

letters

collider in 1963. Electron-positron colliders followed at Frascati, Orsay and Novosibirsk." The role of the Princeton-Stanford team in the colliding-beam machine development has indeed been crucial. Nevertheless, it is not fair to say that electron-positron colliders followed at Frascati, Orsay and Novosibirsk. The work done in the latter institutions and the one done at Stanford were simultaneous—in fact, the first beam-beam collisions ever observed were e^+e^- collisions and not e^-e^- collisions, and this observation was done by the French-Italian collaboration working on the ring ADA, which was then operated at Orsay. (*Nuovo Cimento* 34, 1473, 1964).

J. HAISSINSKI

Laboratoire de l'Accelérateur Lineaire

4/85

Orsay, France

THE AUTHOR REPLIES: J. Haissinski is technically correct. Indeed ADA did observe the first e^+e^- collisions, although at extremely low intensity. My error stems from recalling that the Princeton-Stanford e^-e^- machine was started earlier, in 1958, first stored beam and had the full complement of injection, storage and collision devices designed to do physics experiments. I apologize for the error.

LEON M. LEDERMAN

Fermi National Accelerator

8/85

Laboratory

SDI non-nuclear?

In November 1983, PHYSICS TODAY published a letter (page 116) I had written in support of President Reagan's "Directed Energy Weapon" project; it emphasized the following three principles:

- Only scientists are capable of discovering methods to technically nullify nuclear weapons; hence it is their responsibility to search for such a method

- Beam weapons have practically zero inertial time; hence they can, in principle, defend against nuclear weapons, which require a large inertial time to be transported to a target country
- Beam weapons are nonexplosive and are the most benign weapons; they are useful only for defensive purposes.

In the year and a half since this letter was published, there has been a dramatic expansion of effort in the Strategic Defense Initiative. One approach that is being taken in SDI research, and the one that most concerns me, is the development of an x-ray laser driven by nuclear explosives. This approach, although possibly powerful when achieved, not only contradicts President Reagan's repeated claim of "non-nuclear defense," but also could lead to a dangerously unstable situation by making the SDI concept itself ineffec-

tive. Space deployment of nuclear weapons, even for a defensive purpose, would unavoidably lead to space deployment of offensive nuclear weapons, which would nullify the SDI concept. For SDI to succeed, political agreement to keep space free from any nuclear weapon are essential. Scientists should stick to a non-nuclear means of SDI.

A. HASEGAWA

6/84

Summit, New Jersey

Math anxiety and physics

The article "Math anxiety and physics: Some thoughts on learning 'difficult' subjects" (June, page 60), clearly outlines some major reasons why education in the US is at present in such a difficult situation. I found "The Learning Bill of Rights" to be particularly distressing with its implication that the less competent and responsible students have "rights" that can lead to dictation of policies for the nation's educational system.

It is all well and good to offer assistance to those who need help in acquiring an education, and in the US this has been common practice since at least 1630. But it is quite another matter to spoon-feed those who are unable or unwilling to fulfill legitimate requirements for learning at the college level. We make a big mistake in assuming that higher education is suitable for all and that it must be provided, at public expense, for everyone—regardless of their intellectual abilities or their willingness to reject responsibilities for their own actions. We need to recognize that each person educates himself or herself, and that in a very real sense, there are no teachers but only learners. When we reach the point, as we have in the US, where remedial courses in colleges are commonplace necessities because the educational foundations at lower levels have been inadequate and ineffective, and where significant numbers of former college students intentionally default on repayment of public loans to enable them to acquire higher education, then we have lost our sense of perspective.

Our emphasis on personal "rights" has been greatly overdone in recent years. It has passed the point of rationality and has given our vocal and radical elements an unjust hold on society at large. We need to recognize that freedom and license are fundamentally different and that for every right we claim, we must accept a concomitant obligation or responsibility. Yet, in all the civil-rights demonstrations since the 1950s, and in all the feminist agitations since the 1960s, I have yet to hear any exponent of

continued on page 108

THE COMPLETE SUPPLIER OF LABORATORY SUPERCONDUCTING MAGNET SYSTEMS

AMERICAN MAGNETICS, INCORPORATED has been supplying laboratory superconducting magnets for over 14 years. We are continuing to expand our facilities to meet your increasing demand for laboratory superconducting magnet systems. Our full line of instrumentation will support your system requirements.

