

ADVICE TO BEGINNING PHYSICS SPEAKERS

Public speaking is a necessity of professional life. But what do you do if, like many physicists, you're basically a shy person? Here is some advice on how to give talks that won't wreck your career or humiliate your thesis adviser.

James C. Garland

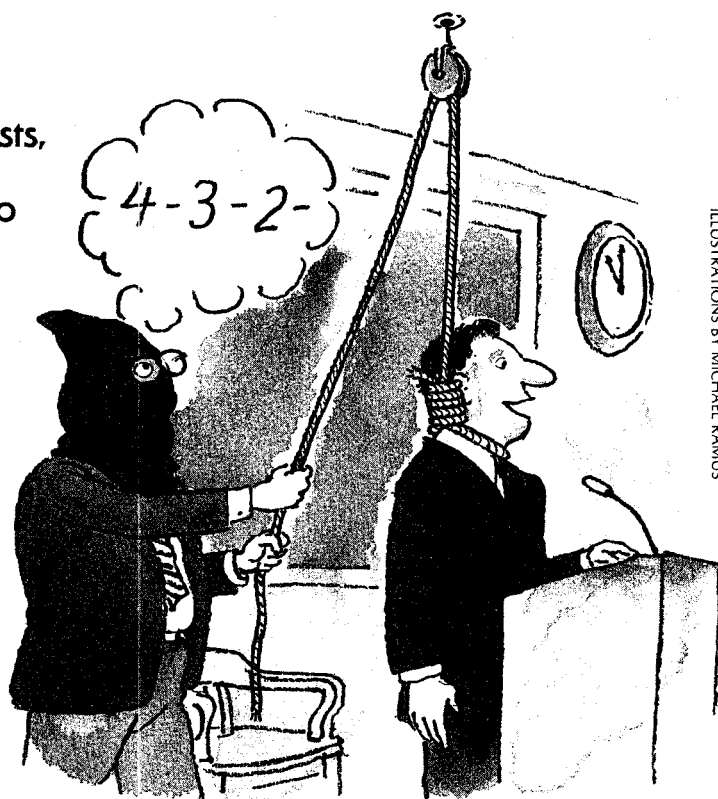
If you're a physics graduate student, it's highly likely that before you receive your degree, you'll be asked to give a talk on your research—possibly at an APS meeting, or maybe just to fellow students. And once you finally graduate, you'll undoubtedly find yourself standing behind a podium. Whatever the situation, it's going to matter that your presentation be well received and that your audience depart with a favorable impression.

Remember: *Whenever you make an oral presentation, you are also presenting yourself.* If you ramble incoherently, avoid eye contact, flash illegible transparencies on a screen, and seem nervous and confused, then your colleagues are not only going to be irritated at having their time wasted, they're also going to question your ability to do your job. However, if you present your ideas clearly and persuasively, with self-assurance and skill, you will come across as a reasonable, orderly person who has respect for the audience and a clear, insightful mind. With this thought in mind, here are a few guidelines to point you in the right direction.

Gauge your audience

The classic dilemma facing scientific speakers is deciding at what level to pitch a presentation when the audience consists of both novices and experts. The most common error is to play only to the experts, the rationale being that the experts' opinions matter the most and that everyone else in the audience will at least leave thinking you're a clever person. Wrong. If you make your talk so technical that only a few can understand it, your audience will resent you not only for wasting their time but also for

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ILLUSTRATIONS BY MICHAEL RAMIUS

It's a capital crime to exceed your allotted time

violating the implicit contract that a speaker has with the audience to always be clear and understandable.

Experienced speakers generally devote the first half or two-thirds of a presentation to a careful introduction of the topic and save the highly technical material for the last few minutes. In this way, the beginners can understand a significant part of the presentation, and the experts will learn some of the fine points. Most importantly, everyone will end up respecting the speaker as an authority on the subject who is also attuned to the audience and respectful of the varied needs of those in it. I am also appreciative of speakers who summarize at the very end the key points they'd like me to remember. That way, if I've dozed through part of the talk or just failed to understand it, I at least walk out of the room with the major ideas reverberating in my head.

Fit your talk to the allotted time

Many consider it almost a capital crime for a speaker to exceed her allotted time. It is not unusual for a session

chairperson at a conference to be quite abrupt with a speaker who rambles on after the timer has sounded. Even in less formal settings, a speaker who ignores the prescribed time limit will quickly alienate nearly everyone in the audience. *Never, ever, speak past your allotted time.* To do so is extremely egotistical, and even if your audience is courteous enough to let you continue, they will not forgive your rudeness.

