

continued from page 13

fore ending up as a theoretical physicist working in nuclear physics, solid-state physics, particle physics and basic quantum mechanics. I have had many opportunities to compare my background with those of colleagues and students in Europe and Israel who had learned much more science and mathematics in high school than I had. I generally found that mine was far superior.

In high school I learned how to think, how to study and how to express myself in acceptable English. I learned enough of two foreign languages, Latin and German, to provide a basis for learning two more later on when I needed Hebrew in Israel and French in France. I picked up some typing skill, just for the fun of it, when typing was considered a subject only girls who had no hope of a college education and would need to work as secretaries. I now type and edit directly into a terminal with a speed that surprises today's computer whiz kids, who do not expect such skills from my generation. Above all I learned how to learn new things, to pick up new ideas and new concepts, and to abhor rote learning of facts without understanding something about the reality behind them and the relations between them. I learned that there was always more than one way to solve a given problem and that it was more fun to look for new ways instead of blindly following the standard method in the textbooks.

When I entered Cornell in 1938, the curriculum in electrical engineering included only one semester of electronics. The faculty assured us that although we students were enthusiastic about ham radio, there was no future in electronics. All the jobs were in power engineering, power transmission and so on. Fortunately I had learned from my high school experience not to be constrained by such rules and studied extra physics. Thus I learned Maxwell's equations (then actually opposed by the engineers) by listening to physics courses not in the electrical engineering curriculum.

Physics and technology have changed a great deal since 1938, when the computer terminal did not exist, even in dreams, and the faculty of one of the best American engineering schools believed that there was no future in electronics. Even more dramatic changes can be expected in the next half-century. High school education should be aimed at giving students the broad background and flexibility that they will need to face this changing future and to go beyond the

subject matter that today's best teachers think is important.

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3/90

Is Resonant Tunneling Transistor a Reality?

In their article "Quantum Electron Devices" (February 1990, page 74), Federico Capasso and Supriyo Datta note that "conceptually, the simplest way to build a resonant tunneling transistor is to form a contact with the heavily doped quantum well of a double barrier." The authors state that "this approach is, however, fraught with major technical difficulties, and attempts in this direction have not yet succeeded."

On the contrary, this approach, first proposed by Bruno Ricco and Paul Solomon,¹ has been used to fabricate resonant tunneling transistors.^{2,3} In these devices, the quantum well of an AlGaAs/(In)GaAs resonant tunneling double barrier was doped heavily p-type, and ion implantation was used to make contact to the quantum well.

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3/90

CAPASSO REPLIES: The statement in our article quoted by William R. Frensley, Mark A. Reed and Alan Seabaugh accurately reflects the experimental situation in that neither their reference 2 nor reference 3 describes a working resonant tunneling transistor. The device of reference 2 exhibits negative transconductance ($dI_C/dV_{BE} < 0$, where I_C is the collector current and V_{BE} is the base-emitter voltage), while no peak is observed in I_C as a function of the base current I_B (at constant collector-emitter voltage V_{CE}). Since physically the effect of increasing I_B must be the same as that of increasing V_{BE} (that is, suppression of resonant tunneling and attendant decrease of I_C above a critical V_{BE} and I_B), the claim that the observed negative trans-

conductance is a manifestation of resonant tunneling transistor action is unsubstantiated. In the device of reference 3, on the other hand, no negative transconductance is observed. Finally, both devices have unacceptably large base resistances (≥ 1 k Ω) for III-V bipolars. This has serious consequences for the operation of the device, as shown, for example, by the large collector-to-emitter offset voltage in the collector characteristic.

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6/90

Oratory and the Overhead Projector

The opinion expressed by John Rigden (March, page 73) that the overhead projector has caused us to lose our oratory abilities is off-target. I question first his assumption that physicists and other scientists *used to be* good orators. I also note that the primary purpose of an oration or speech is quite different from that of a talk or lecture accompanied by transparencies. A well-turned speech should inspire an audience to action or to a new frame of mind. Imparting information or understanding is secondary. Oration is of great importance to religion and politics, for example; Winston Churchill and Adolf Hitler come to mind.

A lecture or talk accompanied by transparencies has a different purpose: to convey information, of which a fair fraction should be *understood* and *remembered*. Understanding and knowledge are clearly not an objective of most speeches. (I venture to say that oratory can be a danger to science, as illustrated by the movement of "scientific" topics such as nuclear power, pollution and the greenhouse effect into the realm of political and religious oratory.) Visual aids greatly enhance our ability to remember spoken words. The effective use of an overhead projector can be invaluable in imparting understanding in science.

What Rigden could complain about is the frequent misuse of transparencies. Eighty percent of the transparencies used at scientific conferences are not "well turned," and 80% of the verbiage accompanying the remainder is also not "well turned" and has never been rehearsed. Though the fraction of good talks is small, I wager that things would be worse without overheads. The real problem began when our future scientists decided not to pay attention to high school English and writing classes, and few ever

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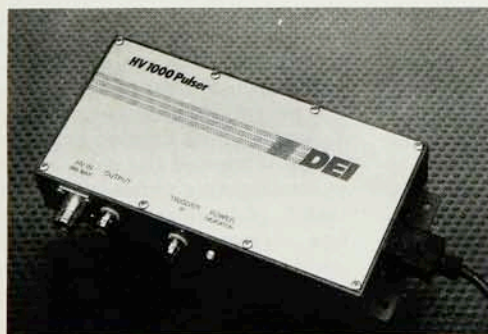
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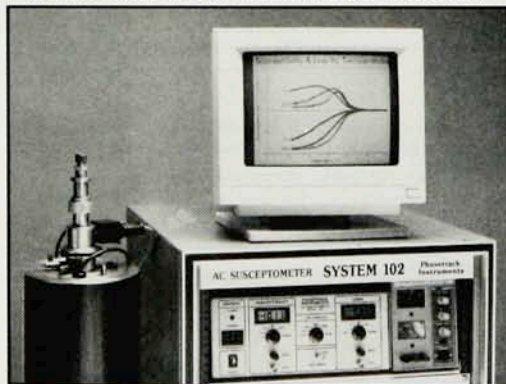
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seriously attempted later to improve their writing and speaking abilities. The situation could be improved somewhat if academics required themselves and their students to read, practice and understand basic speaking principles.

