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University of South Carolina, Columbia, SC 29208. *Wieferich pairs and Barker sequences.*

A Barker sequence is a finite sequence of integers $\{a_i\}$, each ± 1 , for which every sum $\sum_i a_i a_{i+k}$ with $k \neq 0$ is -1 , 0 , or 1 . It is unknown if any Barker sequences exist with length $n > 13$, although a number of necessary conditions on their existence have been established, so restrictive in fact that no value of $n > 13$ was even known that satisfied all of the requirements. We describe a large computational investigation that significantly improves the best known lower bound on the length of a long Barker sequence. The computation involves a large search for Wieferich prime pairs (q, p) , which are defined by the property that $q^{p-1} \equiv 1 \pmod{p^2}$. We also describe some connections between these quantities and some problems of Erdős in number theory and analysis. (Received January 30, 2009)