



AFRICAN MATHEMATICAL UNION

COMMISSION ON THE HISTORY OF MATHEMATICS IN AFRICA

AMUCHMA-NEWSLETTER-3

Eduardo Mondlane University, Maputo, Mozambique, 03.02.1989

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1. OBJECTIVES OF AMUCHMA

The A.M.U. Commission on the History of Mathematics in Africa (AMUCHMA), formed in 1986, has the following objectives:

- a. to improve communication among those interested in the history of mathematics in Africa;
- b. to promote an active cooperation between historians, mathematicians, archaeologists, ethnographers, sociologists, etc., doing research in or related to the history of mathematics in Africa;
- c. to promote research in the history of mathematics in Africa and the publication of its results in order to contribute to the demystification of the still dominant eurocentristic bias in the historiography of mathematics;
- d. to cooperate with any and all organisations pursuing similar objectives.

The main forms of activity of AMUCHMA are as follows:

- a. publication of a newsletter;
- b. setting-up of a documentation centre;
- c. organisation of lectures on the history of mathematics at national, regional, continental and international congresses and conferences.

2. MEETINGS

2.1 VI INTERNATIONAL CONGRESS ON MATHEMATICS EDUCATION

The VI International Congress on Mathematics Education was held at the Technical University, Budapest (Hungary), July 27 - August 3, 1988. For all interested participants, AMUCHMA organized a meeting on August 1, presided by its chairman, on the aims and current activities of AMUCHMA. Many valuable suggestions were collected during this meeting. The following papers were contributed concerning the history of mathematics in Africa:

* Djebbar, A.: The contents of mathematics education in North Africa during the Middle Ages and its role in education today (see # 36, 'Have you read?')

* Shirley, L.: Historical and ethnomathematical algorithms for classroom use Shirley gave an overview of studies on traditional Nigerian, arithmetical algorithms and suggested that such

techniques could be used in classrooms as alternative algorithms: "... children might relate mathematics better to their home culture, by seeing techniques from their own traditional society being applied in the setting of their mathematics classroom".

* Doumbia, S.: On the mathematics in traditional African games
Doumbia informed about the research done by the workgroup "Mathematics in the social-cultural environment of Africa" of the Mathematical Research Institute of Abidjan (IRMA, Ivory Coast). The work has concentrated itself until now on traditional African games (classification, solution of mathematical problems posed by the games and analysis of the possibilities to use these games in the mathematics classroom). The rules of some games like Nigbé Alladian show a traditional, at least empirical knowledge of probabilities.

3. CURRENT RESEARCH INTERESTS

* Teresa Vergani finished a study on "mathematizing codification of proverbs" of the Cabinda region (Angola) and prepared a monograph on mathematical aspects of Angolan intellectual games.

4. SUGGESTIONS FOR FURTHER RESEARCH

4.1. ARITHMETICS AND SLAVERY

E.W.Scripture wrote in 1891 [American Journal of Psychology, Vol.IV, p.2]: "Perhaps brought to the front or produced by the necessity of competing with English traders armed with pencil and paper, many of the old-time slave-dealers of Africa seemed to have been ready reckoners, and that, too, for a practical purpose...[citing T.Clarkson, An essay on the slavery and commerce of the human species, particularly in Africa, London, 1788] 'It is astonishing with what facility the African brokers reckon up the exchange of European goods for slaves. One of these brokers has perhaps ten slaves to sell, and for each of these he demands ten different articles. He reduces them immediately by head into bars, coppers, ounces, according to the medium of exchange that prevails in the part of the country in which he resides, and immediately strikes the balance'. The shipcaptains are said to have complained that it became more and

more difficult to make good bargains with such sharp arithmeticians". Scripture describes one possible way in which the slave trade influenced arithmetical knowledge in Africa. It would be interesting to explore further this and other possible influences, such as the disappearance or undermining of traditional African mathematical education by the physical elimination or 'exportation' of the bearers of mathematical knowledge (editors).

