continued from page 15

Development" held in Baddeck, Nova Scotia, addressed many of the problems that Arunachala Viswanathan mentions.

Everyone attending the workshop agreed that all students from foreign countries attending universities in North America should follow exactly the same scientific curriculum as our own students. In this way we help identify and prepare excellent scientists. However, it was felt that some special attention must be given to the students from developing countries to properly advise them regarding choice of courses available and thesis topics. Already a small brochure addressing this subject has been prepared through the American Association for the Advancement of Science and is available to university administrators and foreign student advisors through the Office of International Science of the AAAS.

It is equally important to advise the students from developing countries (as well as our own) about the special problems associated with establishing small machine shops, libraries, the training of technicians, the writing of proposals and reports, communicating with government and so on. One would hope that in some universities, such speicalized training can be organized. But more broadly it was proposed in Baddeck that special summer seminars might be established that would deal with this range of topics, along with discussions of science policy, the management of small research groups and the development of multidisciplinary groups so the students trained here might better practice physics once they return home. Many of the instructors for the summer schools would be brought from the developing countries since they can best relate to problems there. We hope that this program can be tried in the very near future.

After completing their thesis work in North America, so many of the students returning to developing countries find themselves in a situation where they are not part of a community of scientists working on somewhat related topics but rather alone, continuing work that in no way relates to their homeland. For them it becomes virtually impossible for local govenments to support continuing research. In many cases it is difficult for them to change fields or even associate themselves with other physicists, chemists and engineers in potentially exciting and productive multidisciplinary community of scientists working on the fundamental and applied aspects of a program that can be funded by their governments. Recognizing this, it was requested by the physicists attending the workshop that some assistance be made available so that those who choose to change fields might establish themselves in new areas. An effort is now being made to set up special mechanisms to assist in this area.

There is no question in my mind that we can help our friends from abroad. But this will best happen if we take the time to understand their special needs within cultural situations unique to each country or part of a country from which the visiting scientist comes. Personally, I find that any effort spent along this line is most rewarding.

J. WILLIAM MCGOWAN
Chairman
2/81 *APS-POPA Committee on International Scientific Affairs*

February editorial

One might indeed ask who this man of arrogance is that wrote the February editorial? From what collections of facts does he deduce that there is one ambitious tyranny against which we scientists should muster our collective technical ingenuities?

When Pogo said the enemy was us, he wasn't exempting physicists.

Our contributions have been good and bad, as with any group. Some of us may even have different perceptions about where ambitious tyrannies reside. Not all of us may agree that dedication to missile defense or any other military application of the beauty and spontaneous dedication of our science is satisfying, humane, or advances any cause except the continuation of world tensions, economic dislocation, and the continuing impoverishment of people.

How much more in the tradition of concern for humanity would have been a more modest assessment of the role of science—one that shows a modicum of humility and resonates with the need to dedicate oneself, not to military machines, but to a science that liberates the soul in human pursuits of reason, understanding, equality and brotherhood.

HARRY SHAICH
University of Oregon
3/81 *Portland, Oregon*

THE AUTHOR COMMENTS: In answer to Harry Shaich's first question, I am a 73-year-old American physicist of Hungarian origin who has learned:

▶That discussions, even controversies, are enjoyable when conducted in polite and informative language;

▶That science is not only a liberation of the soul but is also an activity as badly needed for the survival of our society as our daily bread;

▶That peace is achieved not by abandoning arms but by persistent efforts to create common goals and common understandings;

▶That an editorial can be better understood if its criticism is read, and that the criticism can be better understood if the editorial is reread;

And, finally, that Pogo, Teller, Shaich, and even individuals with a touch of greatness such as Bohr, Einstein, Heisenberg, Oppenheimer or Sakharov, are partly right and partly wrong.

