XIII CONFERÊNCIA INTERAMERICANA DE EDUCAÇÃO MATEMÁTICA
CIAEM 2011
26 - 30 Junho, 2011
Recife, Brasil
50 anos do Comitê Interamericano de Educação Matemática

Ethnomathematics in the 1920s – The contribution of Ewald Fettweis (1881-1967) to the History of Ethnomathematics

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Abstract

The main characteristic of a mature science consists in being governed by a paradigm. Stages of early development of a science which have not yet found an established paradigm are called by Kuhn (1962) pre-paradigm periods, and during these periods the pre-paradigm scientists develop their research independently. Within the context of the development of ethnomathematics as a valid scientific theory, Gerdes (1997) had already acknowledged Ewald Fettweis (1881-1967) to be one of forerunners of ethnomathematics.
Fettweis presented a true surprise in our historiographical research. At first, our study attempted to describe the actually innovating fact that he had pursued ethnomathematical research much earlier than 1985, the year of the emergence of ethnomathematics (Rohrer, 2010). But it eventually proved more than this, that he was the first researcher to develop and establish not only the term ethnomathematics, but even to practice it in his lectures, bringing it into a disciplinary level.

Key words: ethnomathematics, history, historiography, ethnology, mathematics education

Introduction

Kuhn's theory of scientific development is relevant to the study of ethnomathematics from two points of view: firstly, for the issue of achieving the theoretical status of ethnomathematics and secondly, for discussing the relation of ethnomathematics to mathematics. The notion of conceptual change had become relevant for historical, epistemological and sociological studies in science. Kuhn's seminal book *The Structure of Scientific Revolutions* (1962), which paved the way for such studies, can be understood as expressing the cognitive turn in history of science (Nersessian, 2003). Within the framework of this conceptualization, the "mathematics" and "science" knowledge evidenced in Naturvölker or "primitive people" constitute not only elements of curiosity, cataloged as ethnology, but contributions to ethnoscience, and in our case

to ethnomathematics; they are elements of science, and hence of mathematics, too. The status of the relation between ethnomathematics and mathematics presents a revealing challenge for the self-understanding of mathematics (cf. Rohrer, 2010, chapter 2).

Kuhn analyzed the development of scientific theories as following certain recurrent patterns. He established essentially four concepts to characterize these patterns: *normal science*, *paradigm*, *scientific community*, and *scientific revolution*. The main characteristic of a mature science, i.e. normal science, consists in being governed by a paradigm. Stages of early development of a science have not yet found an established paradigm; Kuhn calls these stages pre-paradigm periods, and during these periods the pre-paradigm scientists develop their research independently (Kuhn, 1962).

Within the context of the development of ethnomathematics as a valid scientific theory, Gerdes (1997) had already acknowledged Ewald Fettweis (1881-1967), Otto Friedrich Raum (1903-2002) and Georges-Henri Luquet (1876-1965) to be some of the forerunners, i.e., pre-paradigm scientists of ethnomathematics.

Fettweis presented a true surprise in our historiographical research. At first, our study attempted to describe the actually innovating fact that he pursued ethnomathematical research much earlier than 1985, the year of the emergence of ethnomathematics (Rohrer, 2010). But it eventually proved more than this, that he was the first researcher to develop and establish not only the term ethnomathematics, but even to practice it in his lectures, bringing it into a disciplinary level.

The following article presents Fettweis' research and contribution to ethnomathematics and its development as a scientific theory. We will furthermore show that the term ethnomathematics, conceptualized differently, had been used much earlier than 1978, year when Ubiratan D'Ambrosio suggested it at the *Annual Meeting of the American Association for the Advancement of Science* in Washington DC, USA (Rosa & Orey, 2006).

Some biographical notes on Ewald Fettweis (1881-1967)

Ewald Fettweis was born in Eupen[1] on 23 July 1881, and studied mathematics at the Universities of Münster and of Bonn from 1902 to 1906. Qualified as teacher for secondary schools, he became a mathematics teacher, first as Studienrat at the *Städtisches Höheres Lehrerinnenbildungsseminar Düsseldorf* from 1911 until 1920. Thus, he was active in the new branch of secondary schooling for girls leading to academic careers; then he acted as *Oberstudienrat* at the *Auguste-Viktoria-Schule Düsseldorf*.[2] The list of his publications presented by Reich, Folkerts and Scriba (1989) showed that Fettweis became interested in ethnographic research on mathematics after World War I, from about 1920. Since 1921, there were numerous publications evaluating ethnographic findings, in particular about numeracy and reckoning procedures (cf. Fettweis, 1926, 1929a,b).