4.2 THOMAS FULLER AND HIS AFRICAN MATHEMATICAL EDUCATION

Item 33 in 'Have you read?' contains brief information on the calculating prodigy Thomas Fuller (1710-1790) , born in Africa and brought as a slave to the USA in 1724. John Fauvel (Open University, England) was so kind as to track the source of Rouse Ball's article (item 33): E.W.Scripture, Arithmetical prodigies, American Journal of Psychology, Vol.IV, 1891, pp.1-59. Scripture gives the following information (p.3):

"Thomas Fuller, known as the Virginia Calculator, was stolen from his native Africa at the age of fourteen and sold to a planter. When he was about seventy years old, 'two gentlemen, natives of Pennsylvania, viz., William Hartshorne and Samuel Coates, men of probity and respectable characters, having heard, in travelling through the neighborhood in which the slave lived, of his extraordinary powers in arithmetic, sent for him and had their curiosity sufficiently gratified by the answers which he gave to the following questions: First, Upon being asked how many seconds there were in a year and a half, he answered in about two minutes, 47,304,000. Second: On being asked how many seconds a man has lived who is 70 years, 17 days and 12 hours old, he answered in a minute and a half 2,210,500,800. One of the gentlemen who employed himself with his pen in making these calculations told him he was wrong, and the sum was not so great as he had said - upon which the old man hastily replied: stop, master, you forget the leap year. On adding the amount of the seconds of the leap years the amount of the whole in both their sums agreed exactly' [American Museum, Vol.V, 62, Phila., 1799].

Another question was asked and satisfactorily answered. Before two other gentlemen he gave the amount of nine figures multiplied by nine. ...In 1790 he died at the age of 80 years, having never learned to

read or write, in spite of his extraordinary power of calculation." Fuller could find also the sum of geometrical progressions [F.D.Mitchell, Mathematical prodigies, American Journal of Psychology, Vol. XVIII, 1907, p.62]. It would be interesting to search for elements of the rich traditional African mathematical education Thomas Fuller had passed through before being sold as a slave to the USA (editors).

4.3 AFRICAN LITERATURE ON MATHEMATICS (EDUCATION) IN THE COLONIAL PERIOD

It would be interesting to search African literature, including autobiographies, for information on mathematics education in the colonial period and the reaction to it. As an example, we quote two passages from Oginga Odinga's autobiography [Not yet uhuru, African Writers Series, Heinemann, London/Ibadan/Nairobi, 1967]: "When I began to teach I had already formulated in my mind my own teaching principles, influenced very largely by my experience at the hands of teachers. Classroom academic teaching was all very well, I had decided, but it had to be related to day-to-day life, for a child had to use what he learnt in his own life. I knew too that there was never one way of solving a problem, especially a mathematics problem, but the ways were as numerous as the brains in the class. I compared this with the roads leading to Kisumu. There were many ways of getting to Kisumu, I told my class, except there is only one shortest way; given a chance all the students could find this way. My policy was never to insist that the students mechanically followed my way. I was determined to encourage thinking, rather than learning by memory. In the classroom I now controlled as a teacher, my own schooldays were still alive in my experience. Arithmetic had been my first love at the Maranda Primary School and Mzee Shadrach Osewe had always given us the method of solving a problem before the problem itself. We had to follow his method exactly. I had been very poor at this. I would work out my own way of doing the sum and, having obtained an answer, would wait only to hear whether it was correct. On several occasions our answers differed and I had dared to say 'Sir, I think you are wrong'. We had checked the sum together and he was wrong. On one occasion he slapped me hard in the face, telling me to follow the working on the board and point out the mistake there, not to wait till the whole sum was finished. But

when I explained my method he had been pleased that my answer had been correct. At Maseno I had had the same trouble because Carey Francis had also been strict about the method to be used in solving a problem. I insisted on solving problems my own way and eventually Carey Francis had left me to my own methods which he found worked as well as his. By the time I had reached standard six Richard Arina was our teacher, a very accomplished mathematics teacher but a strict disciplinarian, and he refused to let me use my own methods but hit my hands every time I tried. I followed him closely enough to avoid punishment but never changed over completely to his methods of working" [p.45, 46] (editors).

