

IFA - Owari - Adinkra - Clifford (Giza) - Llull - Lukasa origins of E8 - Cl(16) Physics

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IFA

At least as far back as 12,000 years ago, Africans had developed IFA Oracle divination based $256 = 2^8$ elementary states known as the 256 Odu

One IFA way to choose among the 2^8 Odu possible states is to cast an Opele Chain
(image from Folkcuba.com web site)



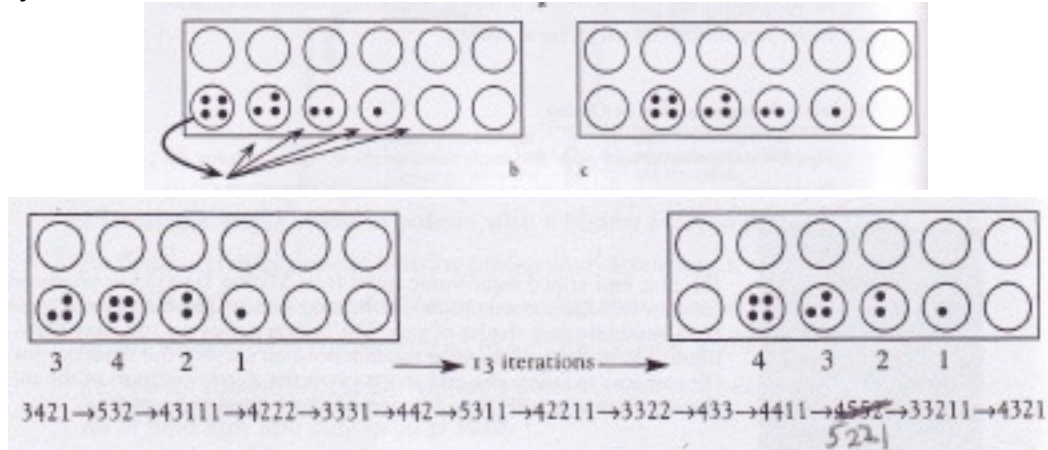
of 8 shells that when cast can land either up or down.

Since the number of sub-hypercubes in an 8-dimensional hypercube is $6,561 = 81 \times 81 = 3^8$,
the IFA Oracle has $N=8$ ternary 3-structure as well as binary 2-structure:

N	2^N	3^N
0		1
1		2 3
2		4 = 2x2 9 = 3x3
3	8	27
4	16 = 4x4	81 = 9x9
5	32	243
6	64 = 8x8	729 = 27x27
7	128	2187
8	256 = 16x16	6561 = 81x81

Owari

The ancient African game Owari is described by Ron Eglash (in his book "African Fractals" (Rutgers 1999) and on his web site at www.csdt.rpi.edu): "... the owari marching-group system can be used as a one-dimensional cellular automaton ...



... transients of many different lengths can be produced. ... the constant pattern is called a "point attractor", and the transients would be said to lie in the "basin of attraction".

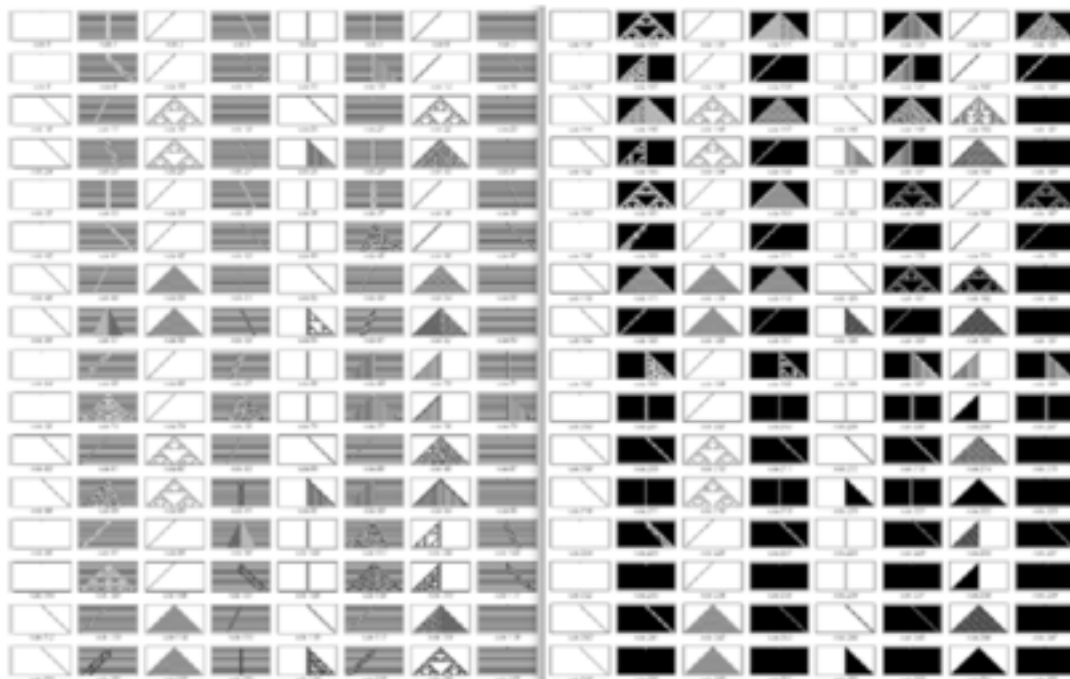
IFA binary 2-structure corresponds to static states.

