the "nostalgia for paradise" through a survey of the ideas associated with shamanism and pharmacology, with frequent forays into apparently distant fields*.[20] Pharmacology refers to the

19 (Furst, 1990; pp. ix, 261) and (Eliade, 1978; pp. 24, 26).
20 (McKenna, 1975; p. 4).

tryptamine psychedelics, in particular, yage (ayahuasca), a plant mixture used ritually by contemporary shamans of the Amazon,[21] and psilocybin mushrooms,[22] both of which abound near La Chorerra. Tryptamine intoxication is associated with an audio hallucination which became a fascination of the brothers. The second part is devoted to a theory of time based on the *I Ching* that was revealed to them in La Chorerra during multiple mushroom trips.

The first chapter of Part One, The Figure of the Shaman, much influenced by Mircea Eliade, proposes that the contemporary shamanism of the Amazon natives is a survival of that of archaic cultures. Like Eliade, the brothers understanding is based on their personal gnostic experiences of shamanic ecstasy. Putting all this together, we are led to the hypothesis that *the shamanism of ancient cultures was involved with psychoactive (shamanic trance inducing) substances*. In other words: paleolithic peoples discovered natural psychedelics, and this may have been a factor in their invention of religion, art, and mathematics.

3.3 Psilocybin, 1976

This work, basically a guide to mushroom domestication, includes an informative introduction furthering the hypothesis that the mushroom cult of Mexico derives from the Aztec culture, and more generally, the development of religion by paleolithic people was triggered by psychedelics. In fact, the Preface to the revised edition of 1986 refers to Meso-American mushroom use as an ancient shamanic religion.

3.4 Archaic Revival, 1991

This book is a compilation of interviews and talks given between 1983 and 1991, from which we will extract just a few points. In a talk at the Esalen Institute in 1983, the first of many, Terence said:

> The tradition of our cultural situation is that we have no shamanic tradition. Shamanism is primarily techniques, not ritual. It is a set of techniques that have been worked out over millennia that make it possible, though perhaps not for everyone, to explore these areas [tryptamine ecstasy].[23]

In an interview with Michael Toms in 1985, he said:

> I think in a sense [the knowledge of psychedelics] signals the rebirth of the institution of shamanism in the context of modern society.[24]

In an article in *Revision* in 1988, he first puts forward his radical theory of evolution. It begins:

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21 Their attention was drawn to yage (ayahuasca) use among the Jivaro of Ecuador by (Harner, 1968).

22 Psilocybin mushrooms came to popular attention through (Wasson, 1957).

23 (Ch 3, p. 45)

24 (Ch. 11, p. 165)

> For perhaps tens of millennia human beings have been utilizing hallucinogenic mushrooms to divine and to induce shamanic ecstasy. I propose to show that the human/mushroom interaction is not a static symbiotic relationship, but rather a dynamic one through which at least one of the parties has been bootstrapped to higher and higher cultural levels.[25]

Later in this article he puts forward the full psychedelic hypothesis:

> The next step in the cultural evolution of the bipedal pack-hunting primates was the domestication of some of the browsing herbivores. With the animals and their manure came the mushrooms, and the human-mushroom relationship was further enhanced and deepened.
>
> Evidence for these speculations can be found in southern Algeria. There is an area called the Tassili Plateau, a curious geological formation. It is like a labyrinth, a vast badlands of stone escarpments that have been cut by the wind into many perpendicular narrow corridors, almost like an abandoned city. And in the Tassili there are rock paintings that date from the late Neolithic to as recently as two thousand years ago. Here are the earliest known depictions of shamans in coincidence with large numbers of grazing animals, specifically, cattle. The shamans, dancing and holding fistfuls of mushrooms, also have mushrooms sprouting out of their bodies.[26]

In an interview with Jay Levin in 1988, he said:

> Shamanism is use of the archaic techniques of ecstasy that were developed independent of any religious philosophy — the empirically validated, experientially operable techniques that produce ecstasy. Ecstasy is the contemplation of wholeness.[27] ... Shamanism worldwide insists that the universe is multi-leveled, populated by beings that can do you great good, do you great harm.[28]

Finally, in the Introduction of 1991, he wrote:

Of all the techniques used by the shaman to induce ecstasy and visionary voyaging — fasting, prolonged drumming, breath control, and stressful ordeals — I now feel confident that the use of hallucinogenic plants is the most effective, dependable, and powerful. (p. 2)

3.5 Food of the Gods, 1992

This book has four parts. Part I, Paradise, expands his radical theory of evolution and the psyche-

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25 (Ch. 10, p. 142)
26 (Ch. 10, p. 147)
27 (Ch. 1, p. 13)
28 (Ch. 1, p. 17)

delic hypothesis.

