

An Example of Traditional Women's Work as a Mathematics Resource

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"Ex Africa semper aliquid novi" Pliny is supposed to have written: "There is always something new from Africa"

Part of the newness of Paulus Gerdes' work in Mozambique [Gerdes 1986a] is that he offers "non-standard problems", easily solved by many illiterate Mozambiquan artisans, to members of the international mathematics education community — who cannot (at first) do them. They have trouble in constructing angles of 90, 60 and 45 degrees and regular hexagons out of strips of paper, problems which are no trouble at all to people for whom the intellectual and practical art of weaving is a necessary part of life.

Recently I have been offering to experienced teachers and teachers in training some of the "non-standard problems" that are easily solved by any woman brought up to make her or her family's clothes* Many of the male teachers are so unfamiliar with the construction and even shape and size of their own garments that they cannot at first perceive that all you need to make a sweater (apart from the technology and tools) is an understanding of ratio and that all you need to make a shirt is an understanding of right-angled and parallel lines, the idea of area, some symmetry, some optimisation and the ability to work from 2-dimensional plans to 3-dimensional forms.

What makes the problems non-standard is the viewpoint of those who set the standards. Gerdes' work, and the work of others in the field of ethnomathematics offer a rather threatening confrontation to the traditional standard setters. Gerdes is up against a number of factors that until recently have tried to determine the education, or previous lack of it, in his country. The freshness of his work is his illustration of the mathematics that already exists in Mozambiquan culture and how he is setting about "defrosting" it.

It is interesting to take Gerdes' analysis and his energy and commitment and to apply them worldwide and in the different context of women's culture. There will be those who will maintain that "women" is too wide a term to allow of a single culture, but the "set of women who make and use textiles in home-making" would certainly seem to fit the definition of culture used by Wilder [1981] in his *Mathematics as a cultural system*.

In mathematical activity, women lose out in two ways. Until very recently, in most histories of mathematics

women mathematicians barely got a mention. Throughout western history, as Alic [1986] shows, the work of women mathematicians and scientists has been "ignored, robbed of credit and forgotten". Better that they should stay at home and do their needlework, a harmless, practical and non-intellectual activity. Many women do their needlework in factories; indeed, in the textiles industry, one of the most globalised of all industries, women are at the "cutting edge" [Chapkis and Enloe, 1983]. Here their lowly status is rationalised by all the usual tales: they "are said to have patience, a tolerance for monotony, nimble fingers, attention to detail, little physical strength, no mechanical aptitude," and so on. In a world where there is little pre-disposition to take women's intellectual work seriously, the potential for giving them any credit for thought in their practical work, at home or in the factory, is severely limited.

The social distinction between the practical mathematics considered appropriate for an artisan class and the theoretical mathematics of élites is older than Plato. [D'Ambrosio, 1985] Yet "Practical, scientific, aesthetic, and philosophical interests have all shaped mathematics." [Kline, 1953] Nowadays practical mathematics is nearly always seen in terms of the application of theoretical mathematics learned in the formal context of school. It often still carries the stigma of being particularly suitable for Low Attainers. Women doing practical mathematics really are at the bottom of the pile.

In fact a single practical activity can, by its nature, generate more mathematics than the application of a theory to a particular case. A recent conference of about 240 mathematics teachers offers an example. The teachers were given an activity posed not as a mathematical one but in the form of an internal memo to his visualisation team from the managing director of an expensive design company, asking for some more than usual ingenuity of design for a pack for a single sports ball for a company he wished to impress. The teachers worked in groups and produced an impressive array of packs together with a list of mathematics they had found themselves involved in, which ran to three pages. More significant though was the behaviour of the groups. Those who perceived the problem as just a mathematical one and only attempted it theoretically found themselves confined to the very limited range of mathematics they had chosen. Those who set about the task in a practical way, however, continually came up with further problems both of construction and design which in turn generated more problems and more mathematics. In

* Such activities are part of a pack of teaching materials in preparation by The Maths in Work Project. Department of Mathematics, Statistics and Computing. London University Institute of Education

short it was the theoreticians who limited themselves by their "theory and applications" approach. The practitioners found themselves involved not only with wider but with deeper mathematics as it emerged from the task itself. Of course, the practitioners were mathematics teachers and therefore knew what to look for, but there is no doubt at all that they surprised themselves

