

OPINION

After-Dinner Physics

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The late Rolf Landauer of IBM called it the signal-to-noise problem. Your signals are the papers you write and the papers that cite them. The noise is all the other papers. To increase your signal, you can try to publish more papers. When most scientists attempt this, they create the situation that we have today: There is such a flood of journals and papers that everyone is at a loss to keep up, and refereeing chores grow proportionally. A typical response to this situation is to read less and publish more—making the situation worse. During my 18 years at the Office of Naval Research, I have never made a funding decision based on how many papers a person has published. A few good papers are more valuable than a stack of mediocre ones.

How do you keep up with the world of physics, and how do others find your papers amidst the accelerated pace of publishing? To amplify their signal by making others aware of their work, many physicists choose the route of traveling to conferences, workshops, and other meetings to present lectures. But most meetings these days follow through with a conference proceedings, further contributing to the signal-to-noise problem. The Gordon conferences are a notable exception.

Having helped start the journal *Fractals* nine years ago, and having edited innumerable proceedings, I'm as guilty as anyone of contributing to the signal-to-noise problem. Perhaps one day we'll direct readers to our Web pages where we will update our papers instead of publishing many different versions in various proceedings and journals.

The lecture circuit solution to the signal-to-noise problem has an inherent uncertainty principle. While travel has its delights (at least in hindsight), it comes at a cost of time and effort. As an example, on a trip to Szeged, in southern Hungary, for Laszlo Kish's "Unsolved Problems of Noise" conference, my flight from Washington, DC, was delayed, causing me to miss my

connection in Frankfurt. When I finally found a later connection through Frankfurt to Budapest, the plane arrived much later at night than I wanted. Now, I needed to find the correct train station for the trip to Szeged. From a choice of three stations I arrived at one on the outskirts of Budapest, but no trains to Szeged were listed on the board. A kindly station worker, who spoke no English, took me down a set of stairs to a different set of train tracks, and the board included a last train to Szeged. He then motioned that I first needed to purchase a ticket and took me to the end of a long line. I'm sure he held the train for me, because it started moving as soon as I got one foot on it. I arrived in Szeged around one in the morning at a peaceful station in the process of closing for the night. There were no taxis in sight. Again, a kindly soul arranged for a taxi to my hotel.

If I had missed the last train, or if another of my serial connections to Szeged had been broken, I would have been stranded. Fortunately, instead, as I entered the hotel, now very late at night, I saw six guys at the bar. To my surprise, I knew each one of them. The beer that night tasted good and the meeting was worth the trip. Just for the record, there was a proceedings.

Paradoxically, in this day of instant communications, physicists find themselves spending more and more of their time traveling. Many trips are a good bit more complicated logistically than the one I just described. Physicists, carrying their laptop computers and cell phones, spend endless hours in taxis, at airports, in the air, on trains, and on other types of transit. This seems almost medieval in today's wireless world, but it does help one's signal. I've known cases of scientists whose work is discussed at meetings they attend, but who do not get a single mention at meetings that they miss.

In addition to exploring the world and its cultures, travel lets you hear lectures in real time and have the opportunity to present your own work to your colleagues. With each meeting, you can feel your signal-to-noise ratio being increased. An added benefit is the treasured time that occurs around the

dinner table. It is the dinner and after-dinner physics discussions that stick in one's mind. Friends and colleagues aggregate into gangs of varying sizes and share conversations over tasty meals. One time in Varenna, Italy, Pierre-Gilles de Gennes asked if he could join our "gang of loiterers." Over dinner the conversation inevitably turns to physics: Who gave a good talk and why and who did not and why. What is really new or exciting in physics and what is awful.

The after-dinner discussions are the times when you can ask the questions that you were too embarrassed to ask during the lectures. You can tell your tablemates that you did not understand anything in a particular lecture and this will unleash a torrent of explanations and vigorous hand-waving. Debate mixes with gossip about physics and physicists. After-dinner physics discussions are more like reading referee reports than reading the original paper. Insight is applauded over formalism. The history of a problem is debated and Pauli admonishments, such as "so young and already so unknown," are repeated. Occasionally, stray remarks lead to collaborations and new work. People bond and networks of friends form.

Some people carry over their views of physics to the personal judgment of physicists. It is much better to make friends and enjoy the discussion of physics than to make bitter enemies. I've seen both cases happen at meetings. These days I spend most of my time with the chaos community, where the high number of interdisciplinary collaborations attests to the spirit of friendship and cooperation. I suspect the absence of a prize in nonlinear dynamics has kept this field friendly and nonpolitical.

From my travels I've nearly forgotten the food poisoning and the near drowning. It is the excitement of learning new physics and the camaraderie that I remember. In the signal-to-noise equation, after-dinner physics discussions weigh heavily on the side of choosing travel for amplifying of one's signal, sense of well-being, and enjoyment of physics. ■

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