3.6 True Hallucination, 1993

Here he tells the full story of the expedition to La Chorerra in 1991. This includes extensive first-person experience with shamans, shamanism, and the knowledge of the tryptamine plants.

I might also mention the two volumes of trialogues by Rupert Sheldrake, Terence McKenna, and myself, which refer repeatedly to these themes. These talks, begun in 1982 and recorded from 1989 to 1998, had some influence on McKenna's books of 1991, 1992, and 1993.

4. Paleolithic Art (after David Lewis-Williams)

The shamanic (or psychedelic) hypothesis has a long history, as indicated above: Eliade (1951), Kirchner (1954), Narr (1959), Wasson (1971), and McKenna (1975). To this list we must now add David Lewis-Williams and his colleagues, Johannes Loubser, Thomas Dowson, Jean Clottes, and David S. Whitley, from 1987. Keep in mind that Paleolithic art has two main categories, mobiliary or mobile (portable) art, such as statuettes, and parietal art, on cave walls.[29] Our story in this section deals primarily with parietal art. Regarding portable art, we have written previously on the Venus figurines, which comprise a class of Upper Paleolithic mobiliary art, widely distributed over Eurasia.[30]

4.1 Bibliographies

David Lewis-Williams, born in South Africa in 1934, published his first paper on rock art and trance dance of the San (Bushmen) in 1972, and received his Ph.D. from Natal in 1978. He published his thesis as a book, *Believing and Seeing: Symbolic Meanings in Southern San Rock Paintings*, in 1981. He went on to become Professor of Cognitive Archaeology and Director of the Rock Art Research Research Unit of the University of the Witwatersrand in Johannesburg. He developed the belief that southern San (Bushman) art was essentially shamanic, and after visiting the European art caves in 1972, extended this shamanic hypothesis to all the Upper Paleolithic caves of the Franco-Calabrian region by 1975. It is mentioned in an article with Johannes Loubser in 1986, announced in a talk in 1987, and published in a controversial article with his student, Thomas Dowson, in 1988.[31]

Johannes Loubser, a South African archeologist, emigrated to the US in 1993. Dowson was an undergraduate student in 1988, and went on to become Research Officer in the Rock Art Research Unit. Lewis-Williams and Dowson subsequently published several books together on San rock art (1989, 1992, 1994, 1999).

Meanwhile, Jean Clottes was born in France in 1933, began to study cave art in 1971, and re-

29 For extensive coverage of these two categories, see (Graziosi, 1960).
30 See (Abraham, 2011, Ch. 1) on the Venus of Lespugues.
31 (Lewis-Williams, 1988).

ceived the Ph.D. in Toulouse for a study of Neolithic dolmens in 1975. Becoming a leading expert on European cave art, he played a lead role in the study of two recently discovered caves, Cosquet (1985) and Chauvet (1994). After a long friendship, Clottes and Lewis-Williams wanted to collaborate. They met at a conference in Flagstaff, Arizona in 1994, and began a joint project in 1995. Together, they visited twelve of the Franco-Calabrian caves, and published a joint book in 1996. The English edition appeared in 1998 as *The Shamans of Prehistory: Trance and Magic in the Painted Caves*. This controversial work was followed by a joint sequel, also in 1996, *Les Chamanes de la Préhistoire: Texte Intégral, Polémique et Réponses* in which the criticisms were addressed.

David S. Whitley, like Jean Clottes, is a prominent archeologist, and also, a friend and follower of Lewis-Williams. An authority on North American rock art, he served as chief archeologist at UCLA. He is the author of several books, including *A Guide to Rock Art Sites, Southern California and Southern Nevada* (1996), *The Art of the Shaman: Rock Art of California* (2000), *Introduction to Rock Art Research* (2005), and *Cave Paintings and the Human Spirit: The Origin of Creativity and Belief* (2009). He suggested to Lewis-Williams and Clottes in 1994 that they work together on the project that resulted in their joint publication of 1996/1998.[32]

Lewis-Williams went on to write three further books relating to the shamanic hypothesis, in 2002, 2005 (with David Pearce), and 2010. In this section we will be concerned especially with these works:

- *Believing and Seeing: Symbolic Meanings in Southern San Rock Paintings* (1981).
- Deceptive appearances: a critique of southern African rock art studies (Lewis-Williams and Loubser, 1986).
- The signs of all times: entoptic phenomena in upper paleolithic art (Lewis-Williams and Dowson, 1988).
- *The Shamans of Prehistory: Trance and Magic in the Painted Caves* (Clottes and Lewis-Williams, 1996/1998).
- *The Mind in the Cave: Consciousness and the Origins of Art* (2002).