4.4 MATHEMATICAL ASPECTS OF TRADITIONAL AFRICAN GAMES

Claudia Zaslavsky suggests that it could be important in the reconstruction of the history of mathematics in Africa to investigate mathematical aspects of traditional African games (cf. Vergani [Current Research Interests], Doumbia [Bookreviews,Congresses]). As a starting point, she indicates the following literature:

1 Russ, Laurence: Mancala games, Reference Publications; 218 St.Clair Drive, Box 344; Algonac, Michigan 48001; USA, 1984,111 pp. - Rules and brief history of many versions of the game known also as Ayo, Bao, Wari, and Mweso.

#2 Klepzig, Fritz: Kinderspiele der Bantu (Games of Bantu-children); Verlag Anton Hain; Meisenheim am Glan, F.R.Germany, 1972, 563 pp. - Includes games of chance, string figures, 'board' games, and riddles.

#3 Béart, Charles: Jeux et jouets de l'Ouest Africain (2 volumes); IFAN, Dakar, 1955, 800 pp. - Children's games, including finger counting rhymes, magic squares, string figures, cards, dominoes, games of chance, manacala-type games, riddles, and arithmetic problems (See review by S.Doumbia).

#4 Centner, Th.: L'Enfant Africain et ses jeux; CEPESI, #17; Lubumbashi, Zaire, 1963, 400 pp. - Games of francophone Central

Africa: sand drawings, games of chance, counting chants, kisolo (mancala) game, string figures, memory games, etc.

#5 Pankhurst, Richard: "Gabata and related board games of Ethiopia and the Horn of Africa", in: Ethiopia Observer 14,3 (1971), 154-206. - History and rules of play of 103 versions of the mancala-type game

#6 Driedger, Walter: "The game of Bao or Mankala in East Africa", in: Mila 3,1 (1972), 7-17. Institute of African Studies, University of Nairobi.

5. BOOKREVIEWS

5.1 Beart, Charles: Jeux et jouets de l'ouest africain, Institut Français d'Afrique Noire (today: Institut Fondamental d'Afrique Noire), Dakar (Senegal), 1955, 2 volumes

Review by Salimata Doumbia (Ivory Coast)

For Charles Beart it was indispensable to know the child well in order to give him an efficient education. Among his activities the child's favourite games have to be studied with interest. He affirms that these activities contribute a great part to the development of the human spirit, and are one of the least studied, at least in this part of the continent. For this reason, during his twenty years in Africa Beart has been interested in games, in order to give a soul ('aâme') to the franco-african society in which he lived. He felt sorrow and worried about the fact that colonialism had arrived at the point of killing the soul of Africans. In this context, Th.Monod, Director of the French Institute for Black Africa, quotes this phrase from one of Beart's letters: "It is not difficult to kill the soul of the Blacks... I am feeling sorrow tonight as one should always, if one has the time to think" [Monod's Preface to 'Jeux et jouets de l'Ouest Africain, Vol.1, p.15]. The soul of the African has several dimensions (just as the soul of each people), and the scientific dimension is not the least important. It is for this reason that the Mathematical Research Institute IRMA at Abidjan (Ivory Coast), preoccupied with the need to keep alive the scientific dimension of the African soul, has started research on the social-cultural environment of the African, including his games. The

work of Beart is itself a descriptive inventory of the games that have been collected by the author. He classified them in the following way:

I Spontaneous games of the youngests

1. Playing with the body;
2. Finery (tattooing and scarifications);
3. Disguise;
4. Playing with emotions (to provoke laughing, fright, suffer...);
5. Emit sounds (verbal games like counting, round dances, incomplete words or phrases; riddles, proverbs, puzzles; stories; theatre, music);
6. Playing with ideas;
7. Manipulative games (construction of playthings).

II Pedagogy of foster-mothers

1. Cradle-songs;
2. Songs to stimulate laughing;
3. Educational songs.

III Selfaffirmation games

1. Hot temper games;
2. Debauchery/disorder games;
3. Order games: arrange and collect;
4. games with arbitrary rules (to tame a horse, to climb a mountain, to track down a nest difficult access to get to...).