But in, say, 10 minutes, how can you possibly convey the significance of the work that you sweated over for the past two years? Rest assured that all speakers wrestle with this problem. The key principle is that virtually any topic can be presented in any amount of time. One could compress the history of the world into 30 seconds if necessary, or stretch out a treatise on the eating habits of the flea to a yearlong series of weekly lectures. (Admittedly, it's hard to imagine either commanding a very large audience.)

Speakers often erroneously assume that very short time limits mean they must emphasize generalities and gloss over specifics. However, you'll almost always give a more lively and interesting talk if you narrow rather than widen the scope of your remarks. Thus if you're giving a lecture to the local astronomy club, it's better to spend your 30 minutes speaking on "The Rings of Saturn" than on "The Planets of the Solar System."

For very short talks, your greatest challenge will be to weed out relentlessly any extraneous subject matter. Any tables or figures or equations that don't contribute specifically to the one or two points you're making must go, no matter how interesting they may be in their own right. Sometimes it seems as if speakers fear their main agenda isn't very interesting, so they desperately try to prop up their talks with diverting little sidelights. Unfortunately, the effect is to distract the audience and make the talk disorganized.

But what should you do if you've got 30 minutes worth of information to convey and you're only allowed 20 minutes on the program? Redesigning the scope of your presentation is the only acceptable solution. What you must *never* do is attempt to squeeze your talk into the permitted time slot by speaking rapidly, flashing through your slides and frantically scribbling on the blackboard. A few years ago I attended a department colloquium during which the speaker, a candidate for a faculty position, zipped through more than 60 transparencies. I can't remember now what his talk was even about, but I can easily recall how irritated I felt and how I never wanted to see him again. And I never have.

Use mathematics and equations sparingly

It is not difficult to integrate equations into your talk if you keep in mind a few simple precautions. First, make absolutely certain that the equations are necessary, and if they're not, toss them out. Equations make a talk harder to understand, they slow the pace, and they are prone to creating confusion. If overdone, they also cause resentment; one literally will hear groans from an audience when a speaker flashes an equation-filled transparency on

the screen. Audiences are especially scornful of speakers who load their presentations with equations because of a misguided belief that the mathematics alone will imbue their work with a more scientific or rigorous flavor.

Second, remember that the goal of your talk is not to impress your audience with your proficiency in doing algebra. There is seldom any need to drag your audience step by step through a derivation or the solution to an equation. Audiences will happily assume that you can solve equations, so forget the algebra and focus instead on the assumptions that led to the equation, the technique that you used to solve it and a careful explanation of the relevance of the solution to your topic.

And finally, keep in mind that audiences need a bit of extra time to assimilate mathematics, so try to make their job as easy for them as possible. It's particularly important to define any unfamiliar symbols and to avoid cumbersome notation. If you're only going to use the scalar form of an equation, then write it out using that notation and leave the generalized tensor version for the textbooks. And don't just plunk down the equation and then stand there like a tombstone for 60 seconds while your audience studies it. You should always talk through any equation you show your audience. For example, as you're writing out $E = mc^2$ on the blackboard, you should say something like, "And so now we see that the energy E is equal to the mass of the object multiplied by the square of the speed of light."

Be sensible about transparencies

The overhead projector has in the past decade become the visual aid of choice for physicists. Experienced speakers often have strong opinions about the optimal number of transparencies for a talk—typically 3 to 6 for a 10-minute presentation, 10 to 15 for a half-hour talk. Although you needn't adhere to hard and fast rules, as a practical matter you should allow several minutes for an audience to absorb each transparency. You'll thus want to avoid transparencies that have only one or two lines of information, just as you'll want to avoid those so jam-packed that they overwhelm your audience.

You needn't write out full sentences on your transparencies (although you should certainly *speak* in full sentences). In other words, if you're planning to say, "Our measurements showed that the period of the pendulum was independent of the mass of the pendulum bob," then your transparency should read, "Period was independent of mass." Eut don't get carried away. It has lately become fashionable to use "bullets" in presentations, and one often sees transparencies that are meaningless lists of words, abbreviations and sentence fragments. The general rule is that the transparency text should be concise enough to be self-explanatory, but no more than that.

Learn where the light switch, focus control and pointer are located *before* your talk. Also give some thought to where you'll stand, because you'll often be blocking the view of part of the audience if you stand beside the projector; if that's the case, stand next to the screen and use a pointer. Make sure you've got a table to set your

transparencies and notes on, because you won't present a very dignified image if you're down on your hands and knees shuffling through your papers in the dark.