IFA ternary 3-structure corresponds to dynamic states.

Owari uses binary 2-choice IFA static states to define

dynamics on ternary neighbor IFA states

producing the 256 elements of Elementary Cellular Automata



(image from "A New Kind of Science" by Stephen Wolfram)

which correspond to the 256 Odu of IFA.

Adinkra

According to The Oxford Encyclopedia of African Thought, Vol. 1, by F. Abiola Irele and Biodun Jeyifo, "... Adinkra are visual forms that ... integrate striking aesthetic power, evocative mathematical structures, and philosophical conceptions ... [Its] cosmic framework is suggested by the Adinkra symbol Gye Nyame ... meaning ...

"This great panorama of creation dates back to time immemorial, no one lives who saw its beginning and no one will live to see its end, except Nyame ...". ...".



The African Adinkra character Gye Nyame

looks like an Opele Chain



Gates and co-authors Doran, Faux, Hubsch, Iga, Landweber, and Miller in arxiv 0806.0050 [hep-th] said: "... Adinkras are directed graphs ...

The fundamental example of an Adinkra topology is that of the N-cube, $I^N = [0; 1]^N$. It has 2^N vertices and $N \times 2^{(N-1)}$ edges.

We may embed it in R^N by locating the vertices at the points

$p = (p_1, \dots, p_N)$ in R^N , where $p_i = 0$ or 1 in all 2^N possible combinations. ...

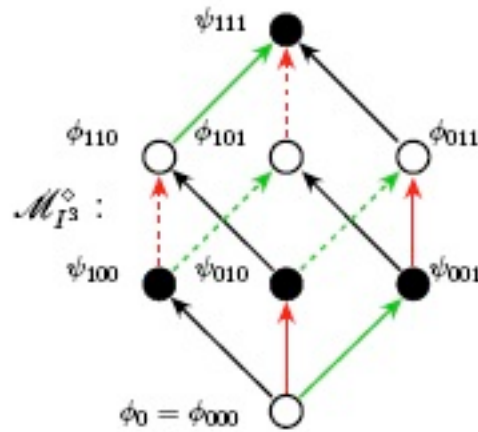
For every vertex, p , the weight of p , written $wt(p)$, equals the number of J in $\{1, \dots, N\}$ for which $p_J = 1$...

As the weights of the vertices are either odd or even, we color them either black or white, respectively ...

We associate the numbers from 1 to N with N different colors ...

The result is called the colored N-cube. ...

We now construct ... M_I^N cubic ... Adinkras ... called Top Clifford Algebra superfields ... let $N = 3$...



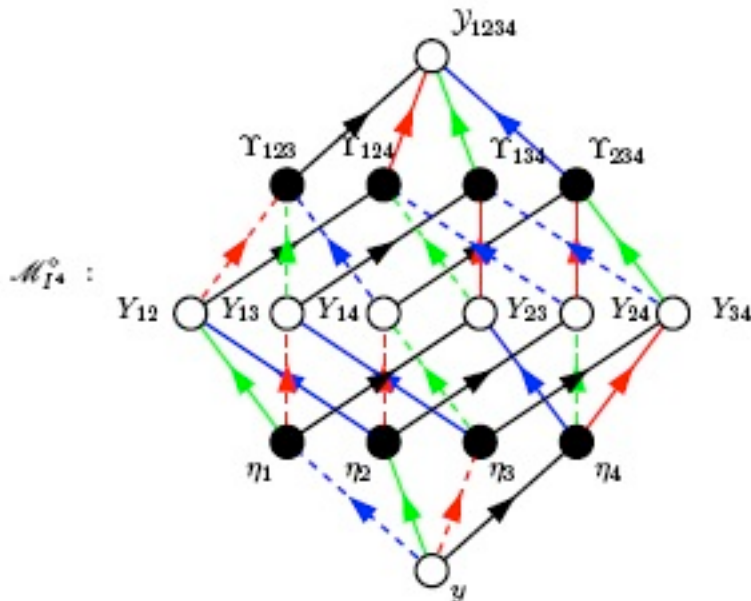
...”

Gates and co-authors Doran, Faux, Hubsch, Iga, Landweber, and Miller in arxiv 0811.3410 [hep-th] said:

“... Herein, we relate Adinkras to Clifford algebras ...

The extreme example is when the Adinkra is one-hooked, that is, there is only one vertex v of lowest engineering dimension, and that this is the unique vertex having all its adjacent edges oriented away from it ...