4.2 Believing and Seeing, 1981

Lewis-Williams is primarily an expert of southern San (Bushman) rock paintings. In Chapters 7 and 8 of this first book he anticipates his shamanic hypothesis in the limited context of the rock art of southern Africa. He uses the word *trance* in place of ecstasy, and *medicine man* in place of shaman.

> Trance performance facilitates contact between the terrestrial world and the spirit world; one conductor of power from the spirit world to the mundane is the animal possessed by the medicine man and celebrated in the medicine song which is his particular forte. Trance makes this relationship particularly real and visual, for the !Kung medicine men say that in trance they "see" the animal that is linking them to the supernatural power over

32 (Whitley, 2009; p. 47)

> which they exercise control. Trance thus enables them to see what they believe.[33]

Hence "believing and seeing" in the title of this work. In other words, the shaman induces ecstasy by drumming, singing, and dancing, sees what is believed, returns to the mundane plane, and paints what he has seen: the triple connection. I do not know if the San used psychedelics in paleolithic times.[34] Regarding the role of trance in the shamanic toolbox, Andreas Lommel, director of the Munich Museum of Ethnology, wrote:

> Part of the shaman's activity consists of trance. During initiation and during artistic creation the essential thing for the shaman is a displacement of the plane of consciousness. Clear consciousness is eliminated. Images are activated on another plane of consciousness. These images are always taken from the world-view, mythology, and religion of the tribe or culture group in question. But instead of these images being given form in a conscious state, this takes place in an unconscious or subconscious state. The shaman sings, dances, mimes — he may even paint and draw in a trance.[35]

It is possible that the shamanic trance may be observed even today, either by an expedition to Amazonia, or by flying to South Africa, or to Japan to attend a Noh play.[36]

4.3 Deceptive appearances, 1986

Here the shamanic hypothesis is mentioned in passing:

> The metaphors and hallucinations that structure San art and also link the art to certain myths and rituals derive principally from a complex of beliefs about trance performance. In the curing dance, the central religious ritual of the San, medicine men exorcise known and unknown ills from all members of the camp. The women, sitting dose to a central fire, clap and sing songs believed to contain a supernatural potency, while the men dance around them with short, pounding steps. As the dance increases in intensity the potency is said to "boil" in the medicine men's stomachs until it "explodes" in their heads, and they enter trance.[37]

4.4 The signs of all times, 1988

The abstract of this article, submitted in June of 1987, reads as follows.

> Elucidation of the geometric signs in Upper Palaeolithic art is hampered by an absence of directly relevant ethnography and by the logical impossibility of inducing meaning

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33 See (Lewis-Williams, 1981; p. 81) and also (Curtis, 2006; p. 218).

34 However, Richrd Katz mentions 15 varieties of medicinal plants now in use. (Katz, 1982; pp. 39, 51)

35 (Lommel, 1967; pp. 11-12)

36 See (Blacker, 1999; p. 31) and (Ortolini, 1995; p. 87).

37 (Lewis-Williams, 1986; p. 267)

> from numerical rock-art data. This paper approaches the signs by constructing a neuro-psychological model of the apprehension of entoptic phenomena in three stages of altered states of consciousness. The utility of the model is assessed by applying it to two known shamanistic rock arts, San and Shoshonean Coso.[38] It is then applied to Upper Palaeolithic mobile and parietal art to show that this art was also associated with altered states of consciousness. Some of the implications of this conclusion for understanding the meaning of entoptic elements, the diverse contexts of Upper Palaeolithic art, the co-occurrence of signs and representational art, and the origins of art are briefly considered.

As this paper was read to a meeting of the Society for American Archeology, and thus written for experts, we will begin with a glossary for nonspecialists.

