Analyse of the MATTHEW WALKER zones used to obtain with THREE 180° twists* a MOBIUS ring yielding two reversals when starting with a VIRTUAL Regular or Semi-regular Cylindrical Knot.

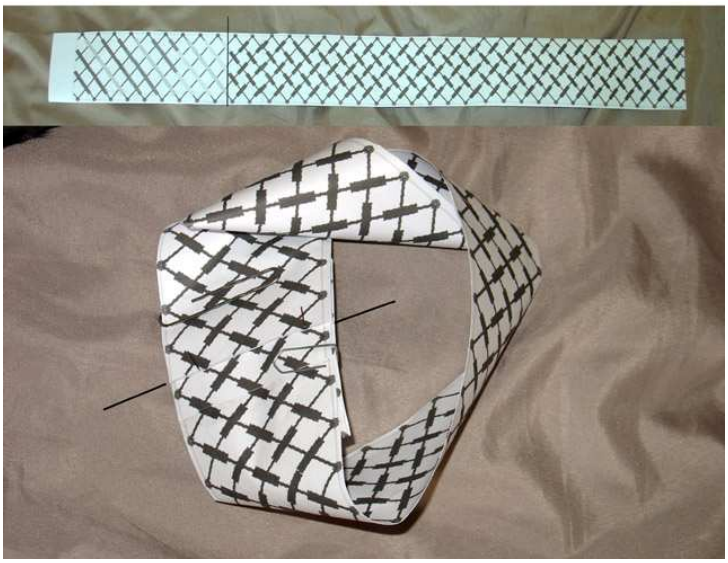
twist*: all the twists in a given Mobius have the same orientation, their clockwise or anti-clockwise direction changes the end result.

Photo 1 (M.S)

During an exchange about Mobius rings of "one 180 ° twist" that had been previously made by Michel (as this Head – Hunter coding pattern *Photo 1),* Charles sent to Michel a .ARI file, made with Claude HOCHET's ARIANE software, of a VIRTUAL Regular Cylindrical Knot showing THREE zones, well separated one from the others, with a Matthew Walker coding, oriented '\' on the horizontal grid with the BIGHT edges at TOP and BOTTOM. See ***Figure 3***. Raoul KALFON is the first to have published, 2013 May 8th, on the Facebook group Mateloteurs a Mobius with three 180 degrees twists.

This disposition into three areas separate from each other had spontaneously appeared practical evidence : have 3 short zones of slack to take back rather than a single large one.
Michel, a curious mind and always alert to not take for granted what is said to him asked if this was the only way to proceed.

Photo 2 (C.H)



Charles replied, a little too fast, "as you want".
An "a priori" statement, therefore "not necessarily meaningful and therefore to be absolutely verified since at NO TIME Schaake mentions the case of Mobius with more than ONE 180 ° twist.

A quick "experimental" protocol was decided, with a very strictly equal sharing, 50% - 50%, just as for the French pâté: One lark, one horse.

Guess who got the horse ?
Both partners were responsible for personal and mutual verification, Michel was

responsible of the practical knotting because of his experience and handcraft and Charles in “backseat the driver" mission undertook exploration on paper . *"(Photo 2)*

OBJECTIVE :

To answer this question : does the RULE FOR LOSS OF BIGHTS incurred after a single 180 ° twist when going from two bight edges to single bight edge and from two faces to a single face still apply by simple multiplication by the number of twists or is there a 'correction' to make.

The usual formula (Schaake) for going from VIRTUAL Cylindrical Knot to the one 180° twist MOBIUS gives "loss of BIGHTS "as being equal to the number of LEADS (PARTS) of the VIRTUAL C.K. is **'L'** (L / 2 on each side of VIRTUAL node).
(Actually, for people missing information Mobius is not a pure exercise 'à la George Mallory "(Everest climber)" : “because it is there” ; the Mobius loop has actual practical INDUSTRIAL implementations - See links provided at the end of the document)

It was not absolutely certain that the rule applies to knots with more than one 180 ° twist with just the use of a simple multiplication by the number of torsion performed.