IV Growing-up games The child likes to grow up, to imitate his elders:

1. Games with rules given by the oldsters (acts of 'heroism' in public; athletics, sports; cooperative games [ceremonies]; combination games that one finds in checker-board games like Awalé, hop-scotch playing, Tiouk-Tiouk, Dili, magic squares and games that resemble the game of draughts);
2. Imitative games (illusion games; imitative games where children imitate utilitarian or semi-utilitarian activities).

V Games and occult forces

1. Rites;
2. Magic and divination;

3. gambling games (cowries and equivalent games, drawing straws, in which hand? How many in my hand?...). However the researchers of IRMA found that, after a mathematical study of a game of the type "how many in my hand", it was not a gambling game, as it seemed at first sight, but a strategic game. As an example we may look to the Kélio game. The Kélio game is played by children in west Ivory Coast. It is played with maize grains or with pea-nuts. The rules of the game are the following. At the same time each player encloses a certain number of grains in his hands. Then the hand is shown to the adversary who has to guess how many grains there are in the hand. If only one of the players succeeds in guessing the number of grains hidden by the other, he keeps his grains and receives the ones that his adversary had in his hand. In the two other cases (when both propose the right number, or when both are mistaken), the players exchange the grains they had in their hands. Each player may play the way he likes, but his move is not a function of an aleatory result obtained with a dice (or with a cauris). In fact the choice of each player at each move is a game strategy. Each move of one of the players may be represented by a pair (x,y) , where x represents the number of grains hidden by the player and y the number he announces. When one limits the number of grains in the game, a matrix table permits all strategies of the two players.

5.2 Aballagh, Mohamed: Raf al-Hijab d'Ibn al-Banna;critical edition, french translation, philosophical study and mathematical analysis, Doctoral Thesis ('Thèse de Nouveau Doctorat'), Université Paris I-Pantheon-Sorbonne (France), 1988, 2 volumes, 747 p.

Review by Ahmed Djebbar (Algeria)

This thesis includes a critical edition (based on 8 manuscripts), a translation into French and an analysis of the most important mathematical treatise of the Maghrebian scientist Ibn al-Banna' (1256-1321), born in Marrakech (Morocco). In this treatise, on the basis of philosophical or mathematical arguments the author justifies certain definitions of the 'Science of Arithmetics', like those that relate to the concepts of unity, number and base, definitions that he had given in his famous work on arithmetics Talkhis and that had been criticized by his contemporaries. In this sense this treatise is a commentary of Talkhis. But at the same time it is a complement of it

as it contains some original contributions, like the demonstration of the famous rule of signs, the justification of the algorithm for the square and cubic root of arbitrary whole numbers, the demonstration of the existence of solutions of quadratic equations by a procedure that had been completely freed from geometry and finally the deduction of propositions, like the one that permits it to express the number of combinations of n objects taken p at a time, with the help of an arithmetical formula.

5.3 Kane, Elimane Abdoulaye: Les systèmes de numération parlée des groupes ouest-atlantiques et Mandé. Contribution à la recherche sur les fondements et l'histoire de la pensée logique et mathématique en Afrique de l'Ouest, Doctoral dissertation ('Thèse d'Etat'), University of Lille III (France), 1987, 2 volumes.

Review by Ahmed Djebbar (Algeria)

As the initial project on the study of the different numeration systems of West Africa turned out to be too ambitious, the author has limited himself to the numeration of the languages spoken in Senegal and in some neighbouring countries. Volume 1 deals essentially with cardinal numeration (3/4 of the volume is dedicated to the description of the numeration of the atlantique group). Volume 2 is dedicated to the symbolic numeration systems. According to the author, the investigations that resulted in this thesis have been motivated by three preoccupations:

- 1) The idea that numeration has base 5 in the Wolof and Pulaar languages of Senegal;
- 2) The debate between philosophers of the African continent on the "problematics of the existence of an African philosophy";
- 3) Research on the possibilities and the limits of orality and of the experience of societies with an oral tradition in the domain of mathematics in a wide sense.

