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CONVENTIONS IN MATRIX OPTICS:
COMMENT ON A NOTE BY RICHARDS

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Klaus Halbach

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In his recent note on conventions in matrix optics,[1] Dr. Richards proposes a notation different from the one used in my paper.[2] I would like to make two remarks to this note:

1. It is unfortunate that every notation that one chooses to use when describing Gaussian optics with matrices has not only advantages but also disadvantages. This includes the convention proposed by Richards, and he agrees with me on this point.[3] Therefore the notation that an individual uses will always be a matter of personal preference. When writing my paper, I considered a number of notations, finally choosing the one most to my liking, although recognizing the disadvantage pointed out by Richards.[1] When this disadvantage is of major concern, I prefer to circumvent it as follows: Instead of introducing column vectors, I use row vectors $(r;r')$. With this notation the vector describing a ray leaving a system is expressed as the vector describing the ray entering the system, multiplied from the right by a product of matrices. The matrices appear in this product in the same sequence as their counterparts do in the conventional diagram with the light going from left to right. The matrices used in this notation are obtained from the ones used in my paper by interchanging the off-diagonal elements. Contrary to Richards' proposal, the desired output quantities are directly obtained in terms of the input quantities; the disadvantage of this notation is the fact that it takes more blackboard or

printing space when the row vectors are written explicitly. Although this choice is also one of personal preference, I feel that it, too, merits consideration.

2. Through an unfortunate sequence of events when correcting the galley proofs,[3] an error was introduced in the note by Richards: In the statement following the matrix connecting the focal planes of a system, the inequality sign has to be turned around, and the statement is meant to apply to a single lens only, not to a system.

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1. P. I. Richards, Am. J. Phys. 32, 890 (1964).
2. K. Halbach, Am. J. Phys. 32, 90 (1964).
3. P. I. Richards (Technical Operations Research, Burlington, Mass.), private communication, 1964.