1 Eupen belonged to the German Empire between 1870 and 1919. The Treaty of Versailles transferred it to Belgium, and it is nowadays part of the province of Liège.

2 The German school system differs greatly from others like, e.g. the Brazilian and Chilean. It is, therefore, not easy to translate into English the different officeholder positions; what can be said is that, the positions Fettweis occupied were in secondary schools that can be considered as teacher education institutions.

Figure 1: A portrait of Ewald Fettweis (date unknown; Reich et al., 1989)

A first biographical information obtained about Ewald Fettweis was that he had been awarded a doctoral degree from the Philosophy Faculty of the University of Bonn, Germany, in 1927 with a thesis (later published as a book) on an ethnomathematical subject, namely *Das Rechnen der Naturvölker* (The Numeracy of the Primitive People).[3]

This doctorate immediately raised curiosity about the academic acknowledgment of ethnomathematical research at that time and in that country. This led to a search for his academic supervisor at the University of Bonn, to find who had inspired and encouraged him with such an unusual subject – and whether it were a mathematician. This research proved to be difficult: contrary to the usual practice, the published thesis did not contain a curriculum vitae and the archives of the University of Bonn had no longer the files of his doctoral process, due to the losses in World War II. Likewise, no files of his later professional positions, if preserved, contained such biographical data (PA-Fettweis).[4]

Eventually, it became clear that there had been no supervisor in the traditional function of a *Doktorvater*, hence of instigating and guiding the elaboration of the thesis: Fettweis had developed this research program by himself, already earlier on.

3 Actually, the English translation of the title does not at all cover the meaning of the German term *Naturvölker*. It literally means nature-bound peoples, as opposed to *Kulturvölker*, i.e., civilized peoples (Fettweis, 1927).

4 Landesarchiv Nordrhein-Westfalen in Düsseldorf, Aktenzeichen: R3M-3-02-1900/09, Signatur: BR PE 7847.

Fettweis' career as a mathematics educator and ethnomathematician

A decisive step in Fettweis' professional career was prompted by a radical reform in the German school system. In 1920, the traditional social separation between primary schooling for lower social classes and a proper preparatory system for the secondary schooling of the other social strata was abolished, and the teacher formation for the new primary schools – as education for all – was elevated to higher education. In Prussia, new institutions were established for this academic form of teacher training: the *Pädagogische Akademien*. By the time of their founding in 1926, Fettweis became professor (*Dozent*) for the mathematical part of the formation at one of them, in Bonn. Besides lectures on basics of mathematics, e.g. number theory, and on teaching methodology and practical exercises, Fettweis announced in 1926 his attempt to tackle also historical and cultural issues as part of the teacher formation (Fettweis, 1926, pp. 453-454). Based on the research he pursued independently for some years, Fettweis, then aged 46 years, submitted his thesis in 1927 at the nearby University of Bonn and obtained the doctoral degree from the Philosophy Faculty (PA-Fettweis). The entry on Fettweis in Poggendorff's *Handwörterbuch* (1937), which is based on Fettweis' own communication, calls him a disciple of Ernst Study and of Adolf Dyroff (cf. pp. 731-732). With Ernst Study (1862-1930), specialized in geometry of complex numbers, he had studied mathematics in Bonn, and Dyroff (1866-1943) was a philosopher who had also published in history of art. But none of them is known to have promoted ethnology or ethnography.

In 1928, Fettweis changed to the position of *Fachberater* (adviser for mathematics teaching) at the *Provinzialschulkollegium Koblenz*, the regional school administration for secondary schools; from 1929 on, he included geometry into his ethnographic interests. He also published two handbooks on teaching arithmetic and geometry in primary grades, for the teacher formation and for the practice of teachers; he included references to ethnographic results on the origins of concepts in arithmetic and geometry.[5] Both became standard textbooks, re-edited many times, until the 1970s. In 1932, he moved again and became vice-director of the *Fürstenwall-Oberrealschule* in Düsseldorf, where he served until 1945.