> *Altered state of consciousness (ASC)*. This concept derives from a tiered model of consciousness, that is, ordinary or mundane reality is but one of two or more (in this case, three) parallel planes of existence. For example, the trance state is flight to an ASC.
>
> *Hallucination*. Perception without stimulus. For example, visions that are imaginary, or unreal. This term, referring to trance visions, is offensive by those to whom the ASC are equally as real as ordinary reality. May appear to any sense, for example, auditory hallucinations.
>
> *Neuro-psychological model*. This model regards the visions of the trance state as hallucinations. That is, they are artifacts of the biological neural network. The term suggests the materialist perspective that the mind is in the brain.
>
> *Entoptic phenomena*. *Entoptic* is from the Greek, meaning *within the eye*. These are visions perceived, but not caused by light, a kind of visual hallucination. The term includes phosphenes (which appear as flashes of light), and visions of an ASC, for example, the peyote form-constants of Klüver (see below).
>
> *Mobile (or mobiliary) art*. Statues of carvings (eg, of bone, antler, rock, and so on) that may be carried easily about.
>
> *Parietal art*. Artwork on cave walls, rock shelters, or large rocks.

In short, the neuro-psychological model of Lewis-Williams and coworkers assumes a shaman (medicine man) enters a trance (ASC) via dancing, drumming, singing, perhaps even by ingesting psychoactive substances, then has visions (entoptic phenomena), then attempts to record the visions in art works. Regarding the connection between entoptic phenomena and psychedelics, they refer to Heinrich Klüver, who studied the visions associated with the peyote trance in 1928.

On the basis of my own experience of the shamanic journey in the 1960s, including living in a

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38 The Coso region is now inaccessible within the China Lake Naval Air Weapons Station in the southern California desert.

rock shelter in the Himalayan foothills of India, I rebel at the words hallucination and hallucinogen. It is my conviction that the various tiers are equally real: The visions are neither ectoptic nor neuro-psychological, but are true visions of alternate states of consciousness.

4.5 The Shamans of Prehistory, 1996/1998

Finally, a full, book-length presentation of the neuro-psychological model of Lewis-Wiliams and coworkers. In Chapter 1, Shamanism, we find a detailed description of the three stages of trance, the definition of a shaman, and the use of hallucinogens. Chapter 2, The Art of the Caves and Rock Shelters, is an introduction by masters intended for beginners. Careful distinction is made between two kinds of art — representational art and signs — which usually appear together. In Chapter 3, One Hundred Years of Searching for Meaning, we find a list of theories preceding the shamanic theory, followed by a history of the new model. Credit is given to Mircea Eliade and Weston La Barre, who each published the theory in 1972. In Chapter 4, Cave Art and Shamanism, we have a rational for shamanism in the Upper Paleolithic, and details of the third stage of trance. Finally, in Chapter 5, The Shamanic World, we discover a plausible scenario for the shamanic creation of the parietal art of the Franco-Calabrian Upper Paleolithic, described as the origin of art, the alpha point for the art of our species.

4.6 The Mind in the Cave, 2002

This is a masterful retelling of the neuro-psychological model, and extends the model to the rock arts of the southern African San and of the natives of North America. Another excellent account of the model has been given by David Whitley.[39]

5. Geometric Motifs

Counting images in the caves of France reveals that 70% of them are abstract geometric signs, and only 30% are the familiar representations of animals. We now focus our attention on the geometric signs, which we will regard in the context of the shamanic (or psychedelic) hypothesis.

5.1 Heinrich Klüver, 1928

The earliest studies of psychedelic images I know were summarized by the German psychologist, Heinrich Klüver, in 1928. He analyzed the visions induced by ingesting mescal (peyote) by himself and others, including reports from 1895 through 1927. He found that a number of geometric forms were seen repeatedly by many of the subjects; he called these *form-constants*. The most common, seen chiefly in the first stages of mescaline intoxication, are:

- grating, lattice, fretwork, filagree, honeycomb, or chessboard design,
- cobweb,
- tunnel, funnel, alley, cone, or vessel, and

39 (Whitley, 2009; Ch. 1)

Figure 5. The 26 geometric signs of Genevieve von Petzinger.

• spiral.[40]

In their 1988 analysis of geometric forms in cave paintings, David Lewis-Williams and Thomas Dowson looked for entoptic phenomena. They extracted a list of six categories:

• grating,
• parallel lines,
• clusters of dots or circles,
• parallel zig-zag lines,
• parallel circular arcs, and
• meanders or spirals.[41]

There is a moderate degree of concordance of these two lists.

5.2 Suzanne Carr, 1995

40 (Klüver, 1966; pp. 22-23, 66)
41 See (Lewis-Williams, 1988; p. 206) and (Lewis-Williams, 2002; p. 182).

An exhaustive study of entoptic phenomena is given in the 1995 MA dissertation of Suzanne Carr.[42] Referring to Lewis-Williams and Dowson, she provides evidence in support of their theory, and responds to their critics. Her thesis includes many examples of mobiliary art.