EDWARD TELLER
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Indirect cost strategy

The discussion on the legitimacy and desirability of indirect costs charged to research grants by academic institutions has been going on in this journal for many months but still seems to suffer from a lack of knowledge about the real cost of operating a university, college or non-profit organization. Unlike the federal government, academic institutions cannot print their own money, which simply means that their revenues must match their expenditures, at least in the long term. Revenues come from tuition (about 20% of the total in public institutions, 40% in private institutions, on the average nationally), state allocations (primarily for public institutions), capital investment (interest, dividends, capital gains, rental; primarily for private institutions), gifts, grants, contracts and sometimes, in addition, revenues from auxiliary enterprises—bookstores, university presses, and so on. The total expenditures of the institution will always include indirect costs such as costs of general administration, physical plant, library, and depreciation of facilities. A prudent administration will try to keep indirect costs ("overhead costs") as low as possible because there is no way to recover all indirect costs, and the difference between total and recoverable indirect costs has to come from unrestricted funds. These unrestricted funds (gifts, capital investment income, and so on) are thus not just the whipping cream on top of the money from external sources; they are absolutely necessary for the survival of any institution. It should also be mentioned that the farming out of work reduces indirect costs generally in those cases only where the work is of a non-recurring and extraordinary nature since contractors have an overhead too and they want to make a profit.

The sad fact of life is that academic

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institutions cannot fully recover all indirect costs associated with federal research grants and contracts. This probably can be seen best in institutions like ours where the main thrust is in research, graduate education is a relatively minor cost factor, and expenses for athletic teams are nil. Here, the simplified method of calculating the indirect cost rate as a percentage of salaries and fringes goes as follows (indirect costs can also be based on the total of direct costs; the indirect cost rates are, of course, different for these two methods):

The total expenditures of the institution are subdivided into the following categories: (1) salaries, wages, fringes, stipends, tuition; (2) equipment and other capital expenditures; (3) charges to restricted funds (grants) for indirect cost reimbursement; (4) depreciation; and (5) other costs like supplies, maintenance, travel, and so on. Subtracted from these expenditures and not considered further in the calculations are the costs of equipment and other capital outlays [that is, all of item 2, depreciation costs of equipment purchased with government funds (part of item 4), and charges for indirect cost reimbursement (item 3)]. The remaining expenditures are then subdivided into direct and indirect costs. *Direct costs* (*A*) of categories 1 and 5 are incurred for three types of expenditures: (a) disbursements from restricted funds such as research grants and contracts, regardless of source (government, private foundations, corporations), (b) disbursements of the institution's own funds for direct programs (including research and teaching), and (c) costs of public relations and fundraising. *Indirect costs* (*B*) of the categories 1, 4 and 5 are incurred for four other types of expenditures: (d) administration, (e) library, (f) physical plant, and (g) depreciation (excluding that for government-provided instruments and facilities). Computer costs may be regarded either as direct or indirect costs. The ratio of $(B)/(A)$ is then the indirect cost rate which in this case is applied as a percentage of salaries, wages, and fringe benefits charged to research grants and contracts.

The share of indirect costs for external research grants and contracts cannot be fully recovered under this government-mandated scheme. First of all, cost sharing is required for federal grants and contracts; that is, the institution must partially fund the project itself through direct and indirect costs. The expenditure allocated to the institute's cost-sharing portion are, however, real expenditures and thus have to be defrayed by unrestricted grants and gifts. Secondly, the purchase costs of buildings, instruments and other capital items do not enter the indirect cost calculations but are recovered through depreciation only. Since annual depreciation is only a percent-

The Twinnes Tale

Two twinnes there were toward
Caunterbury passed
By different roades, oon slowe, oon fast,
But when they meet agin by faytes shore
They fynde that they be twinnes no more.
"Tis strange," sayde they, for knew they
not about,
"Where fynde we oon to solve this riddle
out?"
So abbott, nonne, and monke the twinnes
did aske
Yet none could fynde to ende this weary
taske.
Till oon, a man of Physick found they
there,
"I know the curse that doth these twinnes
ensnare."
So round the banquette table alle did
sitte
With ale and meade and mutton from the
spitte
And after they did many toastes make
The ferste of twinnes was the ferst to
speake:

"Twas thirty days ago oure trippe begun
My brother would by horse and I would
run.
Thus he betook on horse oure equippage
To Caunterbury make oure pilgrimage.
So he and I part forth our separate ways
And I arryve this inne ere thirty days.
For me there was no faery lore to telle
I run by day, I run by nyght as welle
In straight a line as could my feet agrieve
And so in eyne of Gott I here arryve.
'Tis all I know, in trow I fynde it queer
Why I a younger brother fynde me
heere."