Perhaps the role of school mathematics teachers in such circumstances should not be to teach some theory and then look for applications but to analyse and elucidate the mathematics that grows out of the students' activity. Gerdes uses the term "frozen" for mathematics hidden in cultural artifacts, and it is a good one, but there is the danger that a pre-perception of what is there to be frozen could limit what is defrosted. We need a term that implies hatching or germination of undefined potential, as well as defrosting, because much of the mathematical thinking that has become frozen in an artifact has been put there by someone who has *not* been reared on North American textbooks or a standard Western mathematics education with all its attitudes and prejudices. Traditional North American and Western mathematics has ignored it until now (Islamic mathematics has always revelled in it), though the weavers have always known that weaving is an intellectual activity. A glance at any piece of traditional weaving reveals a huge range of obvious geometry to anyone who chooses to notice. How could it have got there without mathematical thinking? Why do people choose *not* to notice?

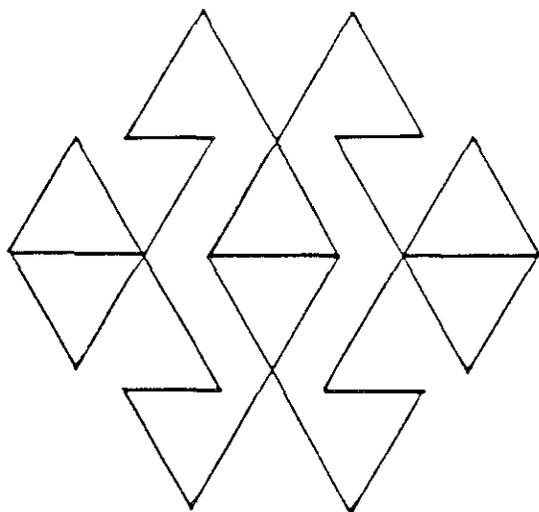


Figure 1

A student studying symmetry in a Western school might be congratulated by his teacher on producing the design in Figure 1 after an investigation starting with an isosceles triangle and involving translation and rotation. The same teacher might draw the attention of the rest of the class to such a pattern and suggest the class analyse together some of the things that have happened to the original triangle; thus synthesis and analysis could take place over one activ-

ity, one student's thinking could be revealed to others and further thought developed

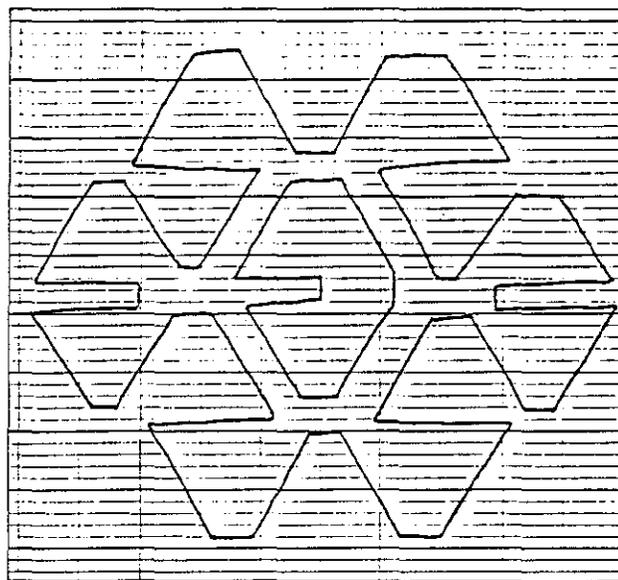


Figure 2

Figure 2 is a sketch of a motif worked on a Turkish flat woven rug, a *kelim* in the possession of the writer. The motif is one of many on the rug and it is sketched in such a way that the lines of the background grid represent generally the warp and weft threads. Unlike Figure 1 where a student can "plant" a triangle anywhere on squared paper and work outwards from it, the weaver has to work under several constraints both of design and construction. The motif has to be placed exactly in relation to other motifs, in relation to the symmetrical border of the rug and the symmetrical centre panel within a wide border, so that the whole rug itself is symmetrical. Construction constraints mean that the weaver works from right to left and left to right on a grid already defined and confined by the number of warp threads. The length of the rug is determined by the design, so that the weaver finishes it when the whole thing is symmetrical.