The first steps of the author in this investigation have thus convinced him of the necessity to base it on an ethno-mathematics. In order to elaborate the thesis, research in four domains was needed: - African linguistics; - history of numeration systems; - works of Africanists; - african languages spoken in Senegal, as understood by a great number of interviews with speakers of these different languages. The first important question that had to be answered by this study

was to know if the partition of the African languages spoken in Senegal in languages with nominal classes and languages that do not know the system of nominal classes, could throw some light on the organisation of their respective numeration. In order to answer this question the author fixed three objectives:

- 1) The description of the numeration systems;
- 2) Their interpretation;
- 3) The appreciation of the epistemological value of these numerations in the light of the general history of numeration. The description (that uses the comparative method) refers to the numerations in about twenty languages spoken in Senegal, of whom some are spoken only by some tens of people (like the Bapé, Basari, Bédik and Koânagi languages). The method chosen for presentation consists of the study of each numeration in the natural framework of its linguistic group and by comparison with those that belong to the same sub-group. This method is long and not without repetition, but has the advantage of facilitating the understanding of the reforms that took place in these numerations, in particular of the spectacular evolution of some of them, like those of the Mandé group. This method that consists of a detailed study of the linguistic structure and the mathematical structure of the expressions, has produced evidence of the fact that the similarity or the difference between numeration systems is not always a function of the geographical distance nor of the inclusion in the same linguistic group or sub-group. The interpretation and the appreciation of the qualities of the numerations studied have been concentrated on one point: the method of enumeration. This permits the author to answer his first question: what are the possibilities and the limits of spoken numerations? It permits him at the same time to combat two attitudes considered equally fatal: - the cultural relativism, that is, according to him, a very widespread attitude among African intellectuals that look for their past and roots; - the "undefined reproduction of the big distinction between, on the one hand the hereditary infirmity of so-called primitive thought and, on the other hand, the production of the peoples that belong to history". In order to appreciate the value of each numeration system, the author adopts the following criterion: the capacity of the numeration to name with clarity the sequence of natural numbers and to express as many numbers as possible. Therefore a numeration should, in the opinion of the author, when naming non fundamental numbers,

observe two distinct but indissoluble rules: a) the principle of order, b) the convention of order. Among his research results, A.E.Kane indicates the following:

- 1) All numerations studied in this thesis satisfy the principle of order, as they express each number by a polynomial structure following a decreasing order of powers of the base.
- 2) With respect to the convention of order, the author evidenciates two types of conventions: - those that dispose, when expressing a number by means of a multiplication of two natural numbers, the multiplier before the multiplicand, and - those that, in the same situation, dispose the multiplicand before the multiplier.

The author finds, on the base of his study, that, with the exception of the Wolof, all these numerations adopted the second order convention, making in this way a "bad choice", as they run into difficulties, especially in the the designation of step-over- numbers like 10,000. These results lead the author to ask himself the reasons for the choice of this second convention. Answering this question, the author puts aside the hypothesis of an arbitrary choice as this characteristic surpasses the distinction between numeration with gender and numeration without gender as well as the one between languages with nominal classes and those that do not know the system of nominal classes. He seeks the answer much more in the speculations about numbers and the existance of a possible latent paradigm that provoked these speculations. In the view of the author this justifies the study of symbolic numerical systems in the second part of his thesis. Among the other results of research by A.E.Kane are the following:

- 1) It gives a systematic description of the numeration in the languages spoken in Senegal and puts exploitable data (susceptible to critique and enrichment) at the disposal of linguists interested in lexicology and mathematicians who are engaged in reform tasks.
- 2) It shows that the spoken numeration systems are susceptible to reform and evolution.
- 3) At the level of expression, the only convention of order that performs well mathematically is the one characterized by a written place-value numeration.

4) And finally, it shows that in spite of the undeniable importance that the structure of the language plays, a spoken numeration system cannot be reduced to language facts but maintains complex relationships with other sectors of culture and nature. With respect to perspectives opened by this research, they refer most particularly to:

1) the role of base 5 in the numeration of the Atlantic group, which is variably manifest in them, and which should be the object of further research by means of a study of the accounting system.