The other brother spake another tale
As if his heade spun round from meade
and ale:
"The storie that my brother spake is trow
We parted at the rocke where Thames
flow,
But alle that pass with me may make a-
fear
Il faut my sobre tale ye must give ear.
My horse a bit along the roade didtrotte,
The countryside was grene, the aere was
hot
But sone my horse went wilde to my
dismaye,
Did sproute wings and jump about with
glee.
'This horse is magical!' my vox did crye
The pony leap'd and up we flew in skye
The ground below look'd like a painters
tray
I watch the earthe flye faster on awaye.
Like this a fortnight passèd I alone
Through stars and skye? Until we reach
the moon.
And when we reach the moon my horse
slowe doun
We touch the spher and then we turn
around.
But al the while I could my brother
see. . . ,
His current route take to Caunterbury
And while I did through sunne and
planettes go
Methought I saw his timé-pièce run
slowe.
"My horse goeth fast," methought, my
minde did telle
"And so my timé-pièce goeth fast as
welle!"
I heard my tock come sooner than his
ticke
"When I get home I shalle be olde and
sicke."
Another fortnight passéd we in flyght
And at this inne arryve this very nyght.
But lo! I be not older to the day,
I fynde my brother older than I be."

The pilgrimes at the table gasp'd in fright
To look upon the twinnes a sorrye sighte.
But then the man of Physicke raised his
vox
"This tale of twinnes be not paradox.
Each brother took his path through time
and space
In trow oon brother flye the other race;
The oon who ran stayd in his reference
frame
The oon who flew in his did not remayne,
For when he touch the moon his horse
did slowe,
'Twas then the time on earth did faster
go.
The proove of this is days by eyne of
fayte
For oon took thirty, oon took twenty-and-
eight
Yet bothe arryve here the same day.
And each reade time the way he thinck it
be.
Though time be different for eache
reference frame
The intervalle of bothe will be the same."

The man of Physicke gave eache brother
looke
Upon the runes of Johnes Wheelers
booke.
And after homage to the Chirche of
Rome
The fatefull brothers set thir course for
home.
But this time he who flew before did run
And he who ran before now flyght begun.
This way the younger two days backe did
gayn,
And so the twinnès twinnès be again!

Heere is ended the Twinnes Tale

After Geoffrey Chaucer, Tales of Caunterbury

Russell J. DaSilva
New York, New York

age of the capital outlay, lower indirect cost rates result for start-up periods. Furthermore, the depreciation does not recover the capital outlays during later years since replacement costs are almost always higher than original purchase costs and the government mandates a linear depreciation. If, in addition, the institution treats depreciation as a pure accounting procedure without setting aside the corresponding monies in a special replacement fund, then the institution is in real trouble later on. In our 9-year-old institution, depreciation alone amounts to 38 percent of the allocable indirect costs. Finally, the cost of public relations and fund-raising has to be treated as a direct cost which is thus not recoverable. At my institution, the non-recoverable fraction of the indirect costs is about 10 percent—even if all of our research and teaching programs could be funded solely through direct and indirect costs from external grants and contracts and even if there were no inflation, we would still be 10 percent short of revenues. In addition, we cannot recover the amounts used for cost sharing.

There are various ways an administrator can try to make ends meet under these circumstances and in most case the help of faculty is needed. Best, of course, would be to have an unrestricted (and even better—an unlimited) endowment fund, which is a daydream. Second best would be to get a lot of money through unrestricted gifts or through state allocations. In the absence of such unrestricted funds, the only alternative under current regulations is to charge as much as possible (if it is allowable, reasonable, and allocable) to direct costs instead of indirect costs, whether it be within a given grant or whether personnel can be moved from unrestricted funds to restricted external funds. A better solution to this problem would be a change of federal policy such as the removal of the cost-sharing requirement or the recognition of research as a legitimate and necessary obligation of academic institutions. This would imply a governmental base funding of research which could eliminate the charging of indirect costs altogether. Many European countries have adopted this model and the results are not bad. Until such policy changes are instituted by the federal government, institutions have to insist on a full recovery of indirect costs. However, I must admit that I did not realize all financial implications of academic financing during my professorial days either. As an administrator still engaged in research, I do see both sides of the coin, however.

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Authors' names

The editors of the journals published by the American Institute of Physics urge authors to use the same form for their names on all their papers. The reader who tries to locate a paper usually turns first to an author index. If the same author spells out the first name on some papers, uses initials on others, is inconsistent in adding a Jr, the reader may miss the paper, or the copy editor who prepares an "author collapse" for an index is likely to make a mistake. Authors who submit manuscripts should check with their coauthors to ascertain what form of their names the coauthors prefer.