For reasons which need to be closely examined, Figure 1 seems to count as mathematics, Figure 2 does not. Most of the reasons suggested to the writer so far do not stand up to much examination. A summary of them is that Figure 2 is simply not taken seriously as mathematics because firstly the weaver has had no schooling and is illiterate and, secondly, she is a girl. It has even been stated outright by more than one mathematics educator that the weaver "is not thinking mathematically", to which the immediate response must be "How do you know? Have you asked her what her thinking was?" It seems that the whole question as to whether Figures 1, 2, neither, or both, are mathematics is hedged about with not much more than attitude. The weaver is simply assumed not to be capable of thinking mathematically.

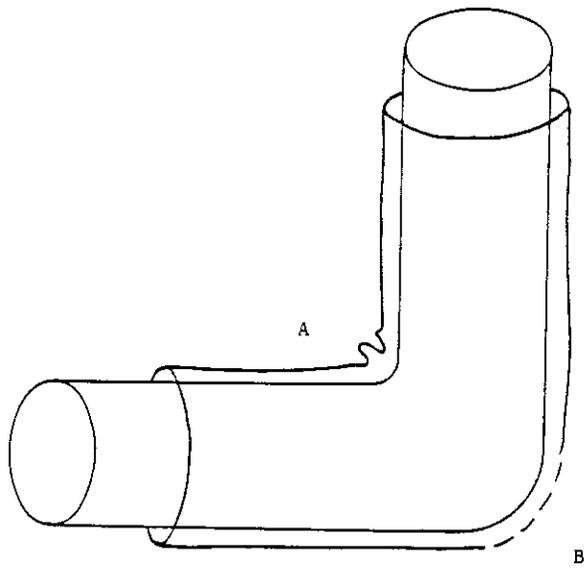


Figure 3

Take another example, this time from industry, the problem of lagging a right-angled cylindrical pipe in a factory (Figure 3) The problem is to prevent the lagging from bunching up at the inside of the angle at A and thus developing a hot spot and stretching out at B, thus developing a cold spot. The factory is a chemical works and the lagging problem is compounded by the fact that the right angle has to open out on occasion to about 180 degrees. So as well as being inefficient in crucial places, the lagging will soon wear out. In industry this is just the sort of problem to which mathematical thinking would be brought.

Why is it that this industrial problem is considered to be inherently mathematical whereas the identical domestic problem, that of the design of the heel of a sock, is not? Dare it be suggested that the reason is that socks are traditionally knitted by Granny — and nobody expects her to be mathematical. What, dear old Gran?

Turn heel as follows: —
1st row — K 12 [14, 16], sl 1, K 1, p s.s o., K 1, turn.
2nd row — P 6 [6, 8], P.2 tog., P.1, turn.
3rd row — K. to last 6 [8, 8] sts, sl 1, K.1, p.s.s o., K 1, turn.
4th row — P to last 6 [8, 8] sts., P 2 tog., P 1, turn
5th row — K. to last 4 [6, 6] sts., sl 1, K 1, p.s.s o., K 1, turn.
6th row — P to last 4 [6, 6] sts., P 2 tog., P.1, turn.

Figure 4

Or is there really some mathematical reason like the problem not being capable of general solution? But the way experienced knitters actually work *is* to a general solution. Sock instructions are tediously written out row by row as in Figure 4 but only the most inexperienced or unskilled worker would actually use them like this. The normal procedure for an experienced person is to follow the pattern only for as long as it is necessary to get the feel of the way the thing is shaping. Women who make socks for families of children often work to their own general solutions (there are several), modifying them for a particular child who has grown.

Why, when we take children to look at the environment so that we can draw out the mathematics, do we always show them the *man-made* environment; cranes, bridges, paving slabs, brick patterns? Why do we *choose* not to look at the closer environment, the one we carry with us? How many men who wear ties are aware of the interesting geometry that is going on literally under their noses?

So what is it about the sock problem that ensures that it will not be taken seriously? Why is it non-standard? Is it simply because it is not normal to couch it in mathematical jargon? Very well then, here it is formally: "Derive a general expression for the heel of a sock".

And as to whether you still wonder if it is mathematics or not, to quote Gerdes again, "Please answer for yourself."

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