The first publication of the term ethnomathematics in 1959

Fettweis claimed to have suffered during the Nazi period and to have resisted their ideology (PA-Fettweis). After the end of World War II, in 1945, he obtained a professor position at the *Pädagogische Akademie* in Aachen and was actively lecturing until 1954 (Poggendorff, 1958, p. 30). According to the Italian ethnologist Falsirol, he lectured there on, among others, ethnomathematics (Reich et al., 1989). In fact, Falsirol used, in the Italian original paper of 1959 that appraised Fettweis' achievements, the exact notion *etnomatematica*, translated to ethnomathematics – and thus, for the first time this term in print:

"Professore all'Accademia Pedagogica di Aachen, dove tenne lezioni di didattica, di storia

5 In Fettweis' book *Anleitung zum Unterricht in der Raumlehre*, the first section of chapter II is dedicated to remarks about the cultural history of measuring surfaces and bodies, and chapter VI is dedicated to interpreting the mathematics behind decorative objects (Fettweis, 1951, Inhaltsverzeichnis).

> delle matematiche e di etnomatematica fino al 1954, egli dedicò e viene dedicando parte considerevole della sua attività scientifica alla matematica e all'astronomia dei popoli considetti primitivi." (Falsirol, 1959, p. 262)

Although the published lists with the announcements of the lectures of the *Pädagogische Akademie* up to 1954 are no longer preserved in the corresponding library, Heinrich Winter, a retired professor from the *Rheinisch-Westfaelische Technische Hochschule Aachen*, student of Fettweis and his successor as a professor of mathematics education, confirmed that Fettweis had given seminars on the subject of ethnomathematics for advanced students.[6]

In a programmatic paper published in 1937, Fettweis fervently pleaded for a close collaboration between ethnology and history of mathematics. In the cultures researched by ethnologists, one should be able to unravel roots for mathematical developments in the first civilizations of Antiquity. And he insisted that history of science has to embrace the entire humanity, so that also the developments achieved in the so-called lower degree civilizations (*niederen Kulturen*) should contribute to the *tree of mathematical science* (Fettweis, 1937a, pp. 277-278). This neatly corresponds to the modern programs of ethnomathematics, which challenge the one-sided restrictions of mathematics to the Western cultures only. Actually, Fettweis had never undertaken field research, but he was eager to assess as much of ethnographic research as possible.

Fettweis' work and many of his publications had been very innovative for the first half of the 20th century, especially in Germany; his legacy may be considered as a preparation towards what is nowadays understood as ethnomathematics. One of his research interests was, as his PhD thesis shows, to study how and why primitive people developed mathematical concepts and knowledge; for this he reviewed available publications in ethnology and linguistic, evaluating a considerable number of different cultures from all continents, including Europe (Fettweis, 1927, Vorwort).

His PhD thesis has already revealed a remarkable dedication to the scholarship of mathematical ethnology; Fettweis evaluated ethnological research relevant for mathematics from all continents and presented it organized systematically according to families of peoples and/or single peoples from: 1) North America and Northern Mexico, 2) Central America, 3) South America, 4) Australia, and 5)Asia (Fettweis, 1927, pp. iii ff.).

Fettweis' further contributions

Some of the articles published by Fettweis are *Über die erste Entstehung der einfachen geometrischen Formen* published in 1929, *Ueber das Verhältnis des Mathematischen Denkens zum Mysthischen Denken auf niederen Kultur-Stufen* published in 1932 and *Arithmetik, Rasse und Kultur* published in 1935, where he mainly studied the origins of mathematical objects and concepts, and of numbering and counting (Fettweis, 1929a, 1932, 1935).

Some titles of Fettweis' publications can easily lead to misinterpretations of the actual position he had in favor of the relevance and importance of studying and researching non-European cultures, particularly because of the use of terms such as *race*, *nigger* and *lower*

6 Personal communication.

degree cultures; these terms were crucial within the scope of the National Socialist's principles, as the Nazi party practiced a strong racist policy against all non-Aryan races;[7] his intention was not to reinforce the belief that these cultures could be inferior, but, on the contrary, he even claimed that they have a higher ability with respect to spatial perception (Fettweis, 1927, p. 18). Some of the articles where he defended his position with strong arguments are: *Was lernt unsere Rechenmethodik aus dem Rechnen der Naturvölker?* published in 1929 and *Ueber die Entwicklung des Räumlichen Vorstellungsvermögens bei völkern nichteuropider Rasse und in der europäischen Vorzeit* published in 1937 (Fettweis, 1929b, 1937b). In another article, he arrived to the conclusion that the primitives would operate with what they are able to visualize, whereas we help each other with abstract knowledge (Fettweis, 1929a, p. 121).