The most complete line of Helium Level meters, Liquid Nitrogen Level meters, Power Supplies, and Power Supply Programmers, Energy Absorbers, Electronic Magnet Current Reversing, Cryothermometers, and Vapor Cooled Current Leads. All designed with the experimenter in mind.

Your one-stop laboratory superconducting magnet system supplier.

Call or write to



AMERICAN MAGNETICS, INC.

P.O. Box 2509, Oak Ridge, TN 37831-2509 USA.
Telephone (615) 482-1056 TLX 557-592

Circle number 14 on Reader Service Card



MATERIALS RESEARCH SOCIETY

Fall Meeting & Show

Boston Marriot Hotel/Copley Place

Show: December 3-5 Exhibitors (as of 7/15/85)

ACADEMIC PRESS
AG ASSOCIATES
ALCATEL
ATOMIKA
AMPLIFIER RESEARCH
BLAKE INDUSTRIES
CALLERY CHEMICAL
CAMECA INSTRUMENTS
CERAMASEAL
EATON
EDAX INTERNATIONAL
CHARLES EVANS ASSOC.
GATAN
GAERTNER SCIENTIFIC
GEC AVIONICS LTD.
GENERAL IONEX
GRANVILLE-PHILLIPS
HIGH VOLTAGE ENGINEERING
EUROPA BV
INSTRUMENTS SA
INTERNATIONAL SCIENTIFIC INST.
ION TECH
JANIS RESEARCH
JEOL USA
KEITHLEY INSTRUMENTS
KIMBALL PHYSICS
LAKE SHORE CRYOTRONICS
LECROY RESEARCH SYSTEMS
KURT J. LESKER
LEYBOLD-HERAEUS VACUUM
PRODUCTS
MATERIALS BY METRON
MICRON OPTICS
MICROSCIENCE
MKS INSTRUMENTS
MMR TECHNOLOGIES
NATIONAL ELECTROSTATICS
NESLAB INSTRUMENTS
NETZCH
NGS ASSOCIATES
NORTH EASTERN ANALYTICAL
ORIEL
OXFORD INSTRUMENTS N.A.
PERKIN-ELMER PHYSICAL
ELECTRONICS
PHILIPS ELECTRONIC
INSTRUMENTS
PHOTON TECHNOLOGY INTL.
PHYSICON
PHYSITEC
PLENUM PUBLISHING
PRINCETON GAMMA-TECH
QUESTEK
RIGAKU USA
RUDOLPH RESEARCH
SCINTAG
SEMICONDUCTOR PROCESSING

Exhibitors Con't (as of 7/15/85)

SOUTH BAY TECHNOLOGY
SPECTRAMASS
SOHIO ENGINEERED MATERIALS/
CARBORUNDUM
SOUTH BAY TECHNOLOGY
SPIRE
STRUCTURE PROBE/SPI SUPPLIES
SURFACE SCIENCE LABS
THERMIONICS LABS
TRACOR NORTHERN
UHV INSTRUMENTS
VG INSTRUMENTS

Short Courses December 6-7

A Program of one- and two-day short courses will complement the science and technology presented in the technical symposia and provide an introduction to other current technologies. Short course topics are:

1. Surface and Thin Film Analysis
2. Ion Implantation into Metals
3. Ion Implantation into Semiconductors
4. Liquid-Phase Epitaxy Techniques
5. Molecular Beam Epitaxy
6. Chemical Vapor Deposition
7. Vacuum Technology
8. Pumping Hazardous Gases
9. Modern Analytical Techniques in Corrosion Research
10. Packaging Technology
11. Cements
12. Deep Level Transient Spectroscopy

For Meeting & Short Course information

contact: John B. Ballance
Executive Director
Materials Research Society
9800 McKnight Road
Suite 327
Pittsburgh, PA 15237
Telephone: (412) 367-3003

Show information:

Bob Finnegan, MRS Show Manager
American Institute of Physics
335 East 45th Street
New York, NY 10017
Telephone: (212) 661-9404

letters

continued from page 15

individual rights emphasize the personal obligations that must accompany acceptance of newly sought privileges.

I sincerely hope the publication of this article does not signal a change in editorial policies for PHYSICS TODAY.

B. DUDLEY

6/85

New Hartford, Connecticut

The article by Sheila Tobias (June, page 60) reminded me of my efforts in the late 1970s to increase the female enrollment in high-school physics. After the junior year, in which about half the chemistry students are female, the overall fraction of female science students drops to one quarter. A similarly sharp drop occurs between eleventh- and twelfth-grade mathematics.

