

A MAGIC TOUR OF EUROPE

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The map depicts a reasonably good picture of seven European countries and their connection by six numbered air routes. With the magician's back turned the subject starts in any country and begins his tour by calling out in sequence the numbers of his flights. When he completes his tour to his satisfaction he announces his ending country. The magician can immediately name his starting country and the direct route to return to it.

Method: Mathematically this is a mod 7 addition trick. That is, the numbers 0, 1, 2, 3, 4, 5 and 6 cycle through by "casting out 7s". For instance, $4+6$ is 10 but in this arithmetic it is 3 after casting out 7. The magician will reduce the spoken number tour at each step to a single one of the possible remainders on division by 7.

The map is designed to cycle the countries alphabetically through A-B-C-D-E-F-G-A as the reader may check by following route 1 seven times. It is not hard to then determine where the subject started. As an example suppose he calls $4-2 (=6) - 3 (=2) - 4 (=6) - 5 (=4)$. So the final number is 4 and the magician knows that to get back to the start one must travel route 3. It is always the case that the final remainder and the return must add to 0 (i.e., 7). So if the final country is Belgium he would have started the third country from B in the cycle, i.e., E (England). Try starting in England and traveling the route. It does not take much practice to become proficient.