Tables 1 and 2, - at the end of the study they keep only an anecdotal interest and of course a real descriptive value-, show that if we take into account the **black** crossings that extend the Matthew Walker coded area beyond the vertical limits of it then in this case the positioning of the areas has a real influence on losses BIGHT as in the case of continuity of two of those areas then the **black** crossings are “swallowed" by the MW area.

It was decided to verify "in the real world" what was happening and it was Michel who was “designated volunteer" in charge of the practical realization.

THREE areas of Matthew Walker coding can be arranged in several ways

111 abutting each other and forming a single area
1 ..... 11 two zones separated from each other, one of them being formed by two zones adjacent to each other. (As we are “in a cylinder the 11 .. 1 is included)
1 ..... 1 ..... 1 absolute non-contiguity

Keep in mind that BIGHTS are lost on *each side* of the VIRTUAL C.K when changing it into a MOBIUS.

In Table 1 & 2 we distinguished **EVEN L** and **ODD L** with each time **ODD** and **EVEN BIGHT** and **SINGLE-STRAND** with **MORE-THAN-ONE-STRAND.**

We will leave to you the care of calculating the different possible results according to the spatial disposition adopted and whether one ignores the black crossings or considers they have the real effect of enlarging the area MW and that these crossings are of course "victims" of contiguity.

MATERIEL ET METHODE

Michel uses cylindrical tool in the vertical reference position, so with BIGHTS borders at the TOP and BOTTOM as in the ARIANE grid.
The coding pattern is **O1-U1** which demands **L** to be EVEN to avoid any defect in the pattern.
It is understood that only ONE laying of the cordage is to be made, any eventual doubling is to be done OFF the tool after taking up the slack.
The first HP 1 is doubled by the last HP ONLY FOR VERY FEW crossings, just enough to ensure the 'locking' of the laid cordage route but not all along its length exactly as it is done for a Turk's Head Knot.

FIRST EXPERIMENTAL VERIFICATION :

THREE NON adjacent areas MW as shown in *Fig 3*.

Fig 3

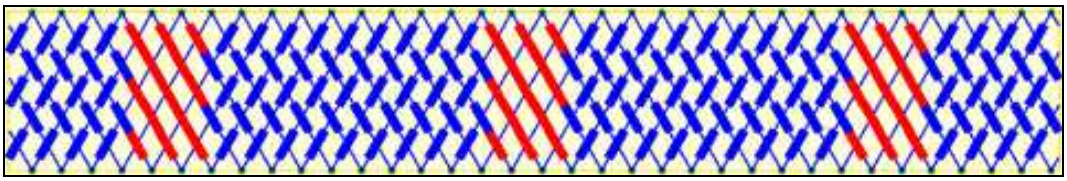


Photo 3

Events were to show that it was a happy coincidence that the RIGHT boundary of the RIGHTMOST Matthew Walker coded area is so far from the RIGHT edge of the grid, this for maintaining a strict adherence to what was specified in METHODS: HP-1 must not be doubled for more than a very few crossing while on the tool.

Photo 3 (M.S) on the left shows the result in the cordage.

As Michel states it: "all my experience of knotting was necessary"