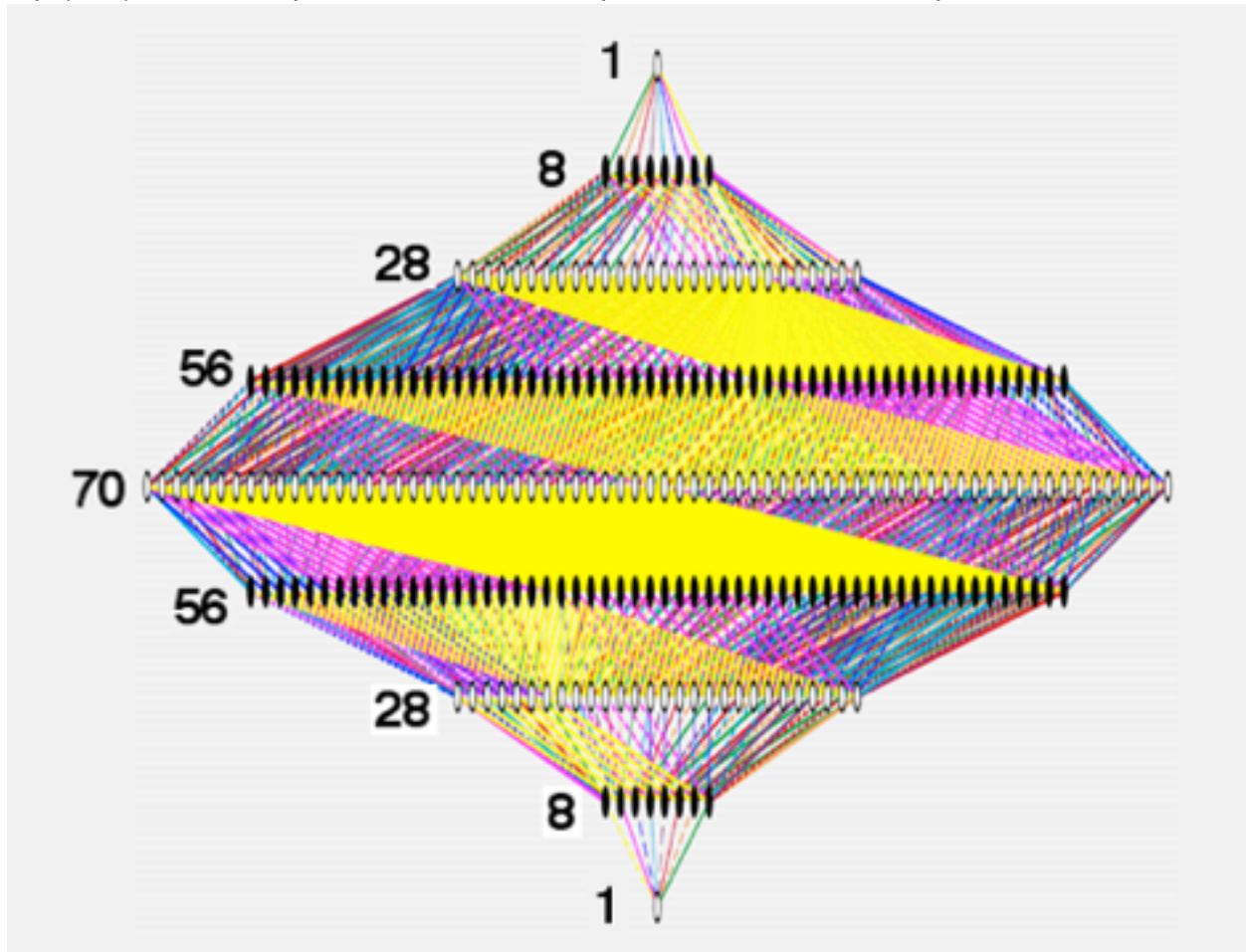
In the one-hooked case ... there is only one Adinkra possible, with only one Adinkra topology, and with only one doubly even code capable of describing it. ... Here is an example of a hypercube I^4 topology ...



...”

G. D. Landweber's 2006 program Adinkramat at <http://www.cohomology.com/> produces Adinkra graphs of MI^N cubic, such as

$N = 8$ of real Clifford Algebra $Cl(8)$ with 28-dim grade 2 = $Spin(8)$
 and graded structure $1 + 8 + 28 + 56 + 70 + 56 + 28 + 8 + 1$
 with $2^8 = 256$ elements corresponding to the 256 Odu and
 $\sqrt{256} = 16$ -dim spinors = 8-dim +half-spinors and 8-dim -half-spinors



The $2^8 = 16 \times 16 = 156$ elements of $Cl(8)$ correspond directly to:
 the 256 vertices of an 8-dim hypercube;
 the 256 Odu of IFA Divination;
 the 256 fundamental Cellular Automata,
 which inherit the graded structure