Practice your talk

Unless you're an unusually gifted speaker, you'll need to rehearse your talk in front of your classmates, colleagues, spouse or friends. It is not enough to think through your remarks, because you won't be able to duplicate the stress you'll feel in front of a real audience. And unless you actually speak aloud, you won't discover the difficult transitions, the hard-to-verbalize ideas or the convoluted lines of reasoning that may trip you up later on. With a bit of practice you'll usually find that your delivery smooths out and that you'll be able to expand your talk more than initially seemed possible. However, you must resist the temptation to speak too quickly just because your words have become familiar to you.

I recommend that you avoid writing out your talk and then reading or reciting it. Although speakers in non-scientific fields often read prepared papers, it is considered



*Practice your speech in front
of spouse, friends —*

bad form in scientific and technical circles, where a more extemporaneous presentation is preferred. If you're using transparencies, they can probably serve as your notes; otherwise just jot down the outline, key ideas and transitions on note cards or a tablet.

While you practice, try to be attuned to any nervous mannerisms. Avoid wringing your hands, pacing back and forth, fidgeting with your microphone strap or jangling the keys in your pocket. We've all attended talks where the speaker was so skittish that we felt like jumping up and clamping our arms around him to calm him down. If you're really panicked, try taking a few deep breaths, gripping the sides of the podium with both hands and distributing your weight equally on both feet.

Dress appropriately

What you choose to wear for your talk is, of course, a delicate subject, and I don't want to sound like your mother. Nevertheless, other people *do* form an impression of you based in part on your appearance, and so my advice is at least to consider what statement your clothing is making. At the very minimum, you should avoid looking like you just dragged yourself out of bed or staggered out of the hotel bar (even if true). To play it safe, you'll want to dress neatly and appropriately.

For men, this means that you shouldn't wear cutoffs and running shoes if most of your male colleagues are wearing sports coats and ties. And don't overdo it either; if you dress like a Wall Street banker, you'll look amateurish and unsophisticated. (Incidentally, it is highly recommended that you check your fly *before* you walk on stage, not when you're standing up there in front of 300 people.)

For women, the same general rule applies: Don't look like a slot, but don't dress to the nines, either. Most career counselors suggest not overdoing the jewelry, staying away from frilly blouses and dresses, and avoiding tight or otherwise revealing clothing and very high heels. Your best bet is a tailored, comfortable dress, skirt and blouse, or suit. Power suits are a bit obvious however; you may as well wear a sign around your neck saying "I've read *Dress for Success*."

Interact with your audience

When you finally present your talk, be sure not to ignore the people watching you. Don't stare like a zombie into the space above their heads, and don't focus intently on your transparencies or the floor or your shoes or a spot on the wall. Experienced speakers pick out several friendly faces and establish eye contact with them, turning first from one person to another and making sure that no section of the room is ignored. If you try this, you'll find that the targets of your attention will smile and nod pleasantly, affirming the points you've made and increasing your self-assurance. You'll also have a better sense of whether to speed up or slow down, or to repeat yourself.

And don't forget to speak up. Inexperienced speakers frequently use too soft a voice, as if subconsciously hoping nobody will hear them. If this happens, members of the audience will usually shout out, "Louder!" but you may as

well save yourself this small embarrassment. No matter how well you have prepared your remarks, your talk will be a disaster if your audience can't hear you.

At the end of your talk, you'll generally be asked to respond to questions from the floor. Inexperienced speakers often dread this moment, because it seems they run the risk of being humiliated or exposed as an ignoramus or having their entire presentation invalidated by a questioner's allusion to an unfamiliar paper. Nearly everyone feels this anxiety, which is why horror stories abound of, for instance, the mean-spirited Nobel laureate who delights in embarrassing junior colleagues with withering, *ad hominem* comments at major conferences.

Actually, it's not difficult to escape from the question session with your dignity intact, provided you never fail to be solicitous and respectful of your questioner and you avoid getting into public arguments. The general idea is that you—and not your questioner—are in the dominant position in the room. From the perspective of the audience, the scales are tipped so strongly in your favor that if you display even a hint of argumentative or condescending behavior, you'll be viewed as a bully and lose the sympathy of everyone in the room. (You'll also run the risk of provoking friends of the questioner to spring to the rescue and really nail you.) With that general precaution in mind, here are a few specific guidelines to ensure your survival:

▷ Let your questioner finish the question. Some speakers get so excited and nervous that they interrupt the questioner in mid-sentence to blurt out an answer to the question they *think* is being asked. This habit is very irritating to the audience, who may not be as adept at reading minds as you. It's far better to bite your tongue and let the questioner drone on; you can use the free time to collect your thoughts.

