Conceptual Developments in Counterchange Symmetry

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The majority of patterns found within commercial and decorative art possess the characteristic of symmetry, where a motif within a design is regularly repeated across the plane. The construction of such regularly repeating patterns is governed by the use of up to four symmetry operations (or symmetries), known as translation, reflection, rotation and glide-reflection. When applied in combinations, these symmetries can produce seventeen distinct structures across the plane. Colour may be systematically interchanged, to produce counterchange patterns; such patterns are considered to be perfectly coloured. Using two colours and allowing these to colour each of the primary all-over pattern structures in conjunction with one or more of their constituent symmetries, a total of forty-six two-colour-counterchange possibilities are achieved. Three-colour-counterchange, the principal theme of this paper, allows for twenty-three possibilities.

This paper examines a range of geometric concepts, underlying the construction of regularly repeating patterns. These concepts form the basis of a systematic means by which textiles and other surface patterns may be classified with respect to their symmetry characteristics. Concepts associated with the perfect colouring of regular repeating patterns are examined, and original illustrative examples of the twenty-three three-colour-counterchange possibilities are provided. The intention of this paper is to ensure accessibility to a non-mathematically-aware audience. In addition, the vital role played by other scholars (including Woods, Schattschneider and Washburn and Crowe), in the dissemination of these concepts to a wider audience is acknowledged.