SELF-DESCRIPTIVE EULER MAGIC SQUARES

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In the November 1996 Word Ways, I introduced the Euler square (also known as a Graeco-Latin square), which is by its method of construction automatically magic. All rows and columns add up to a common sum since they merely consist of rearrangements of the same basic components:

Bc	Ad	Da	Cb
Db	Ca	Bd	Ac
Cd	Dc	Ab	Ba
Aa	Bb	Cc	Dd

For example, the four capitalized letters can be assigned number names such as ONE HUNDRED, FIVE HUNDRED, SIX HUNDRED and FOUR HUNDRED (one letter can even be set equal to zero); the four lower-case letters can then be assigned any number names between ONE and NINETY-NINE.

Obviously, the magic property of the Euler square is preserved if one writes out the number names Bc, Ad, etc., and replaces each number name with the sum of its gematric letter-values (A=1, B=2, ... Y=25). By trial and error, it is not difficult to select number names so that the magic constant does not change. The original Euler square is then called self-descriptive, a property that no individual number name possesses (i.e., no number name has a gematric sum equal to itself).

Euler Square

102	14	308	240
340	208	114	2
214	302	40	108
8	140	202	314

magic constant = 664

Gematric Version

165	104	179	216
214	181	211	58
236	188	84	156
49	191	190	234

magic constant = 664

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The editor asks: if one starts with a non-Euler magic square (of any size), can a self-descriptive magic square be found? If not, can a non-Euler magic square be transformed into a gematric square having a <u>different</u> magic constant? If the gematria is sufficiently simple (for example, A=B= ... = Y=1), Lee Sallows showed that the answer to the latter question is yes: see "Alphamagic Squares" in the May 1991 Word Ways. For what other gematrias can the magic property be preserved? A scrambled-alphabet gematria, perhaps?