TITLE:

Symmetry

and the

ALHAMBRA   MOSAICS
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BRIEF ABSTRACT:

Every pattern has a *symmetry group.* What is it?

Wallpaper patterns have only **17** symmetry groups. Why?

Do all 17 appear among the *Alhambra mosaics?*

LONG ABSTRACT:

Every pattern has some *symmetry* which mathematicians study using the idea of a *symmetry group.*

Wallpaper patterns have only 17 types of symmetry groups (Evgraf Fedorov, 1891). **Modern proof** (William Thurston and John Conway, 1970's): Every wallpaper pattern can be folded into an *orbifold*. The features of this orbifold are terms in its *Euler characteristic equation.* This equation has only 17 different solutions.

The 700 year old mosaics in the **Alhambra Palace** in Granada, Spain are among the world's most beautiful wallpaper patterns. Do all 17 wallpaper groups appear among the Alhambra mosaics? Yes and no!

BIOGRAPHY:

Fredric Ancel received a Ph.D. in mathematics from the University of Wisconsin – Madison in 1976 specializing in the area of topology. He held research positions at Princeton University and the Mathematical Sciences Research Institute in Berkeley and faculty positions at the University of Texas in Austin and the University of Oklahoma in Norman before joining the faculty at the University of Wisconsin – Milwaukee in 1986 from which he retired in 2016. He has published various research articles in topology and geometry, advised masters and Ph.D. students and created various undergraduate and graduate courses in these areas.