6L 35B VIRTUAL Regular Cylindrical Knot that became a

$6L_{mobius}$ $52B_{mobius}$

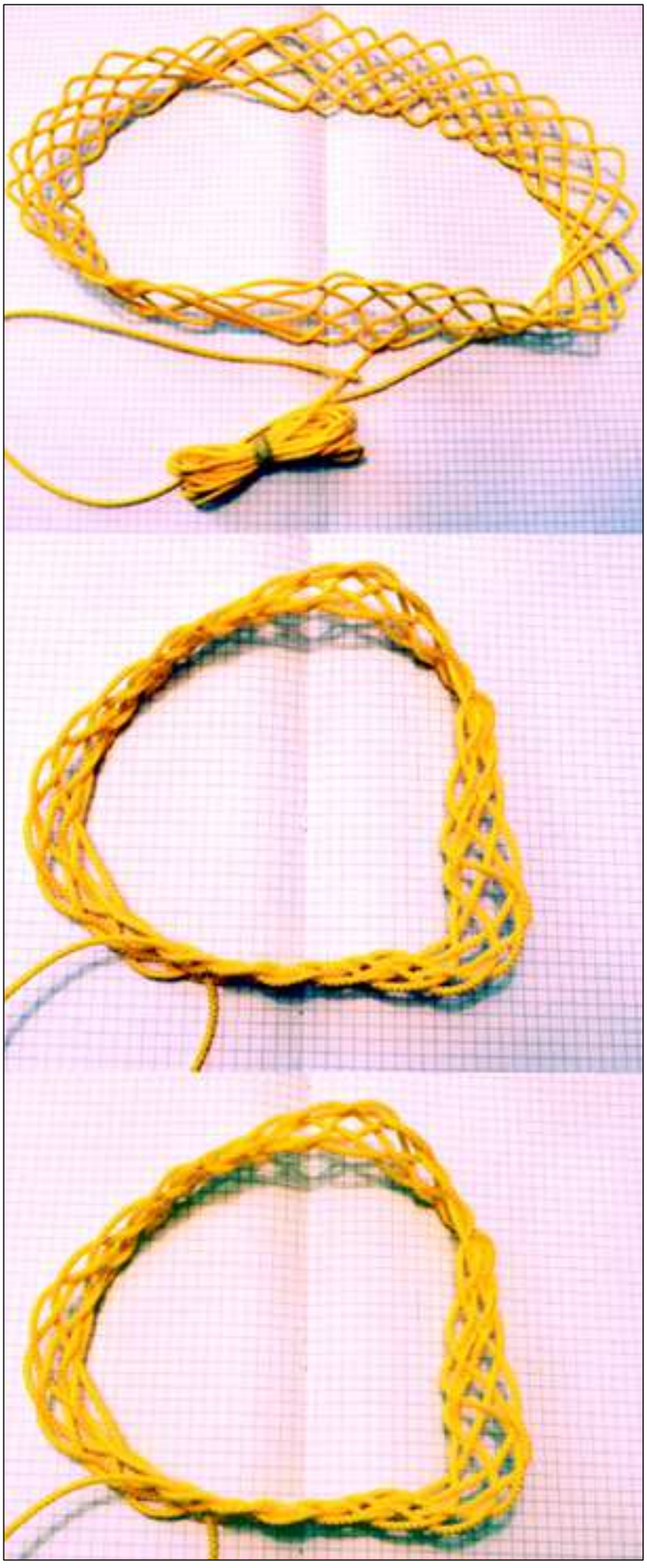
or

$6L\_35B\_\_6L_m\_52B_m$

Hence a LOSS of BIGHTS equal to 18 or 3 * L
(35 * 2) - (6 * 3 twists) == 70-18 = 52
So it seems that black crossings do not play ANY ROLE and that only the crossings belonging to the MW coded zone (strictly included between the vertical limits.) have an effect.

Here are the steps
Photo 4 (M.S)

Photo 5 (M.S)



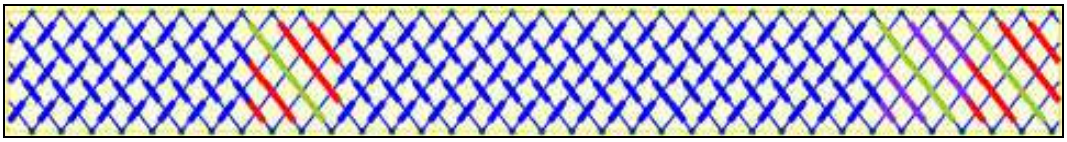
For the next verifications we will be showing fewer details since the same procedure is applied each time.

