Peter Schönemann, Purdue University:

Even before our tribute to Louis Guttman has appeared in print[1], we now learn that Henry Kaiser has also left us.

Kaiser was one of Guttman's most loyal admirers. He incorporated many Guttmanian ideas on factor and radex theory into his own thinking. Yet, in contrast to Guttman who eventually abandoned factor theory altogether, Kaiser remained faithful to Thurstone's conception of multiple factor analysis as a "general scientific method" for the analysis of human abilities. He never wavered in his commitment to this "psychometric" view of factor analysis.

Kaiser is probably best known for his Varimax rotation method, which he developed while still a graduate student. Instead of maximizing sums of row variances, as had been done before, he maximized sums of column variances, which led to an astonishing improvement in overall performance. The popularity of Varimax continues unabated, garnering more than 1300 citations so far.

However, as a cross section of his citation record (1973/74, 1979/80, 1984/85, 1989/90) shows, there was more to Kaiser than just Varimax. To appreciate his conception of psychometrics, one has to turn to three major papers he published between 1960 and 1970. They account for another third of his roughly 100 citations per year, which means that only four out of a total of 110 articles account for more than two-thirds of all his citations.

The first in this trilogy of programmatic articles appeared in *Educational and Psychological Measurement* in 1960, "The applications of electronic computers to factor analysis." In this article, he outlined his vision of psychometrics in the computer age. When he wrote it, there was still an urgent need for tying three major problems of classical, "exploratory" multiple factor analysis together: "The communality problem and the question of the number of factors ... and the problem of rotation" (p. 143).

In the fifties, these problems had to be dealt with one at a time: First one estimated communalities, then one decided on an extraction method, then on the number of factors, and finally on the rotation method. Kaiser felt with arrival of computers the time was ripe for integrating these separate steps under a unifying rationale: "Factor analysis will eventually come out of the realm of strange, mystical, ad hoc, half-art, half-science sort of numerology into the camp of reputable methodologies because of the possibility of attacking factor-

[1] To appear in a future issue.

analytic problems in a mathematically respectable fashion through the use of high-speed computers" (p. 149).

He looked towards Guttman for cues for such an overarching rationale, adopting Guttman's work on Image Analysis for solving the communality problem and his work on eigenvalue criteria for solving the number of factors problem. As a temporary solution of the rotation problem he offered Varimax, at least until more robust algorithms for oblique rotation might be found. As it turned out, the only robust method for oblique rotation which eventually emerged was Hendricksen and White's (1964) Promax which in turn, relies heavily on Varimax.

In his 1960 article, Kaiser anticipated several themes for his later work. For example, he pointed to a connection between classical reliability theory and Guttman bounds which eventually became the basis for Alpha Factor Analysis:

> "Very recently, I have worked out all of the formulas for the Kuder-Richardson reliability of factors. One remarkably simple result is that for a principal component to have positive Kuder-Richardson reliability, it is necessary and sufficient that the associated eigenvalue be greater than one – a finding corresponding exactly to Guttman's algebraic lower bound" (p. 145).

Five years later, Kaiser and Caffrey (1965) proposed Alpha Factor Analysis as a psychometric (as opposed to statistical) rationale for factor analysis so that each of the "alpha factors ... successively has maximum generalizability" (p. 7). Because, as the authors showed, only alpha factors with eigenvalues larger than one have positive generalizability, this approach provided a natural answer for the number of factors problem, in accord with his quest for a unified factor method.

Finally, in the third article in this trilogy, his Presidential Address to the Psychometric Society, "A second generation little jiffy," Kaiser (1970) offered a further refinement as the factor method de rigeur in the computer age. In this article, he combined elements of Guttman's image analysis and eigenvalue bounds with Chet Harris' (1964) suggestion to rotate eigenvectors orthogonally before rescaling them to arrive at an oblique simple structure. This, then, was Kaiser's final answer to the challenge he had posed for himself a decade earlier, "the problem of attacking factor-analytic problems in a mathematically respectable fashion through the use of high-speed computers."

As it happened, just about that time mainstream psychometrics turned away from its previous psychometric foundations towards much greater emphasis on statistical inference. Both Kaiser and Guttman deplored this trend which seemed to put mathematical elegance before psychometric relevance, and both vented their views in no uncertain terms, Guttman (1977) in his "What is not what in statistics" article, and Kaiser (1976) in his review of a well-

known text on Factor Analysis as a Statistical Method: "This small and beautifully written book ... is a monument to the sterility of statistical thought in factor analysis" (p. 586).

Thus Kaiser remained faithful to his psychometric origins, refusing to bend with the Zeitgeist, which soon, ever more erratically, veered from one paradigm to the next (LISREL, MDS, IRT, ETC), without leaving discernible traces of lasting results.

Kaiser belonged to an era of psychometrics when the problems still preceded the solutions. Granted, not everybody who cited his articles had actually read them; some cared more about his programs which carried the endorsement of a former President of the Psychometric Society than for his psychometric theories. What matters, though, is that Henry Kaiser earned his reputation on his own terms, as one of the most productive, most accomplished, and fiercely loyal representatives of the Thurstone school.