▷ Be prepared to rephrase the question. If the room is large or the questioner has a weak voice, you should always repeat the question for the benefit of the audience. It also is important to rephrase the question succinctly if, as frequently happens, the questioner is confused or disorganized. Your goal should be to make the questioner seem as intelligent and perceptive as possible, even if the person is a complete dunderhead.

▷ Keep your answers short. Stick to the point and don't use the answer as an opportunity to digress to a related subject. Usually a protracted answer sends the message that you aren't really sure of yourself and so are trying to cover all the bases. A wordy response makes a bad impression on the audience, especially if it's near the end of the session and they're anxious to meet their friends at



*Control
your feelings: never
argue with an aggressive questioner*

the lobby bar.

▷ Confess your ignorance. If you should be thrown a curveball, don't respond defensively or with irritation. It's far better to say, "I'm sorry, I'm not familiar with that paper" or "I haven't considered that point yet." Of course, if you find that you've never read *any* of the papers or considered *any* of the points raised by your questioners, then perhaps you should consider another profession.

▷ Deflect hostile questions. One day you may encounter an angry or aggressive questioner. Although the experience is distressing, there's really no need to panic. Remember that nobody likes a public display of belligerence, so the audience will instinctively take your side. No matter how angry you feel, you must resist the temptation to fight back with a snappy retort or put-down. And *never* argue with your questioner. Instead, simply say something like "I'm sorry, but it appears we have a difference of opinion. This probably isn't the proper forum for a debate, but I'll be happy to discuss the matter with you in private." There will be plenty of time later for you to get even with the creep.

Now a final bit of advice. Everyone knows that a good joke or two can liven up a presentation. However, unless you're a naturally funny person, I'd recommend laying off the canned humor. The little anecdote that sent your good-time buddies into convulsions the night before over a pitcher of beer may have quite a different effect on the stone-faced strangers watching you in the cold light of morning. That's one lesson you don't want to learn firsthand. Trust me. ■

WHAT'S WRONG WITH THOSE TALKS?

N. David Mermin

My friend Professor Mozart recently ran across some advice to young physicists on how to give talks (James C. Garland's article in *PHYSICS TODAY*, July 1991, page 42). He came to me seething with indignation. "What's the problem, W. A.?" I asked. "I thought Jim Garland spelled out concisely and effectively just about everything the novice ought to take into consideration."

"As you say," he snarled, "it was a precise recipe for how to produce a contemporary physics talk—an almost perfect codification of all the ingredients."

"Well what more could you ask?"

He gave me a look of withering scorn. "The contemporary physics talk is a disaster," he proclaimed. "The only pleasure it affords is the relief that washes over you as you realize, finally, that perhaps the end is in sight. To assemble a respectable audience you have to bribe people with cookies and muffins. You must offer gallons of coffee to those honorable enough not to take the food and run, to help them maintain consciousness during the next hour. The article in *PHYSICS TODAY* did a masterful job of passing on to future generations everything necessary to maintain this dreary art form."

"You're unfair," I reprimanded him. "There are too many things about lecturing that you, an experienced speaker, simply take for granted. If you think the article gave young physicists bad advice, have you anything better to offer?"

"They were not given bad advice. They were given excellent advice for making the best of an inherently hopeless situation. But pretending that the standard physics talk of today is an acceptable form of commu-

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nication breeds hypocrisy in the old and experienced and nurtures self-doubt in the young and innocent, who not only have to undergo the wretched experience of attending physics talks but also torture themselves worrying why they're not enjoying the ordeal. I would have urged speakers to get to the root of the problem."

"And just what might that be?"

Without another word he thrust into my hands a battered handwritten manuscript covered with coffee stains and smeared with muffin crumbs, evidently labored over during many hours of intolerably dull seminars and colloquia. Then he walked off in a huff.

Though appalled by some of the opinions expressed in the document he handed me, I reproduce it below in its entirety as a counterbalance to the conventional wisdom.

Advice to Beginning Physics Speakers (and Intermediate or Advanced Ones)

William A. Mozart

Bill Mozart is Rachmaninoff Professor of Physical Science somewhere in the depths of central New York. He has been forced to embed these precepts in another's article, because PHYSICS TODAY discriminates against imaginary people.

If you have taught physics you know it is virtually impossible to write too easy an exam. Yet nobody acknowledges that the same is even more true of the physics talk. It is absolutely impossible to give too elementary a physics talk. Every talk I have ever attended in four decades of lecture-going has been too hard. There is therefore no point in advising you to make your talk clear and comprehensible. You should merely strive to place as far as possible from the beginning the grim moment when more than 90% of your audience is able to make sense of less than 10% of anything you say.

