The Tits-Freudenthal magic square yields a description of certain real forms of the exceptional Lie algebras in terms of a pair of division algebras. At the group level, the first two rows are well understood geometrically, with the minimal representations of $F_4$ and $E_6$ expressed in terms of the Albert algebra. In the third row, the minimal representation of $E_7$ consists of “Freudenthal triples”, essentially a pair of Albert algebra elements.

We summarize here several recent results at the group level. First, we describe how to use Cartan decompositions involving all 5 real forms of $E_6$ to identify chains of real subgroups of the particular real form $SL(3, \mathbb{O})$. Second, we give a new description of Freudenthal triples in terms of “cubies”, the components of an antisymmetric rank-3 representation of (generalized) symplectic groups, thus providing a unified, geometric interpretation of Freudenthal triples as a single object, a new description of the minimal representation of $E_7$, and an interpretation of the group $Sp(6, \mathbb{O})$. Along the way, we also discuss the closely related “$2 \times 2$” magic square of orthogonal groups. (Received September 21, 2014)