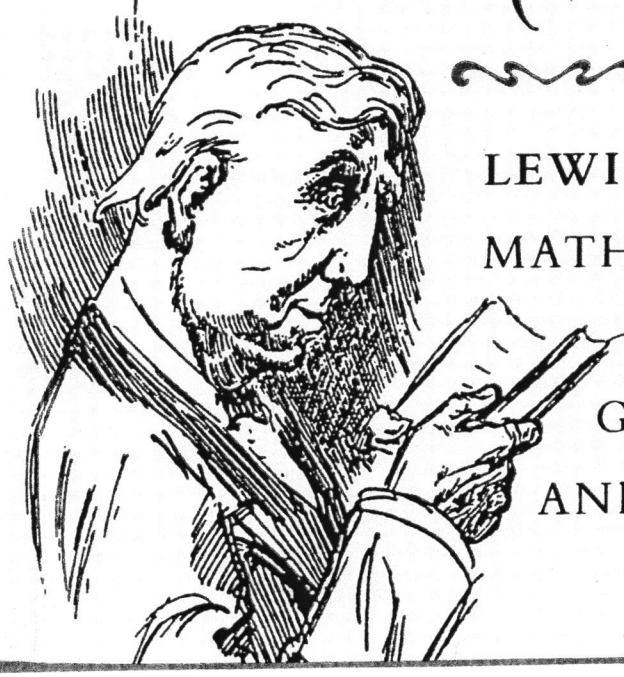
MARTIN GARDNER

The Universe in a Handkerchief

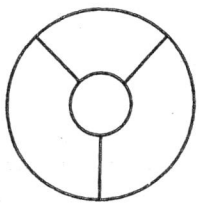


LEWIS CARROLL'S MATHEMATICAL RECREATIONS, GAMES, PUZZLES, AND WORD PLAYS.

In the biography of his uncle, Stuart Dodgson Collingwood quotes from a manuscript found among Carroll's effects:

> A is to draw a fictitious map divided into counties.
>
> B is to colour it (or rather mark the counties with *names* of colours) using as few colours as possible.
>
> Two adjacent counties must have *different* colours.
>
> A's object is to force B to use as *many* colours as possible. How many can he force B to use?

The answer is four. The first player can force B to use four colors with this ridiculously simple map:



On more complicated maps it is not obvious whether a fifth color is required. Actually, every map on the plane or on a sphere can always be colored with four colors so that no two regions of the same color share a boundary. This was only a conjecture in Carroll's day, so he could not have known with certainty whether the answer to his question was four or five. Even today a tiny uncertainty lingers over the validity of the proof of what is known as the "four-color map theorem." The

proof occupies such a horrendous mass of computer printouts that there could be a subtle flaw that no one has yet detected. Even if the theorem is true, as it almost certainly is, it still awaits a simple proof that does not require hours of computer time.