It is in the nature of physics talks that they should be boring and confusing. You, the speaker, struggled through ten years of college and graduate school to reach the point where you could do research in your chosen area, acquiring arcane skills available to only a narrow range of practitioners. To attempt in the space of an hour to provide your audience with even the minimal background necessary to savor your recent research achievements is a doomed undertaking.

Yet we do give talks. Why? Only when this is understood can there be hope of producing an acceptable lecture.

The best reason to lecture on your work is that it affords you the opportunity to rediscover why you did it. The most important question to ask yourself in preparing your talk is why on earth any physicist might be interested. This is dangerous. There is always the risk you will find no answer. But that is not necessarily a cause for alarm. Often when working on a problem for a long time, one does indeed forget what first led one into that line of endeavor, so if at first you can find no answer, think some more. What is there in the subject to capture the imagination of one lacking your highly specialized skills?

Give yourself a week. If you still can find no reason why anyone not directly involved in the work should find it anything but tediously obscure, then you should find something else to talk about. Indeed you might then seriously consider finding another area of research. Often merely preparing to give a talk can yield up such beneficial insights without your ever actually having to deliver the talk.

But suppose you do remember why you got into your current line of research. If you succeed in conveying that early freshness and excitement to somebody else, your talk will be an unqualified success, even if you never manage to describe a single one of the splendid things you uncovered when

the project was well under way. Those interested in such technical matters will ask you questions in private. For no matter how detailed you might be tempted to make your talk, it cannot possibly be detailed enough for those few who are knowledgeable enough to appreciate such refinements. And no matter how basic and elementary you make your treatment of those fascinating technical accomplishments, virtually none of them will penetrate the minds of the overwhelming majority of your audience. Your only goal must be to furnish ordinary physicists with some modest glimpse of what sustains your own interest in your subject.

What brings even well-intentioned efforts to grief is the misconception that it is necessary for speakers to talk about their own contributions. There is no need to say anything whatever about what you did yourself. Your personal work in the field qualifies you to give a talk only because it may have led you to discover how to break through the formidable barriers preventing the subject from engaging the interest of outsiders. If you can manage to do this *and* encompass a contribution or two of your own, that is fine. But if your own contributions are unfit for public display in such a forum, that too is fine, provided you do not persist in displaying them anyway. This should be kept in mind even when designing "job talks" or presentations at specialized conference sessions. Sometimes you have no choice but to speak of your own work, but even then it is best to devote the greater part of your talk to giving the clearest possible context for that contribution.

Never, ever, have I heard anybody complain about a talk on the grounds that "I understood everything in it." People feel good after talks they understand. Even those few people who hear nothing they didn't already know can derive substantial enjoyment from hearing their subject presented well. The most important thing your talk can do for such experts is to give them an opportunity to learn how to do better in their own talks.

Other points to keep in mind:

▷ Humanists, who take words more seriously than physicists do, often read their talks from a prepared text. When the talk is delivered with animation and impromptu asides, the results can be spectacular, for the written language is more powerful and concise than informal speech, and a richer and more attractive medium. Most physicists deem it undignified or unsporting to read a prepared text.

Rubbish!

▷ The physics talk has, in any event, evolved toward the reading of a prepared text, but in an entirely unsatisfactory way. Many physicists do read their talks, not from a paper text, but from a sheet of transparent plastic projected on a screen. This combines the worst of both approaches: The spontaneity of improvisation is lost, but the elegance of writing is not achieved, since the verbal contents of the plastic sheet are fragmentary stammerings, not written language. To make things worse, text on plastic sheets can be read by an audience faster than the speaker can anticlimactically deliver it, unless the abominable practice is employed of covering up most of the plastic until the moment of revelation. Sheets of plastic must never be used to convey the purely verbal, which should be either spoken extempore or read aloud from a paper text.