Photo 6 (M.S)

SECOND EXPERIMENTAL VERIFICATION

1 zone and farther along 2 zones adjacent to each other

Fig 4



VIRTUAL Knot : 6B 35B

Figure 4 corrected *by MS to prevent the situation that must be dealt with when THE FIRST HALF PERIOD pass through the MW zone*

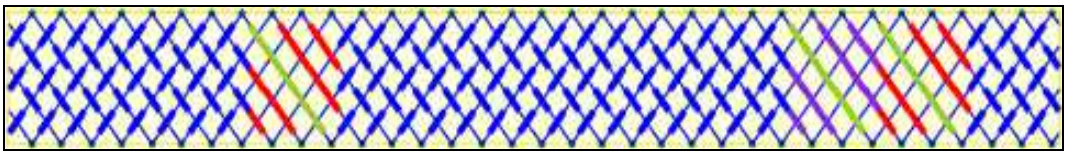


Fig 5 The frame reference is : Half-periods of ODD numbering go from BOTTOM-RIGHT to UP LEFT : HP No. 1 is more favourably positioned if it does not contribute ANY CROSSING in the Matthew Walker coded area (so the last DP will automatically be outside the MW too) here it is "a bit of a close shave ", a little farther away, without any exaggeration would probably be more comfortable, that is if we want to strictly comply with what is said in the method: NO double the DP 1 for more than a few crossings.
Without this precaution of keeping the DP 1 OUT of the MW it will be necessary, while still on the tool, to resort to various tricks to ensure the stability of the knotting prior removing it from the tool.(make a knot linking HP-1 to last HP, doubling 1,2,3…DP, etc)

Fig 5

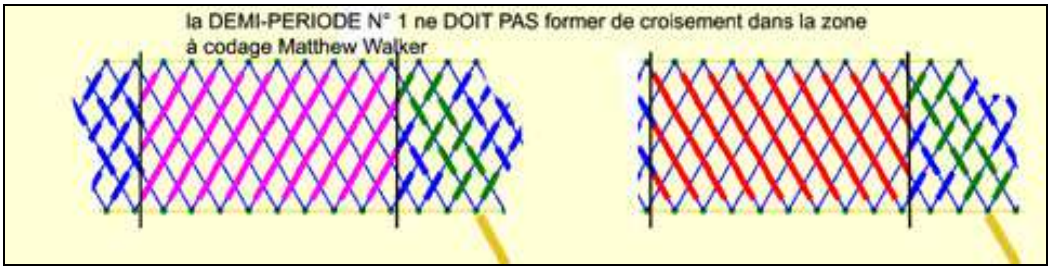


Photo 7 (M.S)

So **6L_ 35B_ 6Lm_ 52Bm**

Loss of BIGHTS 18 or **3 * L** , Yet again : number of 180° twists multiplied by **L**
(35 x 2) - (6 x 3) = 70-18 = 52

Once again the black crossings are irrelevant and only crossings strictly located BETWEEN the MW boundaries are to be taken into account at the moment.
Photo 8 shows the inadequate passage of HP No. 1 through the Matthew Walker coded area which causes a situation needing procedures not complying with 'methods' to stabilize the cordage route laid before taking it off the tool. It is after having detected this situation that Michel redrew the ***Fig 4*** grid as ***Fig 4 rectified*** which led to the exposed knot .

Photo 8 (MS) with a HP No. 1 that participates in the formation of crossings in the Matthew Walker coded area.

Photo 8a (MS) the Photo 8 "not complying " with 'method was corrected

THIRD EXPERIMENTAL VERIFICATION

3 contiguous areas.

Michel took the opportunity to show in more detail *Photo 9 (MS)* the disadvantage of letting HP No. 1 form one or more crossings in the Matthew Walker coded area if you want to avoid the need to resort to some foxy solutions which are not complying with "method" (ex : doubling 2 or more HP) to stabilise the knotting prior taking it off the tool.