A concrete example of mathematical constructions can be found among the indigenous people from the Xingu region, in the Brazilian Amazonia; when the girls menstruate for the first time, they receive a piece of cloth called *uluri* (an isosceles triangle with 7 cm basis, and 3 cm height) that will be put on her pubic area and will be held with cords coming out from the three corners of the triangle, in order to protect this part of the body against witchcraft. In this *uluri* there is a rhombus drawn; this rhombus represents the *meréschu* fish,[8] which is the symbol of fertility that has to be transmitted to the girl who shall become a mother (cit. Kunike in Fettweis, 1929a, pp. 114-115).

Fettweis also explained that the construction of the rectangle was derived from the cardinal points, which were commonly venerated almost in the whole world; e.g., the hut of the fortune-teller in Imerina, Madagascar has the form of a rectangle pointing north and south in its longest side and both, the door and the window are on the west side of it (cit. Soury-Lavergne & De La Devèze in Fettweis, 1929a, pp. 117-118). Finally, the development of housing construction also shows a source for the appearance of simple geometrical forms; this has been, during all history of the humankind, a natural and empirical mathematical problem of optimization: how can I build a big room using the least amount of material as possible? He concluded that primitive people having bendable material available built beehive huts, i.e., a half sphere, whereas the cultures having inflexible material would build huts with a cone roof (cit. W. Schmidt & W. Koppers in Fettweis, 1929a, pp. 119-120).

One of Fettweis' main thesis was the importance of studying the mathematical knowledge of the living primitive cultures in order to obtain a full understanding of the state of mathematics in the old high cultures:

> "[...] das Studium der mathematischen Kenntnisse jetzt lebender primitiver völker und Naturvölker [ist] förderlich, um volles Verständnis zu erlangen für die mathematischen Zustände in den ältesten Hochkulturen." (Fettweis, 1932, p. 207)

The article, *Arithmetik, Rasse und Kultur*, dealt with the question on whether the development of number and computation modes are race dependent or not. Fettweis' main conclusion was that one may find, in all cultures, and from all race groups (white, black and

7 According to the Nazi's ideology, Aryan people were the Herren-Rasse, of Caucasian origin, destined to rule the world, while in particular the Jewish race represented Untermenschen.

8 The name of the fish meréschu is given in the Bakaïrí language; it is a flat lagoon fish that belongs to the piranha family (cf. von den Steinen, 1894, pp. 101,260-261).

yellow), different beginnings for the numeration process. It is hence not possible to establish a connection between mathematical development and race. The range of mathematical achievements in a specific culture is conditioned to the level of development in its society. Hence, if a society has evolved to a more complex system, so will the arithmetic develop according to it. In Fettweis' own words:

> "[...] der Umfang der Rechenkunst bei einem Volk [hängt] von der Höhe seiner Kultur ab, und dass, wenn die kulturellen Bedürfnisse wachsen, die Rechenkunst ganz von selbst mitwächst, gleichgültig um welche Rasse es sich handelt." (Fettweis, 1935, p. 74)

It is very interesting to remark that, in the article *Was lernt unsere Rechen-methodik aus dem Rechnen der Naturvölker?* from 1929, Fettweis admitted that psychology would not be enough to answer the many questions in the didactics. Ethnology, linguistics (philology) and the history of culture play a strong role within the subjects and cannot be excluded. And he was convinced that primitive cultures in a lower developmental societal stage with respect to our mathematics can help us show and understand how to improve and encourage mathematics education (Fettweis, 1929b, p. 158).

Final Remarks

Through Ewald Fettweis' scientific program we are able to confirm the existence of a pre-paradigm period belonging to the development of ethnomathematics. In fact, Rohrer (2010) has seen that, since the first half of the twentieth century, several scholars developed ethnological research on mathematical practices and were working as isolated individuals and unable to communicate with each other. It was during this period that the term "ethnomathematics" had already been established as we were able to show.

Fettweis had rejected the traditional notion of cognitive inferiority of the *Naturvölker* and had rather attributed to them cognitive abilities analogous to the so-called "civilized" peoples. By considering as a starting point his assertion of humankind taken as a categorical unity, one is led to the assumption of having mathematics as the union of numerous, at least culturally different mathematics. The so-called Western mathematics would be just one among many other forms of mathematics; it could no longer be distinguished as having traditional priority. And these facts immediately open up questions on whether and how it would be possible to claim a universality and an objectivity of mathematics; questions that had been already raised by Wilder and by von Glasersfeld (Rohrer, 2010).

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