▷ Sheets of plastic are only for illustrative figures, graphs or data, and unavoidable elementary mathematical analysis in the absence of a blackboard. Even when so used they almost always have too much on them. Many in your audience will have an unobstructed view of only the upper half of the screen, and many will be seated quite far from it. You must therefore put very little on each sheet, leave the lower half empty and make everything extremely large and uncluttered. If your analysis or diagram is too intricate to present in this way, it is too intricate to be in a talk at all. Just as one should go through a manuscript many times, ruthlessly cutting the redundant, so too should one keep redesigning a plastic sheet to reduce its contents to the bare minimum. You will be present when the sheet is on display. Most details are

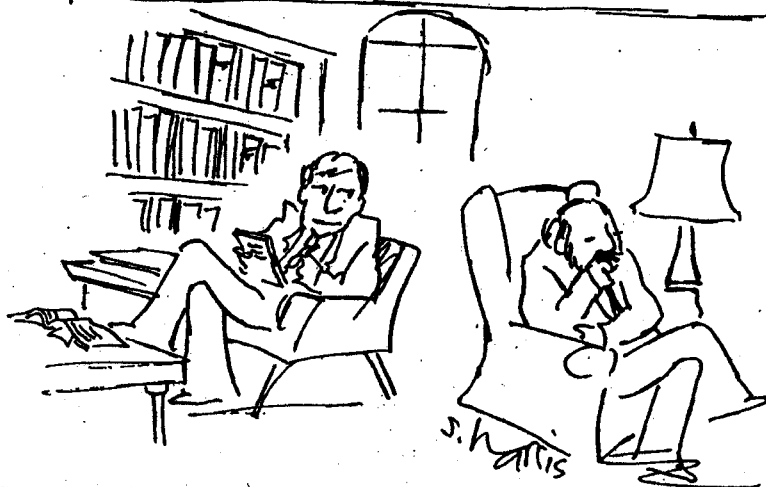
better supplied orally.

▷ We are fortunate to live in an age of informal dress. When giving a talk, wear whatever makes you comfortable, remembering only that a filthy or outlandish costume may be viewed by your audience as a sign of disrespect or incipient lunacy. Do not worry whether all your buttons are buttoned. Once you start down that perilous path you can wonder whether there is ketchup on your nose, a large chalky smudge on your back or a piece of stickum with a coarse message maliciously affixed to an inaccessible part of your person. Assume that if you are in disrepair somebody in your audience will have the kindness to call it discreetly to your attention, permitting you to fix the problem on the spot. If it's not called to your attention, it's not a problem. If it is, simply say, "Ah, mustard on my ear? Sorry about that," wipe it off and continue.

▷ On those few occasions when a physics talk delves into the history, sociology or social psychology of the subject, the audience wakes up and listens. Though most professional journals frown on such digressions, they are entirely appropriate in a lecture. Reading aloud from the reports of hostile referees, for example, almost invariably rouses an audience from its stupor as well as giving you a rare opportunity to make it vividly and painlessly aware of your own contributions.

▷ The ubiquitous heavy-handed concluding summary should be omitted; a talk should tell such a good story that a summary is uncalled for. Imagine *War and Peace* ending with a summary. There is no better way to make an audience happy than briskly finishing a talk five minutes earlier than it expected you to. Like this. ■

THEORETICAL PHYSICIST WITH POWERS OF ESP STEALING A THOUGHT EXPERIMENT FROM A COLLEAGUE



continued from page 15
and the Quest for Nuclear Power, 1939–1949, Cambridge U. P., New York (1989).

4. M. Walker, *Nature* 359, 473 (1992).
5. J. Bernstein, *New York Review of Books*, 13 August 1992, p. 47.

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12/92

Tips for Sympathetic Symposium Speakers

I always enjoy Professor Mozart's off-beat observations and tendentious manifestos, as well as the more cautious suggestions of his medium David Mermin, who is lucky to have such an interesting visitor. (We never see any "Mozarts" out here in the Midwest, though I think Elvis occasionally visits Urbana discount stores.) Regarding the Reference Frame discussion on the physics seminar (November 1992, page 9): I have seen enough worthy talks in my few years to know the situation is far from hopeless, yet I couldn't help but recall some of the worst talks I have ever seen.

▷ A specialist in certain highly technical applications of advanced mathematics to solids began his talk portentously: "I'm sure you've all seen hundreds of talks on this topic, so I won't insult your intelligence with a lengthy introduction." The talk was completely incomprehensible to nonspecialists. Members of the audience demonstrated their intelligence by fleeing in droves.

▷ During one seminar, several faculty members in the audience—mind you, we're talking about real professors here, not just us dumb grad students—found one of the speaker's central assertions dubious. He deigned to spend a moment explaining it but then abruptly cut off the discussion, here reconstructed with modest poetic license.

Speaker, responding to question: This elementary point you raise may or may not be valid, but I don't care; I have made great strides, and they alone justify the rest of my presentation.

Listener: It is infinitely more satisfying to understand 0.01% of a seminar than 0.00%.

Speaker: Let us not tarry; I have prepared a large number of transparencies and it is vitally important for me to display every one of them.

▷ A visiting theorist says, "The experimentally relevant case is for U , but I still think the case for U is interesting." He does not

explain why. Are we supposed to know? Or is it only interesting to other people studying the same limit?