Photo 9 (M.S)

Photo 9 bis (M.S) retouchée par C.H

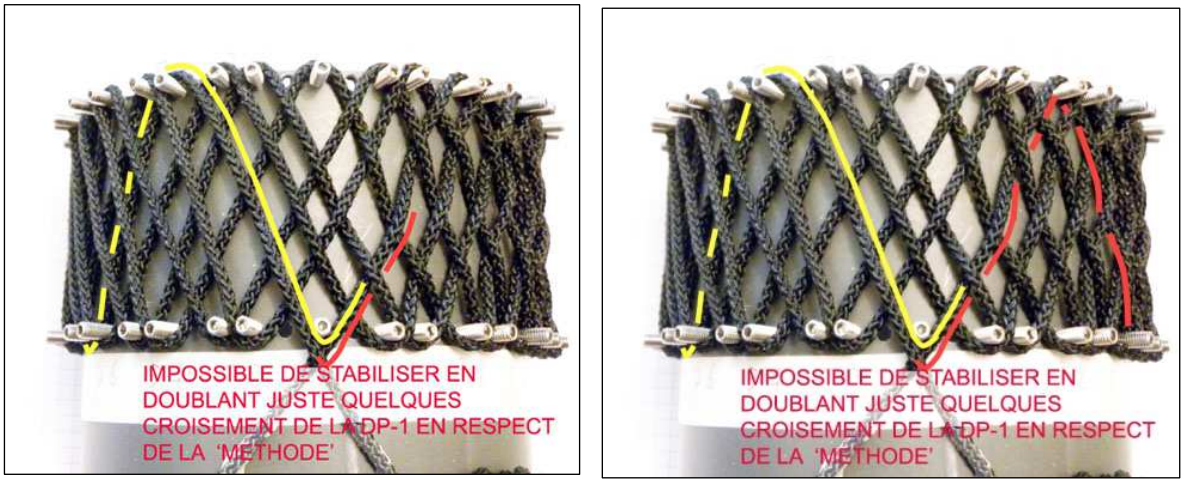


Fig 6 grid 3 contiguous areas and HP No. 1 out of MW area for all its crossings

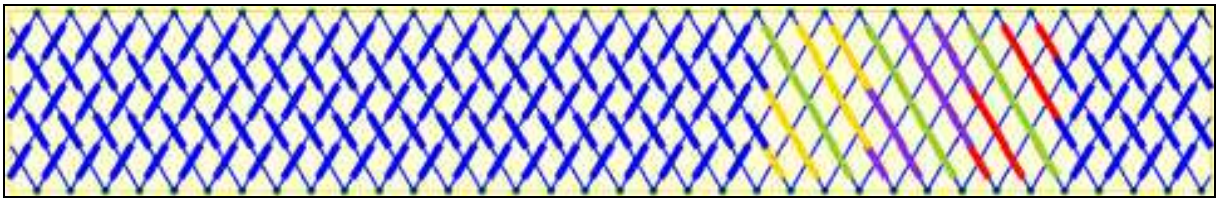


Photo 10 (M.S)

18B or **3 *L** Bights Lost – has a single face (controlled 3 times)
(35 x 2) - (6 x 3) = 70-18 = 52

So **6L_ 35B_ 6Lm_ 52Bm**

CONCLUSION :

This is not a mathematical proof that would have immediate and irrefutable general value, but it is an honest practical verification made with a knot that was randomly taken, so there is no immediate reason to believe that it is a special case and it PRAGMATICALLY follows that for more than one 180 ° twist
The loss of bights during twisting is equal to the number LEAD (PART) multiplied by the number of 180° twists made.

Furthermore it was established that the 'practical situation' will be easier if Half Period n° 1 DOES NOT make any crossing in the Matthew Walker coded area but stays away. Doing this is the best if one wishes to avoid being obliged to used foxy tricks to stabilize the cordage laid prior to taking it off the tool for dressing (taking off the MW area slack among other things) and setting with eventually doubling or tripling. SCHAAKE gives neither of these results since he deals only with the case of single 180° twist Mobius and if he does not explicitly speak about the practicality of avoiding that the HP No. 1 runs through the MW coded area if you want to be in the simplest possible situation **SCHAAKE CONSTANTLY KEEPS THE HP-1 FAR AWAY THE MW area in his grids.**
Plus do not forget that it is the simplest coding (O1-U1) that was experimented with and that other patterns may create other problems if the HP-1 goes through the MW area. For knot made "for keeps" stay away of the MW and keep the use of HP-1 running through the MW area for experiment or dexterity exercises.

