The Riemann-Siegel formula gives one of the most efficient ways of computing the Riemann zeta function on the critical line. The formula was discovered by Riemann, but published much later by Siegel who deciphered it from Riemann’s notes. Siegel wrote in 1932 that it should be possible "without much difficulty" to generalize the formula to include the Hardy-Littlewood approximate functional equation, valid in any vertical strip. I’ll describe this natural generalization for the first time. Ingredients include the Mordell integrals which appear in the theory of mock modular forms, and an interesting new family of polynomials related to Hermite polynomials. These polynomials have functional equations coming from the functional equation of zeta, and all their zeros seem to lie on certain lines.