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This Week's Citation Classic

Quate C F, Wilkinson C D W & Winslow D K. Interaction of light and microwave sound. *Proc. IEEE* **53**:1604-23, 1965.
[Stanford University, Stanford, CA]

The coupling between coherent sound and optical waves—Brillouin scattering—was calculated in terms of the classical parametric equations for traveling wave systems. A discussion of the activity over the entire field is included together with experiment results which confirm the model of a two-wave system coupled through the photoelastic and electrostrictive constants. [The *SCI*® indicates that this paper has been cited over 135 times since 1965.]

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"In the early 1960s I returned to the University from a position in the Research Laboratories of Bell and Sandia. I was part of the faculty expansion of that period (expansion that saturated the ranks and made it more difficult for young people who aspire for those positions). I wanted an area for my research that related to my background in microwave electronics —an area that would endure over the extended period of time required for training of graduate students —an area that was not pre-empted by the faculty that were here before me. Coherent light was a field with great potential. It was clear to many people that some method would be found to use coherent light in communication systems. We knew from this that it was important to seek methods for modulating and deflecting optical beams. We chose acoustic waves as our preferred method simply because I had learned something about this form of radiation from Klaus Dransfeld some years earlier. I was present when Klaus wanted 'a cavity for the purpose of generating sound waves in quartz crystals at microwave frequencies.' At the time I was both startled and skeptical as it was an entirely new thought for me. Dransfeld was undeterred and he went on to write a paper with Hans Bommel which proved to be a cornerstone. Most of the work on high frequency acoustics has been influenced by this initial paper.[1]

"The surprising element —the one thing that we were not able to predict—in our choice of acoustic waves as a method for controlling light was the survival of this technique in face of competing technologies. Both electric and magnetic fields can be used to modulate optical beams. They represent tools for a wide audience as compared to the few who were fascinated with acoustic wave technology.

"Our work on the optical interactions with acoustic waves was noted outside of the United States. I was invited to visit Russia in 1966 to attend the May meeting of the Popov Society. In Moscow, I met I.L. Fabelinskii and walked through his laboratory in the Lebedev Institute.

"Fabelinskii —a renown authority on the scattering of light from sound —is a gentle man —an impressive scholar in the classic sense. The visit which lasted for no more than two hours made a strong impression. It was obvious that other people working in his laboratory liked him.

"During our conversations he reminded me of the origins of light scattering. In our paper we had cited Brillouin as the man who started it all with a publication in 1922[2] and we now refer to the phenomena as 'Brillouin Scattering.' In Russia Mendel'shtam independently discovered the same effect in 1918 but his publication was delayed until 1926. Together we talked about this man who could maintain his productivity in the midst of a political revolution and generate ideas that were good enough to provide work for us some 50 years later.

"Coherent optical beams are often modulated with beams of sound. The model in this paper provides a useful method for predicting the behavior of devices based on this effect. This may account for the paper's frequent citation."

1. **Bommel H & Dransfeld K.** Excitation of very-high frequency sound in quartz.. *Phys. Rev Lett.* **1**:234-6, 1958.
2. **Brillouin L.** Diffusion de la lumiere et des rayons X par un corps transparent homogene. *Ann. Phys.* (France) **17**:88-122. 1922.
3. **Mandel'shlam L I.** *Collected works.* Moscow. USSR: Izd. Akad. Nauk SSSR, 19V. Vol. I.