1

8

28

56

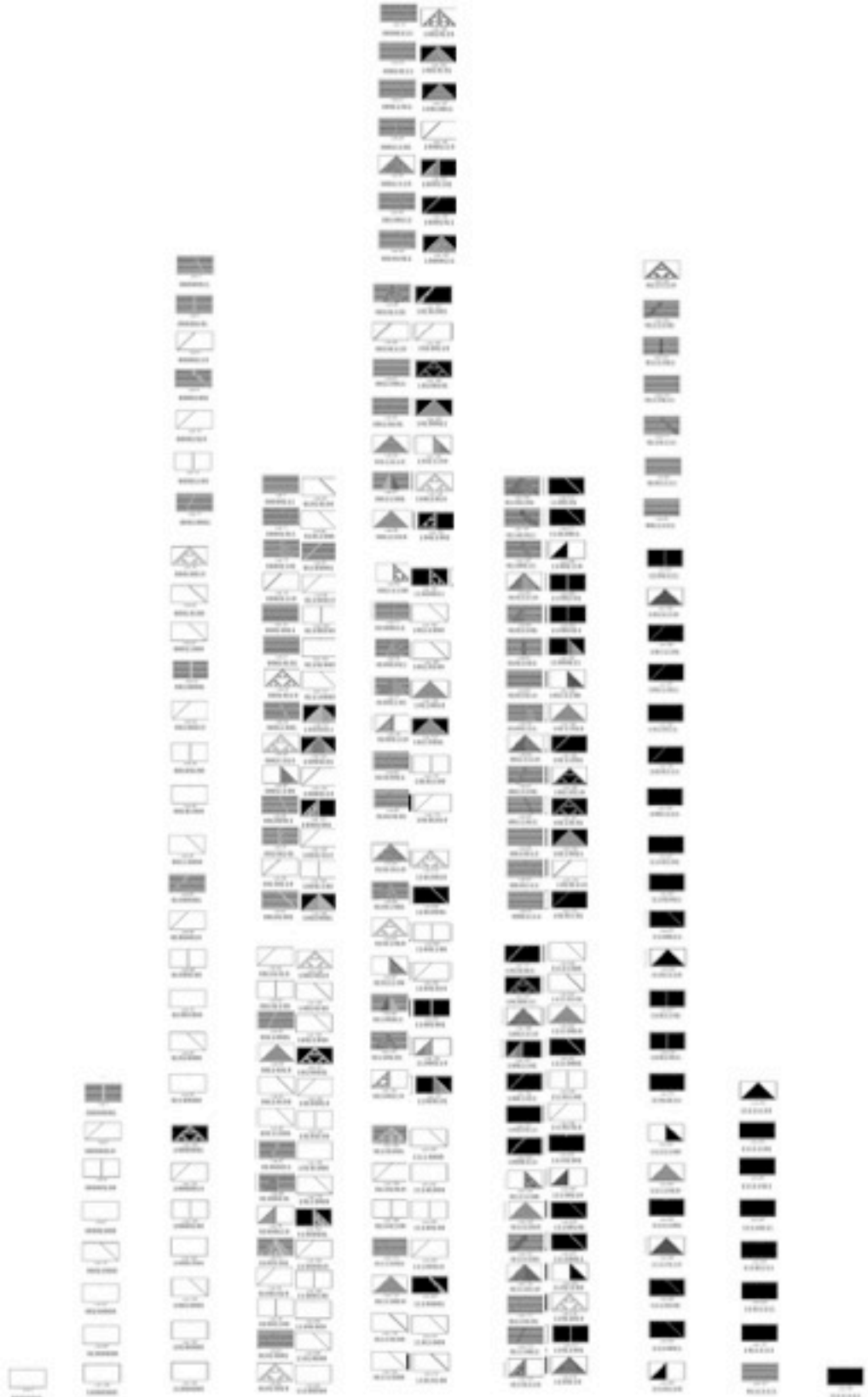
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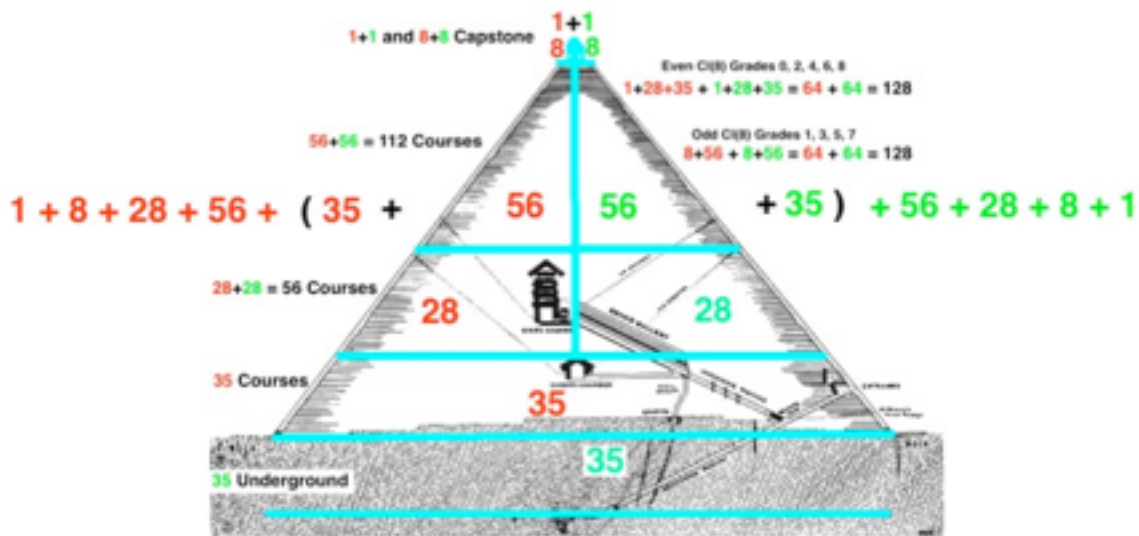
Clifford (Giza)

Adinkras show how the 256 Odu of IFA have the structure of the 256-dimensional Real Clifford Algebra $Cl(8)$ which is the algebra of 16×16 Real Matrices and whose full spinors, corresponding to columns or rows of the matrices, are 16-dimensional.

