increases led to lenticular damage in the control experiments. Thus heating effects are to be presumed significant until experimentally shown otherwise.

The above writers argue against a far stronger claim about their study [12] than was actually made. Moreover, their comments pertain to a paper [2] that appeared some months after our own. For several reasons, neither the calculations of the above authors, nor the experimental evidence in [2, 12] seems able to refute our suggestion, even when extended to the more recent paper.

First, the actual temperature rise within the lens will exceed the minimum values calculated above, by an amount that depends on the very uncertain heat transfer characteristics of the exposure chamber. It appears from sketches in the paper by Stewart-DeHaan *et al.* [12] and the more recent paper [2] that the lens was located at the bottom of a perforated glass tube through and around which the coolant was pumped. The theory that is cited in the above letter pertains to an isolated object located in an unbounded coolant flow, which is quite different from the actual situation. If saline were trapped between the glass surface and the lens and subsequently heated by the microwave energy, or if a substantial portion of the surface of the lens were occluded from the coolant flow by its contact with the glass support, calculations assuming "optimal" cooling would seriously underestimate the temperature rise within the tissue.

Second, the portion of the experimental observations that cannot arise from bulk heating is unknown. Both [12] and [2] reported that damage was observed after exposure to CW microwave energy, that was somewhat less than that observed after exposure to pulsed fields with the same time-averaged SAR, but the results from the CW exposures were not presented for comparison. Presumably, some of the effects that are referred to in the above letter are observed only after exposure to pulse-modulated fields of high-peak SAR and result from other stresses than bulk temperature rise. However, the damage was correlated in [12] and [2] with variations in only one field parameter, the time-averaged transmitted power from the generator. If the experiment was well controlled, this would be proportional to the bulk temperature rise in the lens. Therefore, there is fundamentally no way to experimentally separate bulk heating from "nonthermal" effects from the data that are given, without the rather questionable speculations in the above letter. And there is at present no other established mechanism for microwave-induced damage to the lens. It might be, as the above writers suggest, that their results are completely unexplained, but that does not appear to us to be a constructive argument.

The above comments were limited to the physics of the experiment. The more important question is what was the mechanism for the damage that was observed. This question can only be answered by the experimentalists themselves. Nevertheless, we offer the following observation. It appears that the lenses were cooled by calcium-free solutions during irradiation. Brief exposure to calcium-free media will produce damage in (calf) lenses that resembles that reported in [12] and [2] subsequent to microwave irradiation. (J. I. Clark et al., "Cortical opacity, calcium concentration and fiber membrane structure in the calf lens", *Exp. Eye Res.*, vol. 31, 399–410, 1980). Calcium removal, being a diffusion-controlled process, might be expected to depend critically on the temperature of the lens and other experimental factors. Moreover, it is widely considered that calcium efflux from tissues is sensitive to perturbation by electromagnetic fields, although the physical mechanism is not yet established.

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Comments on "Hollow Image Guide and Overlayed Image Guide Coupler"

A. PRIETO, E. RUBIO, J. RODRIGUEZ, AND J. L. GARCIA

The authors of the above paper[1] failed to acknowledge several publications dedicated to the same subject. The so-called hollow image guide has already been studied by the E.D.C. method with the name of π guide, as well as another dielectric structure named T guide [2]. The same paper shows a good agreement between the theoretical and the experimental results which were measured by means of a movable electric field probe with the end of the dielectric waveguides finished in a short circuit.

In a second paper published later [3], we have studied the former dielectric guides and the image guide, the isolated image guide and the inverted strip dielectric waveguide by Schelkunoff's method. This study allows us to determine the dielectric and metallic losses presented by any kind of dielectric guide. We have also proven that being the guides equivalent (with the same transversal surface), the losses of guides T and π are similar, and lower than the equivalent image guide. However, the quality

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[1] J. F. Miao and T Itoh, *IEEE Trans. Microwave Theory Tech.*, vol. MTT-30, pp. 1826–1831, Nov. 1982.

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factors presented by the T and image guides are higher than the ones presented by the π equivalent guide [4]. Furthermore, the transversal decay of the electromagnetic field on the π guide is much lower than it is on the image or T guides. Consequently one has to use to use higher minimal curvature radii for the π guide, and thus one has to enlarge the circuit dimensions.