2) the influence of the Arabic language and of Islam both in the introduction of an integral decimal system in certain cases and in certain numerological aspects. This influence has only been touched on in the thesis and should, according to A.E.Kane, deserve a more profound treatment. As one may understand by this review, Kane's thesis offers at the same time very rich materials, a methodology adapted to the specificities of oral cultures, proper reflexions both on the studied materials and on the debate provoked by these results, and finally new research perspectives, some of them suggested by the results obtained and some by the questions of the author.

6. HAVE YOU READ?

#34

Ascher, Marcia: Graphs in cultures (II): a study in ethnomathematics; in: Archive for History of Exact Sciences, West-Berlin, Vol39, 1988, no.1, 75-95

This paper discusses and analyzes interest in continuous tracing of figures as it is evidenced in Africa among the Bushoong and Tshokwe (Angola/Zaire/Zambia region). Included are figures, statements about the cultural context, and associated geometric and topological ideas. Emphasis is on the structure of the figures and also, where possible, processes of construction are elaborated.

#35

Couchoud, Sylvia: Recherche sur les connaissances mathématiques de l'Égypte pharaonique, Institute of Egyptology, II University of Lyon, Lyon (France), 1983, 420 p.

Couchoud's Ph.D. thesis on mathematical in pharaonical Egypt, deals with

- 1) arithmetical operations and the notion of fraction, including a study of of 'red auxiliaries' (pp.14-39);
- 2) geometry (metrology, plane figures and solids, nbt-notion) (pp.40-188);
- 3) procedures which are equivalent to equations and series (pp.189-330);
- 4) solutions of concrete problems (distribution of daily food rations, production of sandals, delivery of wood, etc.) (pp.331-371).

36

Djebbar, Ahmed: Le contenu de l'enseignement mathématique dans le nord de l'Afrique, au moyen-âge et son rôle dans l'enseignement actuel, École Normale Supérieure, Alger (Algerie), 1988, 16 p.

After a short description of mathematical activity in north Africa during the Middle Ages, the author describes the mathematical contents taught at that time (decimal system, six arithmetical operations, polynomes and and the algebraic and geometric solution of polynomial equations).In the last part he underlines the cultural value of this rich heritage of medieval mathematics for education today in North Africa.

37

Gerdes, Paulus: On possible uses of traditional Angolan sand drawings in the mathematics classroom, in: Educational Studies in Mathematics, Vol.19, 1988, 3-22

"Following a brief description of the drawing tradition of the Tchokwe people (Angola), some possible uses of their pictogramms in the mathematics classroom are suggested. The examples given in this paper range from the study of arithmetical relationships, progressions, symmetry, similarity, and Euler graphs to the determination of the greatest common divisor of two natural numbers".

38

Gerdes, Paulus: On culture, geometrical thinking and mathematics education, in: Educational Studies in Mathematics, Vol.19, 1988, 137-162

"This article confronts a widespread prejudice about mathematical knowledge, that mathematics is 'culture-free', by demonstrating alternative constructions of euclidean geometrical ideas developed from the traditional culture of Mozambique".

39

Kubik, Gerhard: African space/time concepts and the tusona ideographs in Luchazi culture with a discussion of possible cross-parallels in music, in: African Music, Grahamstown (South Africa), Vol.6, 1987, 53-89

In this paper the author deals with those pictographs of eastern Angolan culture that are characterized by a highly geometrical construction and examines their space/time relationships. He shows that these drawings "flourish upon abstract principles of a mathematical nature similar to those in some older traditions of African music".

40

Lea, Hilda: Traditional mathematics in Botswana, in: Mathematics Teaching, London (UK), 1987, 9 p.

Reports on an investigation into traditional mathematics in Botswana carried out by University students. Old people were interviewed to ascertain how mathematical activities were carried out in the past, and how some older people do mathematics today. Contains information on counting, arithmetical operations, measurement of length, volume and time, geometrical forms.

41

Lumpkin, Beatrice: The Pyramids: ancient showcase of African science and technology, in: Blacks in Science; Transaction Books, New Brunswick NJ (USA), 1983, 67-83

"The pyramids and other great monuments of Egypt and the Sudan are the product of a long development of African science and

technology. Their development is traced from the mud brick beginning to the great pyramids and temples. Planning of the monuments is described; examples are given of written plans, and the level of mathematics and technology required for pyramid building are discussed. Possible methods of construction of the pyramids are considered".

