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This Week's Citation Classic

Marcuse D. Mode conversion caused by surface imperfections of a dielectric slab waveguide. *Bell Syst. Tech. J.* **48**:3187-3215, 1969.
[Bell Telephone Labs., Holmdel, NJ]

This paper contains a mode conversion theory for slab waveguides with core boundary imperfections. Random coupling of guided and radiation modes causes loss, coupling between two guided modes can lead to total power exchange if a sinusoidal core boundary perturbation has the correct spatial period. [The *SCI*® indicates that this paper has been cited over 115 times since 1969.]

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"This paper marks a turning point in my career. After returning in September 1967 from a year's leave of absence at the University of Utah, I had foolishly embarked on the enterprise of trying to make GaAs injection lasers. Having worked as a theoretician throughout most of my career, I felt that I should prove my universality by embarking on an experimental venture. In retrospect it was predictable that I would become unhappy working in the laboratory, trying to make photoresist behave itself and to persuade gold contacts to stick to the surface of GaAs. It thus was in desperation that I grasped at the first theoretical job that offered itself, trying to rescue my sanity. Fortunately, I hit on an excellent subject at just the right time.

"The application of optical fibers to communications had just become feasible with the demonstration by Corning Class Works that low loss fibers could indeed be made.[1] My boss, Henry Marcatili, mentioned to me that the problem of understanding the vulnerability of fibers to geometrical imperfections was urgent. I immediately grasped at this hint, left the unhappy lasers waiting in the laboratory and sat down to tackel the problem of fiber losses caused by roughness of their core surface. To get quick results I chose not to work with the more complicated cylindrical geometry of actual fibers but rather with the much simpler problem of planar slab waveguides. The only novelty of this analysis was the use of the modes of the continuous radiation spectrum: otherwise I relied on the standard coupled mode theory.

"Soon after I had written my paper I discovered that I had competition. V. V. Shevchenko in Russia had used the same mathematical methods without, however, applying them to the same problem.[2] Another serious competitor was A. W. Snyder who contacted me soon after he discovered that we were working along very similar lines.[3]

"The success of my paper did the trick. I never returned to the lab to try to make lasers, but reestablished my reputation as a pure theoretician. My paper was successful because it came at the right time. It solved a problem whose answer was needed by the optical fiber community."

1. **Kapron F P, Keck D B & Maurer R D.** Radiation losses in glass optical-waveguides. *Appl. Phys. Lett.* **17**:423-5, 1970.
2. **Shevchenko V V.** *Continuous transitions to open wave guides.* Boulder, CO: Golem Press, 1971. 170p.
3. **Snyder A W.** Asymptotic expressions for Eigenfunctions and Eigenvalues of a dielectric or optical-waveguide. *IEEE Micr. TMT* **17**:1130-8, 1969.