Reply[2] by J. F. Miao and T. Itoh[3]

The authors of the paper [1] thank the authors of the above comments for drawing attention to the existence of excellent works reported elsewhere. Due to limited communication skills, the authors of [1] could not detect the papers referenced in the comments. It should be noted, however, that the primary objective of [1] is to develop a directional coupler with additional design parameters after a simple theory of analysis is experimentally confirmed.

The generalized telegrapher's equation by Schelkunoff has previously been used by Ogusu in analyzing a number of dielectric waveguides [5].

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Comment on "Variational Methods For Nonstandard Eigenvalue Problems in Waveguide and Resonator Analysis"

G. J. GABRIEL

In his recent work[1], Lindell proposes variational methods for so-called nonstandard eigenvalue problems with sweeping generalities. To be sure, unorthodox formulations and solution of broad classes of problems ought to be encouraged, provided that they are consistent and that they are cogently demonstrated to offer significant improvement over existing knowledge. It is the purpose of the following comments to prove the inherent fallacy of the proposed principle and to call attention to aspects of this work that seriously deviate from established principles and usage of mathematics. These deviations offer a partial explanation for failure of the proposed method. For convenience, whenever equations are reproduced here they are numbered as the original work followed with the suffix L.

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[1]I. V. Lindell, *IEEE Trans. Microwave Theory Tech.*, vol. MTT 30, no 8, Aug. 1982.

PROOF OF FALLACY

According to Lindell, the nonstandard eigenvalue problem is formulated as

$$L(\lambda)f(r)=0, \qquad r\in S \tag{1L}$$

$$B(\lambda)f(r)=0, \qquad r\in C \tag{2L}$$

where f is a vector field defined at points of a two-dimensional plane S bounded by a closed curve C, a subset of S. The operator $L(\lambda)$ is linear and depends on a parameter λ, interpreted as the eigenvalue, and $B(\lambda)$ is another linear operator which primarily states the boundary constraint on f at points on C. To arrive at the variational principle, the rather unorthodox notion of boundary inner products is introduced resulting in the so-called generalized Green Theorem stated in (3L). It is then asserted that the linear functional

$$F(\lambda;f)=(f,L(\lambda)f)+(Cf,B(\lambda)f)_b \tag{5L}$$

is a variational principle in that when $F(\lambda;\ f)=0$, then the variation δF vanishes whenever the variation $\delta\lambda$ vanishes, provided that f is a solution of the system (1L) and (2L). Here the subscript b denotes integration over the boundary.

To prove the fallacy of this assertion, let us for the moment accept the notion of inner product on the boundary, the generalized Green Theorem (3L), and the ill-defined meaning of adjoint operator. Then, by pure formalities, there results

$$\delta F(\lambda;f)=2[(\delta f,Lf)+(C\delta f,Bf)_b] + \delta\lambda\left[(f,L'f)+(Cf,B'f)_b\right] \tag{6L}$$

where L' and B' are operators denoting derivatives of L and B with respect to λ. Here, Lindell has overlooked the fact that f may be a function of λ, to say nothing for the moment of the alarming presence of variations δf on the boundary! Nevertheless, he maintains that δF vanishes if $\delta\lambda$ vanishes "unless by chance the (second) bracketted term is zero. Hence, if we solve for λ the equation $F(\lambda;f)=0$ the arising functional $\lambda=J(f)$ is stationary when f is a solution of (1L) and (2L) and the stationary value of $J(f)$ is the value of the corresponding parameter, the nonstandard eigenvalue."

Aside from overall improprieties inherent in the formulation as discussed below, the sufficiently decisive question here is whether or not the second bracketted term in (6L) vanishes. Unfortunately, this term which we denote by $A(\lambda)$ does vanish always, as demonstrated next. It is presumed that L' and B' are proper derivatives of operators with respect to λ. Since f is a solution of (1L) and (2L), it also is a function of λ. It follows from (1L) and (2L) that

$$L'(\lambda)f=-L(\lambda)\frac{\partial f}{\partial\lambda} \tag{1}$$

$$B'(\lambda)f=-B(\lambda)\frac{\partial f}{\partial\lambda} \tag{2}$$

where on the righthand side L and B operate on $\partial f/\partial\lambda$. If f is