42

Lynch, B.M. and L.Robbins: Namoratunga: the first archaeo-astronomical evidence in sub-Saharan Africa, in: Blacks in Science; Transaction Books, New Brunswick NJ (USA), 1983, 51-56

"Namoratunga, a megalithic site in northwestern Kenya, has an alignment of 19 basalt pillars that are nonrandomly oriented toward certain stars and constellations. The same stars and constellations are by modern Cushitic peoples to calculate an accurate calendar. The fact that Namoratunga dates to about 300 B.C. suggests that a prehistoric calendar based on detailed astronomical knowledge was in use in eastern Africa".

43

Pappademos, John: An outline of Africa's role in the history of physics, in: Blacks in science; Transaction Books, New Brunswick NJ (USA), 1983, 177-196

Revises conventional assumptions about the role of Africans in the history of physics by outlining some of their contributions to measurement, mechanics, optics, astronomy, metallurgy.

44

Vergani, Teresa: Aplicação da análise factorial das correspondências aos desenhos iniciáticos do povo Cokwe de Angola, in: Revista Internacional de Estudos Africanos, Lisboa (Portugal), Vol.4, 1986, 281-301

This paper gives an application of factor analysis to the study of the symbolical expression of numbers in Tchokwe drawing tradition (Angola).

7. ADRESSES OF SCHOLARS AND INSTITUTIONS MENTIONED IN THIS AMUCHMA-NEWSLETTER

- 1. Aballagh, Mohamed: Université de Fez, Faculté de Lettres et Sciences Humaines, Département de Philosophie, Fez, Marocco**
- 2. Ascher, Marcia: Mathematics Department, Ithaca College, Ithaca, New York 14850, USA**
- 3. Djebbar, Ahmed: Département de Mathématiques, Université de Paris- Sud, 91405 Orsay Cedex, France**
- 4. Doumbia, Salimata: Institut de Recherches Mathématiques, 08 B.P.2030, Abidjan 08, Ivory Coast**
- 5. Fauvel, John: 5 Marshworth, Milton Keynes MK6 3DA, England**
- 6. Gerdes, Paulus: Faculty of Mathematical Sciences, Eduardo-Mondlane-University, C.P.257, Maputo, Mozambique**
- 7. Kane, Abdoulaye E.: Département de Philosophie, Université de Dakar, Dakar-Fann, Senegal**
- 8. Kubik, Gerhard: Burghardtasse 6/9, A-1200 Wien, Austria**
- 9. Lea, Hilda: Department of Maths and Science Education, Faculty of Education, University of Botswana, Private Bag 22, Gaborone, Botswana**
- 10. Lumpkin, Beatrice: 7123 S. Crandon, Chicago IL 60649, USA**
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- 12. Vergani, Teresa: Casa Blanca, Av. dos Bombeiros Voluntários 16, 2765 Estoril, Portugal**
- 13. Zaslavsky, Claudia: 45 Fairview Avenue, 13-1, New York, NY 10040, USA**

8. SUGGESTIONS

What are your suggestions for improving the AMUCHMA Newsletter? What are your suggestions for other activities of AMUCHMA? Send your suggestions, comments, information, questions and any other contributions to the chairman or secretary of AMUCHMA. Send articles, books and manuscripts for the AMUCHMA documentation centre to the chairman.

9. DO YOU WANT TO RECEIVE THE NEXT AMUCHMA NEWSLETTER?

The AMUCHMA Newsletter published in Arabic, English and French is available free of charge upon request. Send requests to the Chairman Paulus Gerdes, C.P.915, Maputo, Mozambique for the English version, or to the Secretary Ahmed Djebbar, Département de Mathématiques, Université Paris-Sud, 91405 Orsay Cedex, France for the French version, or to Professor Mahdi Abdeljaoud, I.S.E.F.C., 43 rue de la Liberté, 2019 Le Bardo, Tunis, Tunisia for the Arabic version.