Michel continued the path alone and he is the first (after Claude HOCHET the creator of ARIANE) to make a FIVE 180° twists EVEN LEAD Mobius shown just above

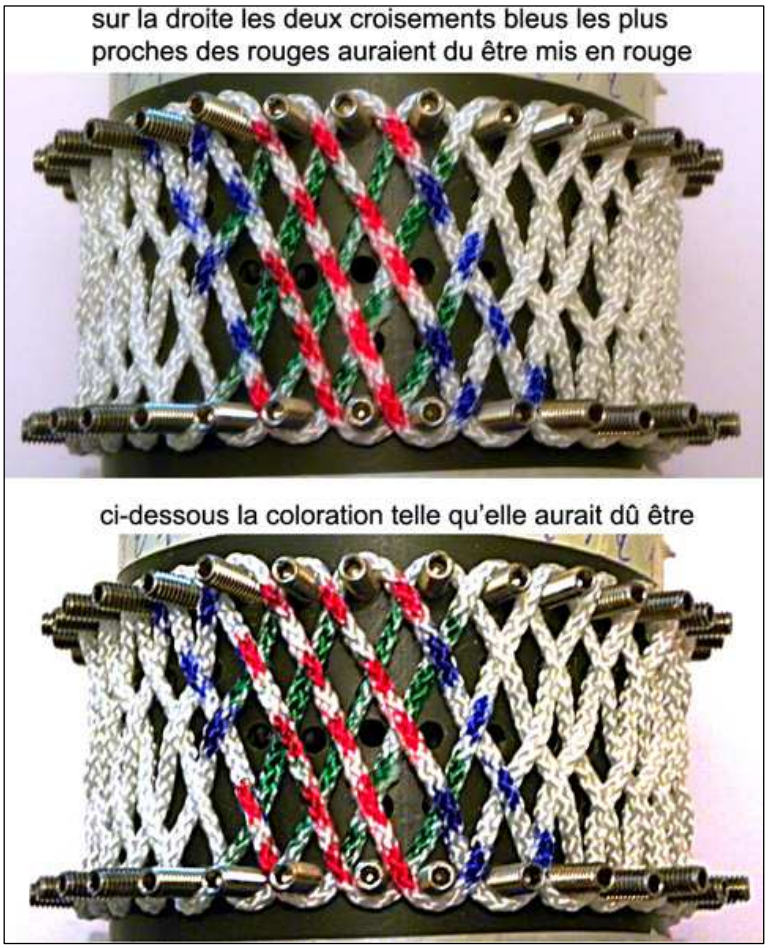
Michel labels it : Moebius 5 6L_53B_6Lm_76Bm | 5 turn (180°),
Moebius 6L_53B_6Lm_76Bm | 5 twists
or triple Moebius | 6L_53B_6Lm_76Bm

(BEWARE in English a turn == 180° a full turn ==360° but in French 180° is UN DEMI TOUR (a half turn) and 360° of e revolution is UN TOUR / A TURN)

This knot also complies with the rule Number of Bights Lost = number of LEAD multiplied by the number of 180 ° twists.

Not content with having been the one who gave us these results Michel pushed curiosity further and proceeded with an idea that I had told him that I had used years ago for the "capsizing" of The SQUARE KNOT. On a Moebius 6L_31B_6Lm_56Bm he show us where the MW coded area parts goes before disappearing.

Photo 11 (M.S)



The idea is to colour with different colours markers, the cordage in the MW coded area as it is done in a grid and add the green UNDER (U) part (see above photo and grid) and take pictures of the dressing and setting.

The small error in colouring two crossing on the left does not destroy the validity of the illustration of the dispersion of the "lengths" of cordage in the MW area in the rest of the knot during the tacking off of the slack and the tightening adjustment.
This dispersion is illustrated in the following pictures

Photo 12 (M.S)

Photo 13 (M.S)

Photo 14 (M.S)

After the second adjustment it can be seen that **the MW pieces have been dispersed in the whole of the knot.**

During the actual constitution of the180° twists the parts of rope that were used to build the MW are gradually 'integrated' by the taking up of the slack inside the knot where they slide.
Of course in this sliding shift there is a total respect for each crossing, they simply change the "piece of rope" that make them but their OVER or UNDER type is fully respected.