On the basis of these and other observations I offer my own conclusion: The proliferation of poor-to-mediocre physics talks is the ineluctable consequence of our funding priorities. We reward firstly research, which is often extremely technical and which in any event demands the generation of original results, though "original results" sometimes fail every measure of value other than never having been seen before; secondly, we reward teaching, which is important, though at its worst it merely trains students to churn out "original results"; and following in a distant third place—because we scarcely reward it—is scholarship.

I hesitate to define "scholarship," but it most certainly includes the passing down of knowledge in a manner more critical and skeptical than we associate with the word "teaching," and a more serious and less self-serving discussion of the merits of particular avenues of research than practitioners are capable of providing. These characteristics have nasty implications. A "scholar" might tell you that your application of recondite mathematical methods is diverting but does nothing for our understanding of physical law. He might tell you that your experiment does not add to knowledge simply because it gives new data points. "Scholars" probably get punched in the nose more often than the rest of us—but wouldn't that brighten up a 4:00 pm snoozer?

While we utopians await the complete intellectual overhaul of physics, I heartily endorse one of the "Mozart" ideas: A speaker does not have to explain in paralyzing detail his or her own research accomplishments. When preparing a talk, imagine yourself in the audience. Think of things in your field that they're unlikely to know but would find useful and understandable. My first year at Illinois I delivered two utterly dreadful talks to classmates, after which I developed this rule of thumb: If you're afraid of insulting their intelligence, then the only intelligence you're overestimating is your own.

(I'm trying to assert my own marketability here, so maybe Reference Frame-doyen Mermin would be kind enough to name this maxim after me.)

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1/93

David Mermin's timely comments and his friend's advice on the present

state of colloquia can be compared to Planck's advice to Schrödinger.

In June 1926 Schrödinger was invited to visit Berlin to give a lecture, and he wrote to Planck for advice regarding the level of presentation. Planck's response¹ is still useful as a guide:

You also ask about the level at which your lecture should best be given, or rather at which it should begin. I would like to propose, in agreement with my colleagues, that you imagine your audience to be students in the upper classes who, therefore, have already had mechanics and geometrical optics, but who have not yet advanced into the higher realms; to whom, therefore, the Hamilton-Jacobi differential equation, if they are acquainted with it at all, signifies a difficult result of profound research, deserving of reverence, and not by any means something to be taken for granted. Under no circumstances, however, should you be afraid that any one of us will consider one sentence of yours to be superfluous. For even if the sentence should not be necessary for an understanding of your train of thought, it would always offer the particular interest of seeing what special paths your thought takes and which particular forms your perception favors. For all of us the main point of your lecture will be what you yourself in your letter designated as a general survey of the fundamentals for the purpose of orientation without much calculation and without many individual problems.

Planck then goes on to suggest that Schrödinger give a second lecture, at which time he can go into greater detail.

Reference

1. K. Przibram, ed., *Albert Einstein: Letters on Wave Mechanics*, Philosophical Library, New York (1968).

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12/92

Many congratulations to N. David Mermin for his Reference Frame column in the November 1992 issue. As an astronomy graduate student, I can relate very well to many of the points he brought up about the disastrous state of today's physical science colloquia.

Grad students here are "expected" to attend most or all colloquia offered

by the department. I find some astronomy talks fascinating and informative. But many others quickly manage to lose and alienate most graduate students—and, I suspect, many faculty members whose areas of research are something other than the speaker's. The attitude many scientific colloquium speakers seem to have is, "I'm going to impress you with how smart I am and what good research I've done." That attitude is what makes speakers include plastic sheets full of equations comprehensible only upon prolonged reflection and graphs complex enough that it would take most listeners at least several minutes to grasp their intended meaning. And then the faculty wonder why grad students seldom ask questions of colloquium speakers. Perhaps it's because we don't want to appear ignorant of something the speaker assumed was "obvious."

The best talks are almost always those in which the speaker's attitude is, "I'm going to teach you something interesting about astronomy." The talks from which I've learned the most do not necessarily cover subjects of which I have extensive prior knowledge. Instead, they are those in which the speaker takes time to explain the qualitative basis of his or her subject. Talks at professional meetings are a different situation, but when speaking to a department whose members have widely varying interests a speaker should always follow this rule: If someone in the audience is also an expert on the speaker's subject, that person may not learn much from the talk, so the two should set aside time for a face-to-face meeting rather than bore their colleagues with somniferous details.

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David Mermin was right to be irritated and depressed by the style, or lack of it, of speakers who give special talks and colloquia.