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3/90

John Rigden's remarks on oratory and the overhead projector are mildly amusing and grossly misleading. If I remember correctly the contemporary accounts, Lincoln was quite right that the world would little note his oratorical presentation at Gettysburg; it was far from a showstopper at the original ceremony, and we still recite "these powerfully moving words" (as Rigden calls them) because someone had the foresight to circulate them in printed form. Rigden also fails to note the effect or reception of former APS President Henry Rowland's verbal presentation—the undeniably effective words are presented and extolled in the same medium in which we would read them from a projection screen.

I use viewgraphs, and I read or paraphrase their contents. I do so deliberately on the basis of research (of others) and experimentation (my own), for two main reasons. One is that a variety of disciplines, from information theory to pedagogy, testify to the fact that a certain level of redundancy is critical to communication, and especially to the learning of new facts or concepts. The other is that there is a wide range of preference in human cognition processes; some people are predisposed to use visual pathways for information intake, while others learn best on an aural basis. Parallel presentation reaches both ends of the learning-style spectrum, and provides reinforcement for those in the middle.

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4/90

It is one thing to advocate the intelligent use of the overhead projector in scientific presentations. It is quite another to accuse the device of retarding the "art of oratory," as John Rigden did in his recent Opinion column. Being a good scientific writer is not exactly equivalent to being a good essayist in the literary sense. The most effective scientific prose is straightforward, logical and consistent with the proven laws of physics or a set of data. We physicists must write within narrower confines, with less artistic flare and fewer structural twists, than our English teachers

might have liked. The same goes for scientific speeches, with or without the overhead projector.

Let me assume (wishfully) that Rigden does not object categorically to the use of the overhead projector, but only to those who tend to abuse it. How many of us have really acquired the fatal syndromes of projector retardation as described by Rigden (despite our earthly flaws of this or that sort as speakers)? The answer is most likely "very few." Then let us go a skin deeper, to those fatally projector retarded. Should we attribute their "illness" to a relatively simple machine that they use half a dozen times a year or to more complicated social and cultural dynamics that they experience over a whole lifetime? Why must we throw away the overhead projector and start reading equations that may be three lines long to an audience with only a human memory and attention span? Is it fair to ask the audience to "take my word for it" when we can easily show them our observations on a transparency and thus motivate some probing questions? Shall I suggest, by analogy, that we dump our megadollar computers because some wise people are saying that the microchips are degenerating our mathematical skills and logical abilities?

The flaws of Rigden's argument, as I see it, are twofold. First, it uses some rather extreme cases to imply a mass "addiction" to the overhead projector. To use something useful often should not be equated with addiction. I seldom hear people speaking of airplane addiction or hotel addiction among those who attend scientific conferences. Second, Rigden seems more willing to blame a machine with no active mind of its own for a human shortcoming than to search for that shortcoming's real (human) causes.

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4/90

The Aruri Case in Retrospect

The problem with the Tayseer Aruri case as it has been discussed in the letters section of *PHYSICS TODAY* (May 1989, page 15; August 1989, page 13) is that it is being intimately tied in with the case for a Palestinian state. Mixing human rights and politics is a cardinal sin avoided by all human rights organizations.

The Occupied Territories are not governed by the law of Israel (which applies equally to all citizens, both Arabs and Jews, and protects their

human rights), since they are not annexed by Israel. As required by the Geneva Accords, the military government governs under the law that was in effect before Israel's conquest of the areas—namely, Jordanian law and the British Mandate for civil offenses, and military law for security offenses. The actions of the military government compare favorably with those of other democracies faced with similar threats to their security.

The Israelis have attempted to minimize excesses and injustices in the Occupied Territories by giving detainees the right to a hearing in front of the Israeli Supreme Court. Nowhere else in the Middle East do Arabs accused of security offenses have the right to appeal their cases before an independent judiciary. Because of the danger to sources, Israel does not reveal the sources or the content of the secret information it uses in developing its case against the accused. Already more than 200 Palestinians have been brutally killed and many mutilated by their fellow Arabs for being alleged Israeli sympathizers or collaborators. However, the Supreme Court is able to review the secret information to determine whether it supports the case against the accused. This is not a *pro forma* situation: The court has overturned the decision of the military government on many occasions. It is generally agreed by objective observers that the Israeli Supreme Court compares favorably in integrity and independence with the American judicial system.

After hearing Aruri's lawyers present their case against all of the public accusations and after review of the secret information, the Israeli Supreme Court decided that the evidence supported the case that Aruri was instigating violence in the territories and allowed his deportation [see *PHYSICS TODAY*, October 1989, page 117]. Aruri was deported not for his views but for his actions. Interestingly, he was deported to France, at his own request, instead of Lebanon, because of fear for his life. Aruri himself appreciates that there are radicals among the Palestinians who will be glad to assassinate him for his views. Israel, which has to live with any decision, must take this into account in deciding whose views will prevail in any negotiated agreement.

The situation in the West Bank is not comparable to what has gone on in the Soviet Union. The threat of the dissidents to the physical survival of the Soviet Union is in no manner comparable to that posed to Israel. Israel accords human rights the same