IFA recognizes the fundamental importance of those 16 dimensions by personifying the 16 as the 16 Orishas

0000	0	Ogbe	- light - birth of Orunmila (wisdom)
0001	1	Osa	- overcome fear
0010	2	Otura	- govern wisely
0011	3	Owonrin	- weather storm
0100	4	Irete	- if you refuse to sacrifice something, you may lose it anyway
0101	5	Ofun	- Oludumare creates Earth, the Odu, the Orishas, and humans
0110	6	Edi	- watch out for obstacles
0111	7	Okanran	- follow plans
1000	8	Ogunda	- Ogun - use technology wisely
1001	9	Iwori	- ask diviner for advice
1010	10	Ose	- truth protects good and destroys evil
1011	11	Oturopon	- raise children well
1100	12	Irosun	- crouch and wait and plan
1101	13	Ika	- you reap what you sow
1110	14	Obara	- cooperate (each hand washes the other)
1111	15	Oyeku	- dark - Oludumare's Earthly creations

Clifford Algebras were not known to European mathematicians until Clifford in the 19th century and not known to European physicists until Dirac in the 20th century but it seems to me that their structure was known to Africans in ancient times. For example, the courses of the Great Pyramid of Giza correspond to the graded structure of $Cl(8)$:



(image adapted from David Davidson image - for larger size see tony5m17h.net/GreatPyrCl8.png)

Further, IFA identifies the 256 Odu with 16x16 pairs of the 16 Orishas corresponding to the 16x16 matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Ogbe	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
2 Osa	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
3 Otura	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
4 Owonrin	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
5 Irete	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
6 Ofun	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
7 Edi	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
8 Okanran	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9 Ogunda	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
10 Iwori	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11 Ose	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
12 Oturopon	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
13 Irosun	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
14 Ike	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
15 Obara	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
16 Oyeku	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Real Clifford Algebras have the property of 8-periodicity so that $Cl(N8) = Cl(8) \times \dots (N \text{ times tensor product}) \dots \times Cl(8)$ meaning that all Real Clifford Algebras, no matter how large, have fundamental underlying $Cl(8)$ structure.

In particular:

$$Cl(16) = Cl(8) \times Cl(8)$$

$$120 \text{ Cl}(16)\text{bivectors} = (28 \text{ Cl}(8)\text{bivectors} \times 1) + (1 \times 28 \text{ Cl}(8)\text{bivectors}) + (8 \text{ Cl}(8)\text{vectors} \times 8 \text{ Cl}(8)\text{vectors})$$

$$64+64+64+64 = 128+128 = 256 \text{ Cl}(16) \text{ spinors} = (8 \text{ Cl}(8)+\text{half-spinors} \times 8 \text{ Cl}(8)+\text{half-spinors}) + (8 \text{ Cl}(8)+\text{half-spinors} \times 8 \text{ Cl}(8)-\text{half-spinors}) + (8 \text{ Cl}(8)-\text{half-spinors} \times 8 \text{ Cl}(8)-\text{half-spinors}) + (8 \text{ Cl}(8)-\text{half-spinors} \times 8 \text{ Cl}(8)+\text{half-spinors})$$

Llull

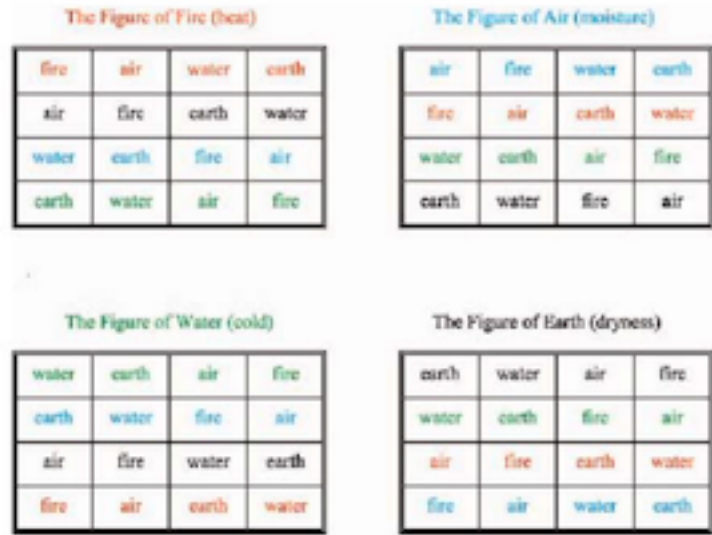
Ramon Llull (1232-1316) of Mallorca lived in a time and place of a unique confluence of Islamic, Christian, and Jewish mystical ideas on a Mediterranean island between Iberia and Africa so he was exposed to ideas including Islamic 16-element Ilm al Raml derived from African 256-element IFA, Christian-Crusader Troubadour 78-element Tarot, Jewish Urim v'Thummim system revealed to Moses for decoding the 72 letters on the 12 stones of the Breastplate of Judgment, and he was able to travel easily to Africa, the home of 256-element IFA.

Anthony Bonner in his book "The Art and Logic of Ramon Llull" (Brill 2007) says: "... Ramon Llull ... grew up in ... Majorca ... conquered [by] ... the Catalans ... where Muslims ... occupied perhaps a third of the population, and where Jews ... were culturally important ... he decided to ... write a book ... directed towards the conversion of the Muslims and Jews ... and settled down to nine years of study, during which he bought an Arab slave so as to learn his language and culture ... [his] autobiography ... has ... gaps, as for instance what he actually studied beside the Arabic language during his nine years of formation ... In about 1283 Llull remodeled his system with the Ars demonstrativa ... Llull's description ... "This First Figure is circular, with A in the center ...



... [It] is made up of sixteen compartments, with ... lines extending from one compartment to another ... In these compartments are written the sixteen dignitaries we understand to exist in God" ...

... The First Elemental Figure ... consists of four quadrangles ...



Elemental Figure

... of sixteen compartments each ...”.

The 16 dignitaries correspond to the 16 Orishas of IFA.

The 120 lines correspond to the 120 bivectors of the Cl(16) Clifford Algebra.