5.3 Genevieve von Petzinger, 2010

Finally, we come to the project of Geneviee von Petzinger.[43] For her MA thesis in anthropology at the University of Victoria in British Columbia, Canada, 2010, she created a relational data base of geometric signs from 146 painted caves in France. From this data, she identified 26 distinct shapes that recur more-or-less frequently. These are shown in Figure 5. Clockwise from top left these are:

1. Aviform (12 sites of the 146, less than 10%)
2. Circle (20%)
3. Claviform (15%)
4. Cordiform, (3 sites)
5. Crosshatch (17%)
6. Cruciform (13%)
7. Cupule (15%)
8. Dot (42%)
9. Finger fluting (15%)
10. Flabelliform (18%)
11. Zig-zag (7 sites)
12. Triangle (20%)
13. Tectiform (10%)
14. Spiral (2 sites)
15. Serpentiform (7%)
16. Scalariform (3 sites)
17. Reniform (Rare)
18. Quadrangle (20%)
19. Positive hand (7%)
20. Pectiform (5%)
21. Penniform (25%)
22. Open angle (42%)
23. Negative hand (15%)
24. Line (70%)
25. Oval (30%)
26. Half circle (18%)

Ignoring the four rare cases (less than 5%) we have a convincing list of 22 geometric signs that are fairly universal. The entoptic categories identified by Klüver and Lewis-Williams are among

42 (www.oubliette.org.uk, accessd 27 February 2011)

43 (www. bradshawfoundation.com/geometric_signs, accessed 27 February 2011)

them (excepting the spiral) but neuro-psychological mechanisms cannot account for them all. We have, apparently, a pre-literate iconic language that evolved from shamanic (trance) practices.[44]

5.4 Most popular motifs

Selecting from this list of 26 recurring forms the most popular (scoring 20% or better) and listing in order of popularity, we have this amazing list of seven forms.

24. Line (70%)
8. Dot (42%)
22. Open angle (42%)
25. Oval (30%)
21. Penniform (25%)
2. Circle (20%)
18. Quadrangle (20%)

These overlap the six categories of Lewis-Williams to some extent. And all are familiar from Euclid's *Elements*, except the penniform, which looks like chicken footprints. Could it be that Plato's image of the cave in the Republic was inspired by cave art?

5.5 The birth of geometry

The *Elements* of Euclid, from Alexandria around 300 BCE, is the second most published book of all time, after the Bible, and is the most important math textbook of all time. Every important mathematician until recently has learned the basic strategies of mathematics from Euclid's works. It begins with primitive notions, the point and the line, and proceeds through thirteen books to the construction of the five Platonic solids, with which (in the *Timaeus*) Plato constructed the universe. The prehistory of geometric thinking, or proto-geometry, must likewise begin with the emergence into human consciousness of some basic notions which are mathematical, that is, which live in Plato's mathematical universe, a world of complete abstraction. That is, to launch geometric thinking, a circle must evolve from being the symbol of something circular into being an abstract circle, that is beyond symbolizing anything. Thus I am proposing here that the abstract geometric forms found in the rock art of the Upper Paleolithic cultures, and their shamanic progeny up to the present day, are proto-geometric primitives. Within the span of the Upper Paleolithic, some 25,000 years or so, these archetypal patterns that archeologists call geometric forms completed an evolutionary process of abstraction in which an iconic language became a mathematical language.

6. Conclusion

This long story on the evolution of a geometric thought-style — along with shamanic religion (the voyage of the soul, magic, the mastery of fire) and the earliest arts (including Venus figurines and cave paintings) in a culture influenced by psychedelic rites — may be regarded as the

44 Compare with the symbolic language in (Gimbutas, 1989; p. 3).

birth of geometric thinking, or proto-geometry. Thus, the prehistory of the geometric mentality goes back at least 35 KYA, or 30,000 years before the R/G bifurcation of the early Neolithic, and joins religion and art as subjects of the psychedelic hypothesis. This bifurcation marks the moment in which the geometric thought-style became the dominate thought-style (or mentality) for our global culture. The bifurcation from representational art to fully abstract art that occurred with Kandinsky around 1910 may be regarded as a recapitulation of the Ur process of the Upper Paleolithic, in which the original generative process was recovered by a modern day shaman/artist.[45]

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45 See (Whitley, 2009; pp. 72-73) for this idea, also (Weiss, 1995) for the full story.

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