H. H. BARSCHALL
Chairman, Publication Board
4/81 *American Institute of Physics*

Electric guns

Your December Search and Discovery story on Electromagnetic Guns and Launchers (page 19) failed to mention a device that has launched intact projectiles at more than twice the quoted "world speed record" of 10 km/s. This device, which was first described by D.V. Keller and R.J. Penning Jr[1] and A.H. Guenther and his collaborators twenty years ago, uses electrically-exploded metal foils to accelerate thin plates to hypervelocities. At Livermore we have made extensive use of this device, which we call an "electric gun," in studies of shock initiation of high explosives.[3–5] Recently, we have become interested in the potential of the electric gun for high-pressure equation-of-state studies and have constructed a gun that is powered by a 100 kJ, low-inductance capacitor bank. In its present configuration, this electric gun has accelerated a 6.35-mm-diameter, 0.25-mm-thick Kapton foil to a velocity of 22 km/s. For our initial high-pressure studies we are using composite, plastic/tantalum projectiles in the velocity range 7–13 km/s which will generate pressures from 0.44 to 1.21 TPa in symmetric inpact experiments. The principles and applications of the electric gun are discussed in a recent paper in *Review of Scientific Instruments*.[6]

References

1. D. V. Keller and R. J. Penning Jr in *Exploding Wires*, edited by W. G. Chase and H. K. Moore (Plenum, New York, 1962), Vol. 2, p. 263.
2. A. H. Guenther, D. C. Wunsch and T. D. Soapes in *Exploding Wires*, edited by W. G. Chase and H. K. Moore (Plenum, New York, 1962), Vol. 2, p. 279.
3. R. C. Weingart, R. S. Lee, R. K. Jackson and N. L. Parker in *Proceedings of the Sixth Symposium (International) on Detonation*, Office of Naval Research, ACR-221 (1976), p. 653.
4. R. K. Jackson, *et al.* in *Proceedings of the Sixth Symposium (International) on Detonation*, Office of Naval Research, ACR-221 (1976), p. 755.
5. R. C. Weingart, R. K. Jackson, C. A. Honodel and R. S. Lee, *Propellants and Explosives*, **5**, 158 (1980).
6. H. H. Chau, G. Dittbenner, W. W. Hofer, C. A. Honodel, D. J. Steinberg, J. R. Stroud and R. C. Weingart, *Rev. Sci. Instrum.* **51**, 1656 (1980).

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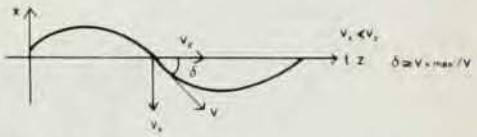
Corrections

May 1981, "Wiggler and undulator magnets" by Herman Winick, George Brown, Klaus Halbach and John Harris appeared with the following misprints:
page 52, caption of figure 3 should read "with polarization parallel (σ)."
page 54, legend of figure 6 for black curves should read "(in operation)" instead of "(under construction)."
page 56, caption of figure 7 should read "Program by Y. Zambre."
page 57, first column "$\langle B\rangle^2$" should read "$\langle B^2\rangle$."
caption of figure 8, should read "(typically 2 microns)."
page 58, third column, fourth line, should read "The undulator radiation retains the intrinsic brightness of synchrotron radiation because . . ."
first figure in box revised as follows:



page 60, first column, starting 14 lines from bottom should read "the transverse beam size (σ_x, σ_y) should satisfy the condition $\sigma/L < \gamma^{-1}N^{-1/2}$, where L is the distance from the undulator to the detector; the electron beam divergence angles (σ_x',σ_y') should satisfy $\sigma' < \gamma^{-1}N^{-1/2}$."
page 62, equation 8 should read

$$B_0 = 2B_r \exp(-\pi g/\lambda_u) \times \frac{\sin\pi/M}{\pi/M}\,[1-\exp(2\pi h/\lambda_u)]$$

middle column, line end of first paragraph should read " . . . from 3–7 keV are shown in figure 9".

May 1981, "Facilities in the United States" by Ednor M. Rowe: table, page 36, "A. I. Bienstock" should read "A. I. Bienenstock"; "Standford, CT" should read "Stanford, CA." □