The $4 \times 16 = 64$ elements of an Elemental Figure correspond to the 64 elements of each of the 64-element components of the Cl(16) spinors:

$$\begin{aligned} & (8 \text{ Cl}(8)\text{-half-spinors} \times 8 \text{ Cl}(8)\text{-half-spinors}) \\ & (8 \text{ Cl}(8)\text{-half-spinors} \times 8 \text{ Cl}(8)\text{-half-spinors}) \end{aligned}$$

$$\begin{aligned} & (8 \text{ Cl}(8)\text{-half-spinors} \times 8 \text{ Cl}(8)\text{-half-spinors}) \\ & (8 \text{ Cl}(8)\text{-half-spinors} \times 8 \text{ Cl}(8)\text{-half-spinors}) \end{aligned}$$

The 120 bivectors of Cl(16)

and

the $128 = 64 + 64 =$

$$= (8 \text{ Cl}(8)\text{-half-spinors} \times 8 \text{ Cl}(8)\text{-half-spinors}) + (8 \text{ Cl}(8)\text{-half-spinors} \times 8 \text{ Cl}(8)\text{-half-spinors}) =$$

$=$ half-spinors of Cl(16)

combine to form the 248-dim E8 Lie Algebra as it lives inside Cl(16).

Lukasa

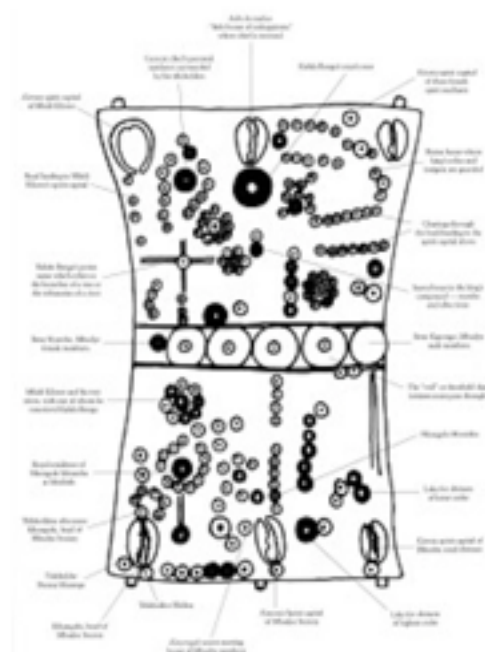
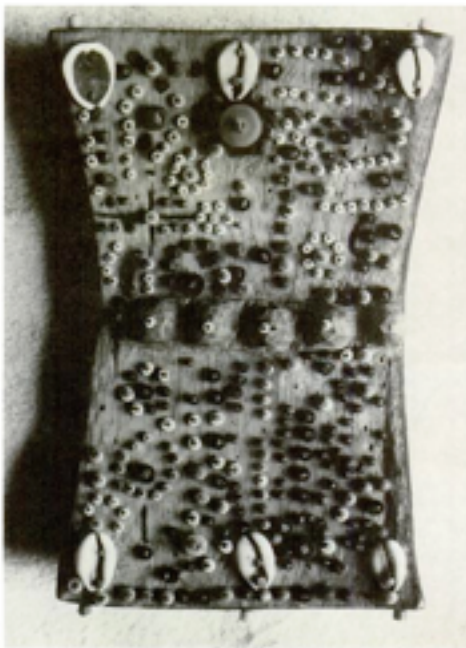
Evans Harrell in "Mathematical understandings of Africa" (Georgia Tech 2014) says: "... lukasa memory board: A sort of map including history and personal and political relationships ... The understanding of a lukasa board has been (mostly) lost. Can we use math to bring some of it back?"

According to Wikipedia: "... The lukasa fulfilled many mnemonic functions ... There were three distinct categories of lukasa ...