At this point the knot is ready to be doubled.

Table 1 (L IMPAIR)

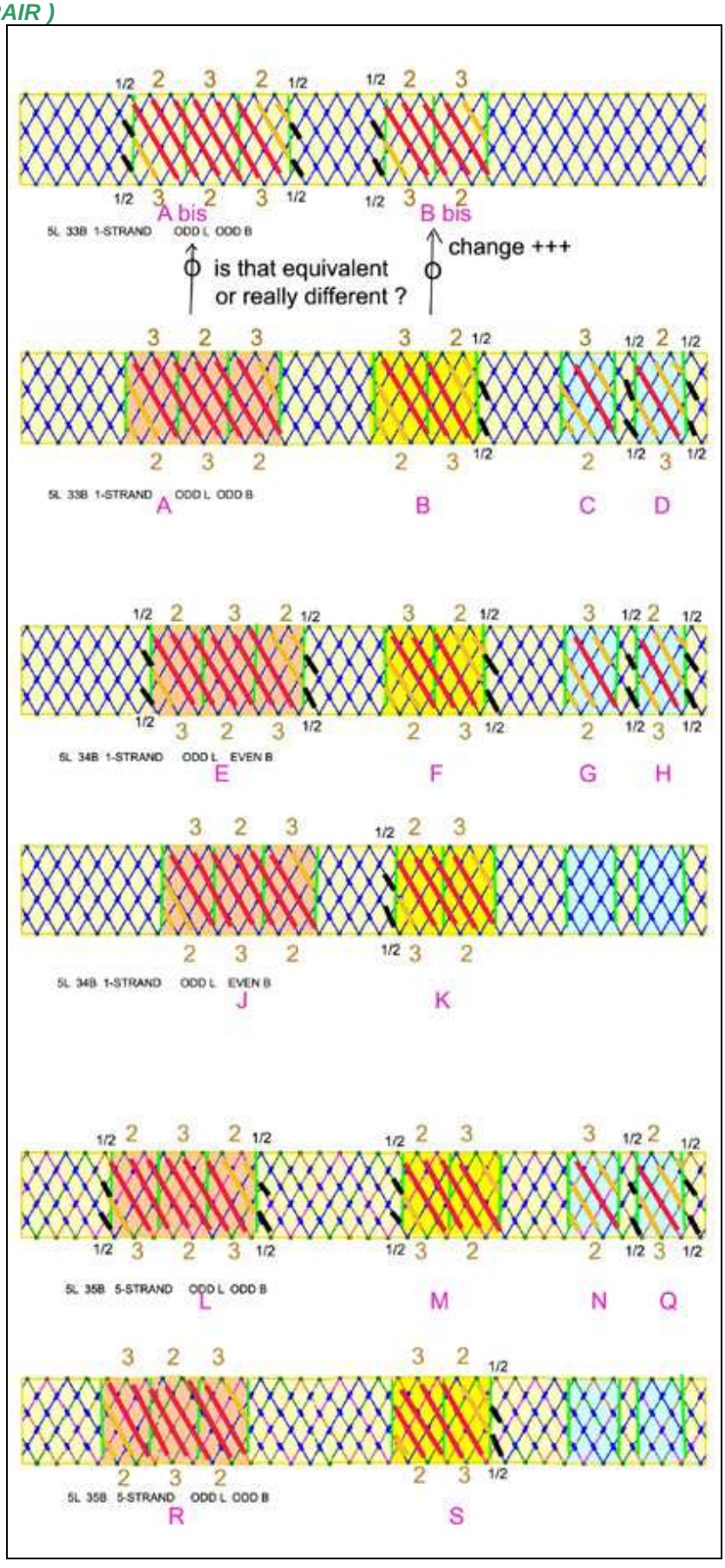
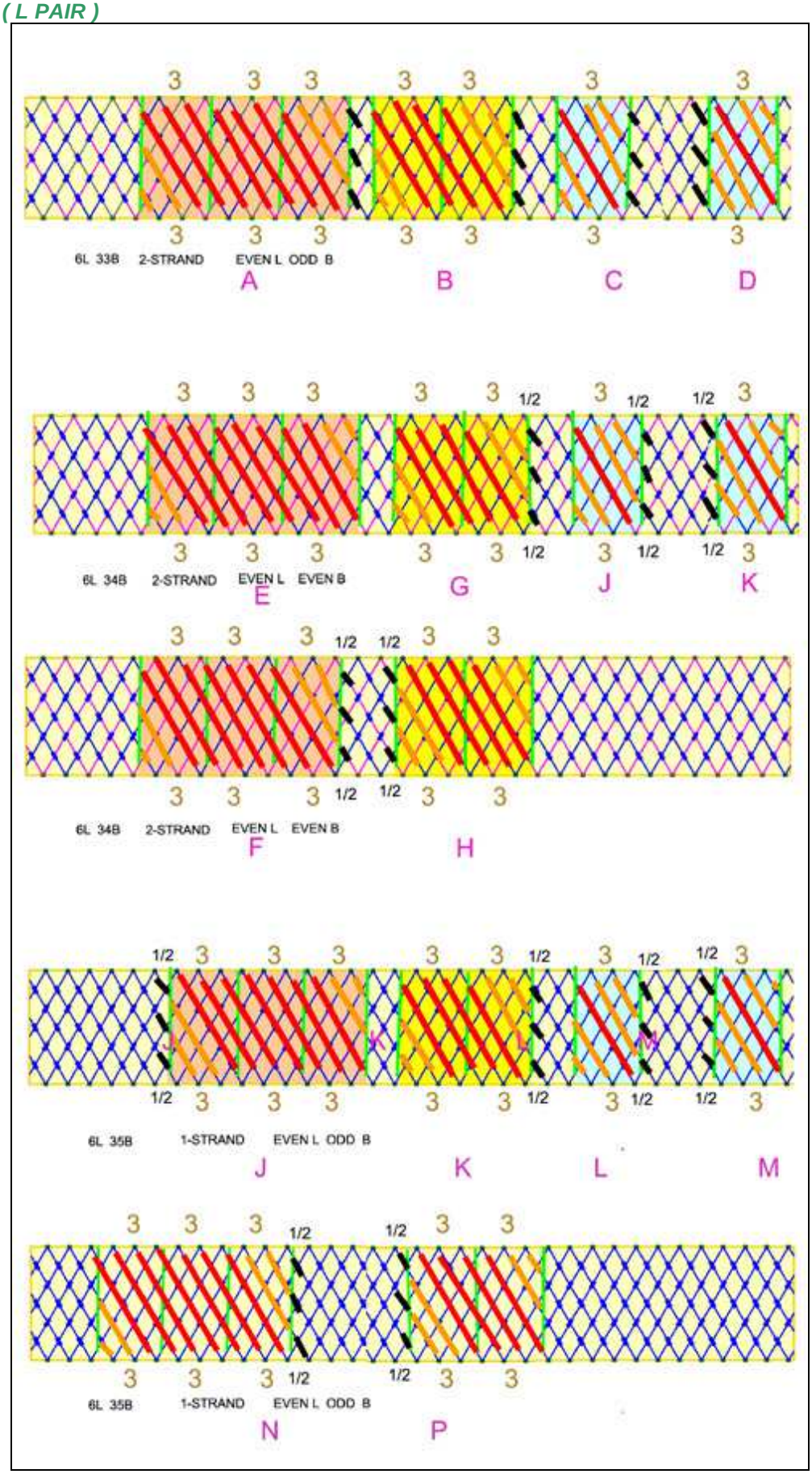


Table 2 (L PAIR)



INTERNET LINKS

http://en.wikipedia.org/wiki/M%C3%B6bius_resistor

http://labspace.open.ac.uk/mod/resource/view.php?id=457077&direct=1
http://www.epilator-review.com/Epilady_Epic_Shave_Lady_52141631.html

http://mathematics.gulfcoast.edu/mathprojects/Moebius%20strip.ppt

http://i.stack.imgur.com/tFJx7.jpg