



The Mathematical Family Tree of Hans Rademacher (with A. Whiteman branch)

cal Journal, and of the *Journal of Mathematical Analysis and its Applications*, and as a reviewer for many mathematical publications. He served as a consultant to Tom M. Apostol and Ivan Niven in the preparation of their article, "Number Theory", for the *Encyclopedia Britannica*. He gave numerous invited lectures, including a one-hour invited address at the American Mathematical Society meeting in Berkeley (1957), and organized or chaired a number of conferences, including two National Science Foundation research conferences in number theory held at the California Institute of Technology (1955 and 1963).

At USC he received research grants from the ONR and the NSF. He produced nine Ph.D. students. Of the eight who are living, five have tenured university positions, and three have positions in industry or government. His Ph.D. students have among them produced seven Ph.D. students, Al's "academic grandchildren". He received a commendation as a "superlative teacher" from Vice Provost John Cantelon of USC in 1971.

Al's early work heavily involved identities and sums, of great importance in number theory. After the war his work turned to the properties of elements of prime number fields. He was instrumental in solving the cyclotomy equations for orders 10, 12, 16, and 20 [5, 6, 4, 8]. While continuing his work on cyclotomy, he started to understand the power of finite fields when applied to combinatorics. His paper, "A Family of Difference Sets" [7], showed that if p and $q = p + 2$ are both prime powers, then a cyclic Hadamard difference set exists for pq elements. This powerful result, which is very widely quoted (it was also proved independently about the same time by D. A. Sprott), has yielded many combinatorial designs and structures and a new family of rate one-third codes found by V. Bhargava (current president-elect of IEEE). In the seventies he saw that Galois theory could be used to construct Hadamard matrices and started to correspond with Jennifer Seberry (Australia) and later with Christos Koukouvinos (Greece), communicating partial results and questions with lengthy handwritten calculations and examples. These collaborations were highly successful, yielding one of only three known families of conference matrices [9], the brilliant discovery of the second family of D -optimal designs [10], groundbreaking work in relative difference sets [11, 12], and a four-continent collaboration [13] with surprising new results on multipliers.

Al was always interested in mathematics and the history of mathematics. He showed Seberry a footnote in the papers of the Royal Society regarding the regular contributions of Miss Florence Nightingale to mathematics.

Rademacher himself paid Al the highest compliment, saying his work was, "not cheap... each paper was a serious contribution to the literature." He leaves behind an impressive array of achievements, and through his students (shown on page 218 of this article) is still contributing to the mathematics of the next generation. Sally Whiteman has established the Albert L. Whiteman Memorial Lecture, an annual lecture series honoring research in mathematics, at the University of Southern California Mathematics Department. Contributions to the lecture fund and suggestions for possible guest speakers will gladly be accepted. For more information, please contact the chair of the Mathematics Department, University of Southern California, Los Angeles, CA 90089-1113; telephone 213-740-1717; or e-mail: info@math.usc.edu.

Selected Bibliography

- [1] *Additive prime number theory in real quadratic fields*, Duke Math. J. 7 (1940), 208-232 (Ph.D. dissertation, Univ. of Pennsylvania).
- [2] *Theorems on Dedekind sums* (with Hans A. Rademacher), Amer. J. Math. 63 (1941), 377-407.
- [3] *Cyclotomy and Jacobsthal sums*, Amer. J. Math. 74 (1952), 89-99.
- [4] *The cyclotomic numbers of order sixteen*, Trans. Amer. Math. Soc. 86 (1957), 401-413.
- [5] *The cyclotomic numbers of order ten*, Proc. Sympos. Appl. Math., vol. 10, Amer. Math. Soc., Providence, RI, 1960, pp. 95-111.
- [6] *The cyclotomic numbers of order twelve*, Acta Arith. 6 (1960), 53-76.
- [7] *A family of difference sets*, Illinois J. Math. 6 (1962), 107-121.
- [8] *The cyclotomic numbers of order twenty* (with Joseph B. Muskat), Acta Arith. 17 (1970), 185-216.
- [9] *Some results on weighing matrices* (with Jennifer Seberry Wallis), Bull. Austral. Math. Soc. 12 (1975), 334-340.
- [10] *A family of D-optimal designs*, Ars Combin. 30 (1990), 25-26.
- [11] *Near difference sets* (with C. Koukouvinos), Bull. Inst. Combin. Appl. 15 (1995), 57-67.
- [12] *Relative difference sets* (with C. Koukouvinos), J. Combin. Theory Ser. A 74 (1996), 153-157.
- [13] *Optimal designs, supplementary difference sets and multipliers* (with C. Koukouvinos, Jennifer Seberry, and Ming-yuan Xia), J. Statist. Plann. Inference (accepted).