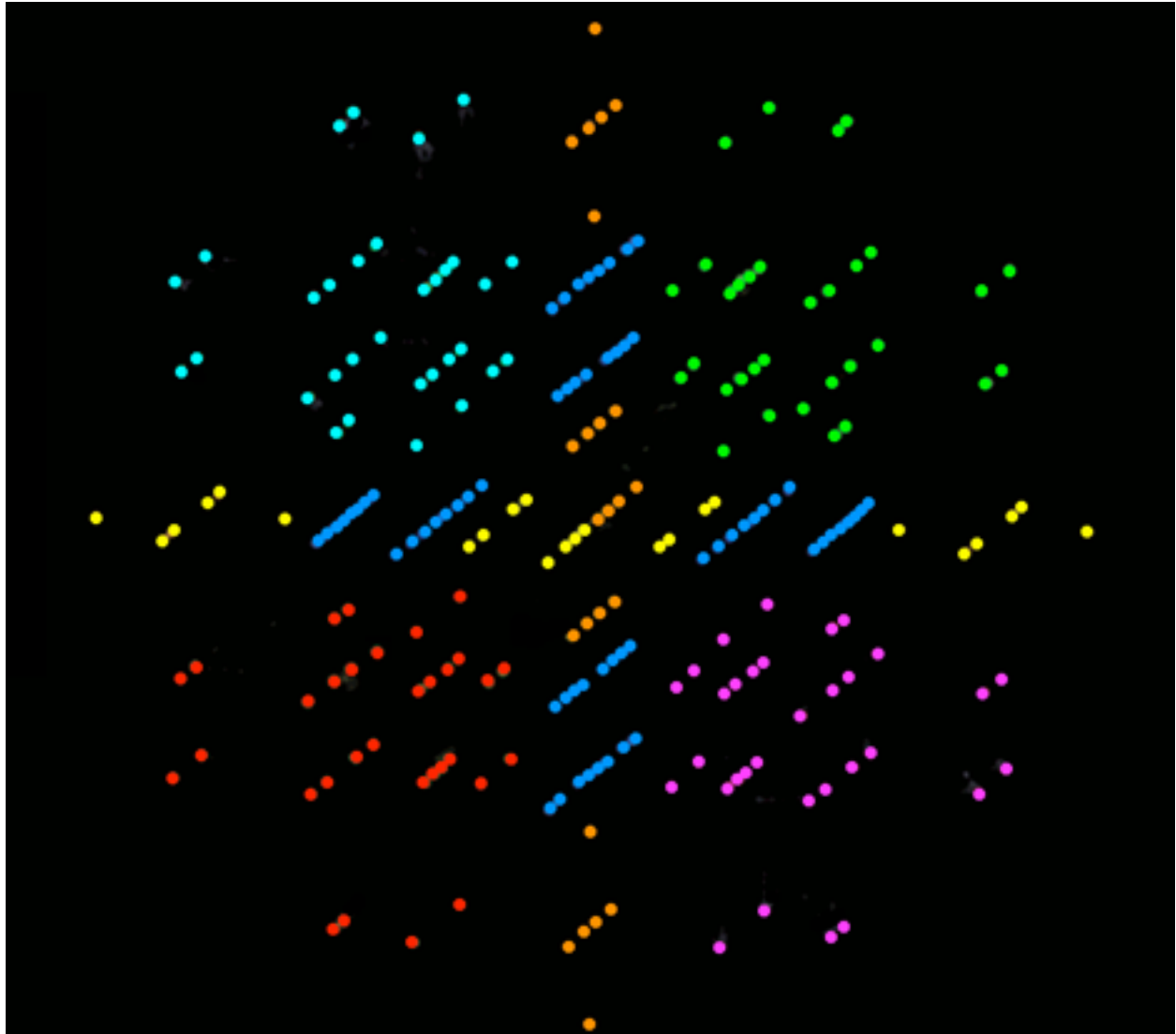
First, the lukasa lwa nkunda, "the long hand of the pigeon," bears information on mythical heroes and early rulers and on the mythical migration routes of the Luba. Second, the lukasa lwa kabemba, "the long hand of the hawk," is concerned with the organization of the Mbudye society.

A third type of memory board was created for the use of individual Luba rulers and contained secret information about divine chiefship. No examples of this type, referred to as the lukasa lwa kitenta, "the long hand of the sacred pool," still exist. ...".

The First and Second types are somewhat like this example from Thomas Q. Reefer's paper "Lukasa: A Luba Memory Device" (African Arts 10, no. 4 (1977):

