12 Coins in Verse

In a Foreward to the Eurica magazine's jubelee issue #60, Ian Stewart mentioned a solution to the 12 coins problem that appeared 60 years earlier in the issue #13:

> Now, I may be biased, but I think Eureka is a brilliant magazine. Many of its articles are classics. In issue 13 (1950) Cedric A. B. Smith, under his pseudonym Blanche Descartes, answered the 12-ball weighing puzzle in a poem, whose crux was the lines
>
> F AM NOT LICKED
> MA DO LIKE
> ME TO FIND
> FAKE COIN
>
> Exercise for the reader: work out what the devil I'm rabbiting on about.

To remind the problem of weighing 12 coins is this:

> *Twelve identical-looking coins are given, and we are told that one of them has a weight different from the other 11. The problem is to determine which coin it is and whether it is heavier or lighter, in only three weighings of these coins on a balance scale.*

So what is it that Cedric A. B. Smith has incrypted in the verse?

Solution

Weighing Coins, Balls, What Not ...

1. ***The Oddball Problem, B. Bundy (https://www.cut-the-knot.org/blue/OddballProblem1.shtml)***
2. ***Weighing 12 coins, Dyson and Lyness' solution (https://www.cut-the-knot.org/blue/weight3.shtml)***
3. ***Weighing 12 coins, W. McWorter (https://www.cut-the-knot.org/blue/weight1.shtml)***
4. ***Thought Less Mathematics, D. Newman (https://www.cut-the-knot.org/blue/OddballProblem2.shtml)***
5. ***Weighing with counterbalances (https://www.cut-the-knot.org/blue/weight2.shtml)***
6. ***Odd Coin Problems, J. Wert (https://www.cut-the-knot.org/blue/OddCoinProblems.shtml)***
    - ***Odd Coin Problems, a shortened exposition (https://www.cut-the-knot.org/blue/OddCoinProblemsShort.shtml)***
7. ***Six Balls, Two Weighings (https://www.cut-the-knot.org/blue/6Balls2Weighings.shtml)***
8. 12 Coins in Verse
9. ***Six Misnamed Coins, Two Weighings (https://www.cut-the-knot.org/blue/6MisnamedCoins.shtml)***
10. ***A Fake Among Eight Coins (https://www.cut-the-knot.org/blue/EightCoins.shtml)***
11. ***A Stack of Fake Coins (https://www.cut-the-knot.org/blue/TenByTen.shtml)***
12. ***Five Coins - One Good, One Bad (https://www.cut-the-knot.org/blue/5Coins1Good1Bad.shtml)***
13. ***With One Weighing (https://www.cut-the-knot.org/blue/OneWeighing.shtml)***

The first line, "F AM NOT LICKED" that consists of 12 distinct letters is a good indication that the letters stand for the coins. There are several variants of a "static" solution wherein 3 weighings are executed of four coins against four coins. The odd coin is then determined from the outcomes of the three weighings. The groups of 4 in each weighing have been judiciously composed and are always the same.

My first thought was that somehow these weighings ought to be related to one of the other solutions (***Bundy's (https://www.cut-the-knot.org/blue/OddballProblem1.shtml)***, ***Dyson and Lyness' (https://www.cut-the-knot.org/blue/weight3.shtml)***, ***D. Newman's (https://www.cut-the-knot.org/blue/OddballProblem2.shtml)***, or ***W. McWorter's (https://www.cut-the-knot.org/blue/weight1.shtml)***.) All my attempts to find the relation were to no avail. Counting letter frequencies did not help. Actually observe the "I" on the right in the natural interpretation of the vesre as a weighing prescription

1: MADO | LIKE
2: METO | FIND
3: FAKE | COIN

The "I" on the right appears three times which happens to no coin in any of the other solutions.

So, my thinking went, either there was an error - unnoticed by Ian Stewart - or the approach should be entirely different. This is what I came up with. Assume that one of the 12 letters "F AM NOT LICKED" is heavier or lighter than the rest. What would be the outcomes of the weighings? To solve the problem the 12 outcomes must satisfy two conditions:

1. They all must be distinct.
2. None may be an L-R reflection of the other.

(One label is the L-R reflection of another if the latter is obtained from the former by replacing L with R and R with L.)

The need for the first requirement is obvious. The second precludes the possibility that the same three outcomes could be interpreted as one of the coins being heavier and also as another coin being lighter than the rest. So let's put together a table of the outcomes. An outcome will be described by three letters L(eft), R(ight), or E(ven), a letter per weighing. L meaning that the left side was down, R that the right side was down, E that there was balance. The second row is obtained under the assumption that the letter at the top is heavier than the rest. For the third row we assume that it is lighter.

F	**A**	**M**	**N**	**O**	**T**	**L**	**I**	**C**	**K**	**E**	**D**
ERL	LEL	LLE	ERR	LLR	ELE	REE	RRR	EER	REL	RLL	LRE
ELR	RER	RRE	ELL	RRL	ERE	LEE	LLL	EEL	LER	LRR	RLE

All the labels appear distinct and the second and the third rows do not mix. Thus the table explains Smith's solution to the puzzle.

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