I long ago learned of sound advice given by a minister in the Scottish Presbyterian Church who was teaching aspiring young ministers how to give a sermon. It applies to physics as well, and I have endeavored to practice it. The minister said: "First you tell them what you are going to tell them, then you tell them, and then you tell them what you've told them. Then you sit down." I commend this approach to anyone planning to give a talk. It should help to keep the audience awake and, with

any luck, attentive.

I should add advice given to me in 1967 by Felix Bloch. I was chatting to him after he gave us a colloquium talk and said how much I enjoyed it, especially as I was familiar with some of the material. He wagged a finger at me and said, "Never underestimate the pleasure you give an audience by telling them something they already understand."

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Professor Mozart's advice on presenting physics talks contained much that was helpful, but I believe that most experienced speakers would disagree with him on the use of text in overhead transparencies, especially when the speaker's native language is not English. In such a case, written text on the transparency can be essential. Some years ago, I heard a French nuclear spectroscopist from CERN give a talk (in "Franglais") on his group's experiments with irradiating very hot liquid metal targets with high-energy protons. One sentence early in the talk was, "We begin by 'eating the target.'" That got the audience's attention!

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MERMIN REPLIES: Only those speakers Professor Mozart disapproves of need the advice of J. F. Allen's much quoted minister. If you take Mozart's advice instead, what you tell them will be so lucid and gripping that you could even sit down after telling them what you were going to tell them. After you have actually told them, they should all then be perfectly able to tell you what you've told them, making it tedious at best for you to do it yourself. Planck's advice to Schrödinger, on the other hand, is precisely what Bill Mozart had in mind.

I was surprised to learn that many young physicists (like Douglas O'Neal) take it for granted that speakers deliberately give incomprehensible talks in the hope of impressing their audience. That this view should be so widespread is a sad commentary on how we conduct our profession. My theory has always been that such speakers are not doing it on purpose but suffer from the bad examples they have seen themselves as students and from a failure ever to have asked themselves just who it is they are addressing. Many seem to be speaking only to themselves. I find it hard to believe their purpose

is to be unintelligible. If the stragem is indeed to impress with impenetrable erudition, then it has (at least with me) precisely the opposite effect. I pay no further attention to people who give such talks—it is simply not worth the effort.

I agree with everything Jim Carubba says. If he could find a more pithy formulation of his maxim (I can't—maybe a Latin translation would do the trick) I would gladly name it *Lex Carrubbensis*.

Finally, R. A. Esterlund has a valid point. I faxed a query to Professor Mozart, who is currently in the Urals, trying to assemble a team of coal miners to do some cut-rate tunneling in Waxahachie. Here is his reply:

I'm embarrassed to have forgotten that when the lecturer or listener is not a native speaker the redundancy provided by sheets of plastic can be a significant help. But efforts should still be made to reduce the text on the screen to a minimum, rather like subtitles in a foreign film. The deadly effect of the practice on those who can understand you without it should not be overlooked.

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Technology Transfer Touted

James S. Langer makes a valuable contribution concerning our understanding of the relationship between materials research and technology transfer with his article in the October 1992 issue (page 24). The concept of technology transfer is often discussed in the context of international competitiveness in the global marketplace. The United States currently exports 10.5% and imports 10.9% of its gross domestic product. Thus the future of the US economy will be determined far more by what happens in domestic markets than in international competition.¹

The issue of technology transfer should become a common policy thread among the university, governmental and industrial sectors, which form the R&D spectral components of basic research, applied research, development and production. Furthermore, it must be accepted not only at the policy level but at the managerial and technical levels as well. The R&D spectrum, which forms the supply side of technology

Fifteen Ways to Get Your Audience to Leave You

I have found 15 effective ways to transform good science into a poor presentation. Here is the list, which I use for my own benefit and that of my students:

1. Cover too much material.
2. Include too many details.
3. Start with too much small talk.
4. Run over the allotted speaking time.
5. Avoid telling the audience why your research has been done.
6. Overestimate, or at least fail to assess, the audience's level of knowledge.
7. Fail to make contact with the audience.
8. Ignore the inherent difference that exists between oral and written communication.
9. Waste time searching for a specific overhead foil somewhere in your pile.
10. Use unexplained terminology, abbreviations and acronyms.
11. Use unexplained symbols in text or equations.
12. Use unexplained graphics.
13. Present overhead transparencies that are unreadable.
14. Read *in extenso* from projected transparencies.
15. If the moderator has just introduced you to the audience, alienate both parties by opening your presentation with such details as your name, your affiliation and the title of your talk.

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