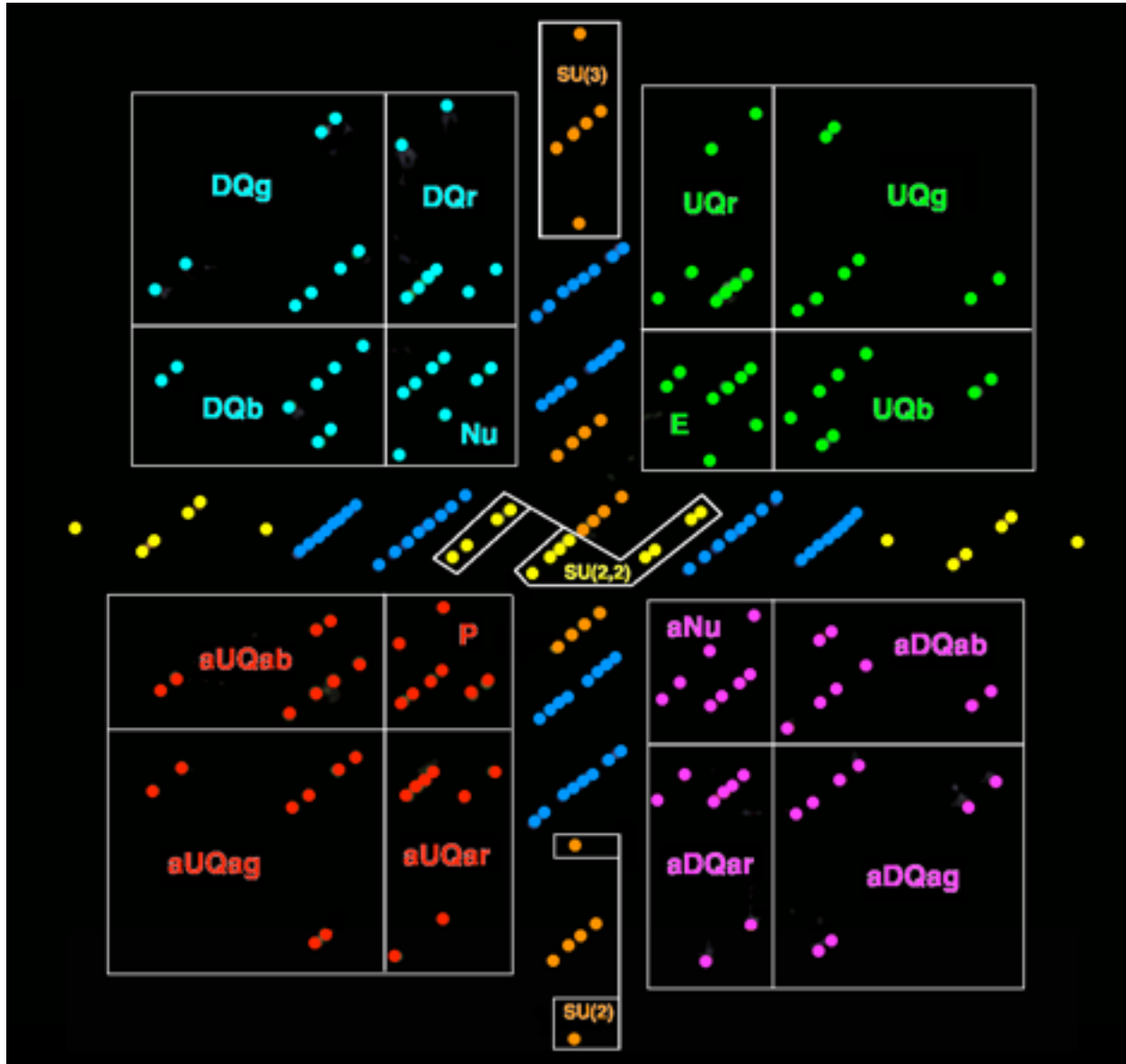


As to the Third type, the long hand of the sacred pool, my view is that it includes maps of states of E8 Physics as embedded in Cl(16), such as physical interpretations of the 240 Root Vectors of E8. For example, here is a 2-dim view of a 3-dim cube-type representation of the 240 E8 Root Vectors



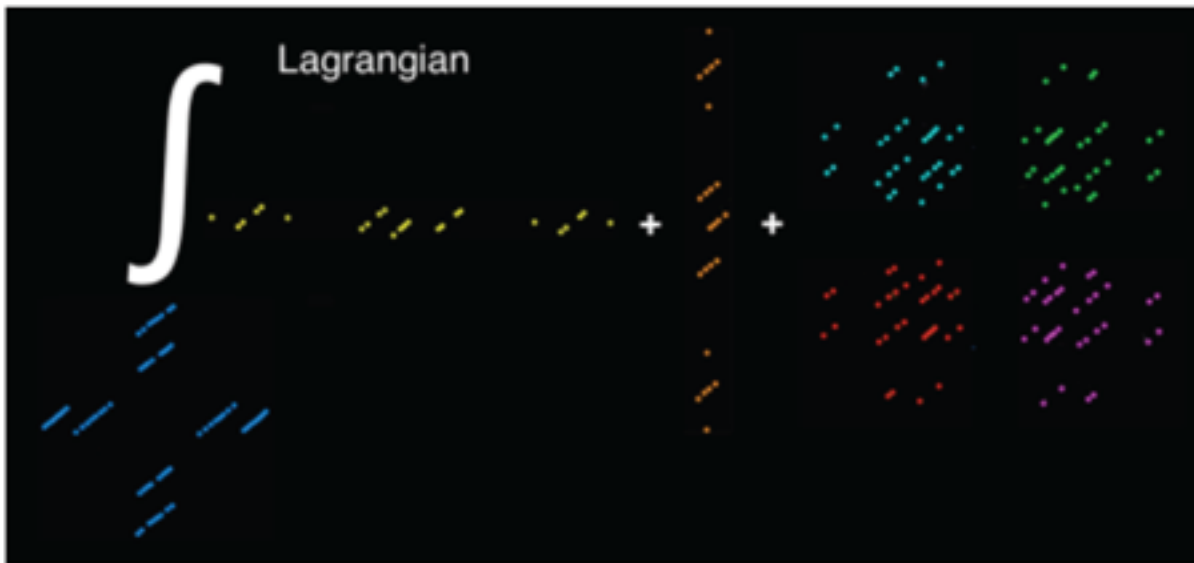
and

here are physical interpretations in of each Root Vector



E = electron, UQr = red up quark, UQg = green up quark, UQb = blue up quark
 Nu = neutrino, DQr = red down quark, DQg = green down quark, DQb = blue down quark
 P = positron, aUQar = anti-red up antiquark,
 aUQag = anti-green up antiquark, aUQab = anti-blue up antiquark
 aNu = antineutrino, aDQar = anti-red down antiquark,
 aDQag = anti-green down antiquark, aDQab = anti-blue down antiquark
 Each Lepton and Quark has 8 components with respect to 4+4 dim Kaluza-Klein
 6 orange SU(3) and 2 orange SU(2) represent Standard Model root vectors
 24-6-2 = 16 orange represent U(2,2) Conformal Gravity Ghosts
 12 yellow SU(2,2) represent Conformal Gravity SU(2,2) root vectors
 24-12 = 12 yellow represent Standard Model Ghosts
 32+32 = 64 blue represent 4+4 dim Kaluza-Klein spacetime position and momentum

that allow construction of a physically realistic Standard Model + Gravity Lagrangian



A realistic generalized hyperfinite von Neumann factor AQFT is constructed by taking the completion of the union of all tensor products of $Cl(16)$ containing E_8 , which process is assured by 8-Periodicity of Real Clifford Algebras.

For details of how this works, see viXra 1508.0157 .

In summary:

**African IFA, Owari, Adinkra, Clifford (Giza), and Llull
give math for $E_8 - Cl(16)$ Physics
that is realistically described by Lukasa maps.**