Together with a female science teacher, I tried to elicit reasons from the junior class females for their possible avoidance of senior math or physics. We met with the young women in their chemistry classes and found that avoidance was generally based on their perception of advanced math and science as being career-oriented courses for students, usually described as males, who would be embarking upon rigorous professional training. Appalling for the liberated 1970s, many of the females were unashamed to admit that they foresaw themselves as housewives for whom the rigorous preparation would be both unnecessary and academically demanding.

My colleague and I were evidently rather successful in encouraging the female students to explore their motives, because the female enrollments in the next year's physics sections were significantly increased. The effect, however, was not all I had hoped for. The physics classes that year were difficult to motivate and the students frequently expressed distaste for the subject. Not surprisingly, an unusually large number dropped the course during the first semester. Consequently I was not disappointed that we didn't repeat our efforts in subsequent years.

There are several apparent differences between the attitudes of the males and females in my physics classes. Among the students with lower-than-average grade averages, the males generally continue the course while the females generally drop it. Among the higher-average students, the females score as well as, and frequently better than, the males; however, the females say they memorize more and solve fewer problems by reasoning techniques. In view of this, I am not surprised that even the females carrying high grades often say they don't like physics. Yet the males seem

VUV PMTs for low light level detection.

Thorn EMI has developed a complete line of Vacuum UV and solar-blind photomultiplier tubes with magnesium fluoride windows. Available in 2-inch diam. with linear focused structure, and 3/4-inch diam. linear focused, this line of standard PMTs offers a wide selection of spectral sensitivity—from 110 to 800 nm, for detecting UV to near IR.

Typical dark currents of

10^{-11} A at a gain of 10^6 enable the user to make very low DC measurements, or to use photon counting techniques.

Typical rise time of the 14-stage, linear-focused tubes is 2.2 ns, which makes them especially suitable for experiments in plasma research, fusion, fast UV lasers, Cerenkov radiation, shortlived free radicals, and other applications requiring fast response time.



The spectral response of Thorn EMI UV PMTs falls into three groups:

- Response below 220 nm: CsI and KBr photocathodes.
- Wavelengths shorter than 360 nm: CsTe and RbTe photocathodes.
- Broadband: alkali and trialkali photocathodes (630 and 850 nm respectively). Eliminate the need to change detectors in the middle of an experiment.



NORTH AMERICA
THORN EMI
Gencom Inc.
23 Madison Road, Fairfield NJ 07006 USA
Telephone 201 575-5586 Telex 221236

REST OF WORLD
THORN EMI
Electron Tubes Limited
Bury Street, Ruislip, Middlesex HA4 7TA, England
Telephone: Ruislip (08956) 30771 Telex 935261

Circle number 64 on Reader Service Card

From Springer-Verlag . . .

Applied Mathematical Sciences Titles For the Physicist

Volume 52 . . .

Variational Inequalities And Flow In Porous Media

M. Chipot

Important results on the regularity of the solution of obstacle problems are followed by a self-contained treatment of the model approach of fluid flow through porous media.

1984/118 pp./13 illus./Paper \$16.00
ISBN 0-387-96002-3

Volume 51 . . .

Singularities And Groups In Bifurcation Theory

M. Golubitsky and D.G. Schaeffer

Introduces singularity-theory methods in the context of bifurcation theory. Includes three case studies exploring how singularity-theory methods assist in analyzing applied problems.

1985/463 pp./114 illus./Cloth \$38.00
ISBN 0-387-90999-0

Volume 50 . . .

Sound Propagation In Stratified Fluids

C.H. Wilcox

Develops a theory of sound propagation in stratified fluids whose densities and sound speeds are essentially arbitrary functions of the depth.

1984/198 pp./Paper \$19.80
ISBN 0-387-90986-9

Volume 46 . . .

Scattering Theory For Diffraction Gratings

C.H. Wilcox

"The aim of this short monograph is to develop a theory of the scattering of acoustic and electromagnetic waves by periodic surfaces . . . The problem is presented clearly and concisely and the book should prove useful to everyone involved in research in this area."

—*Optica Acta*

1984/176 pp./4 illus./Paper \$19.00
ISBN 0-387-90924-9

Volume 42 . . .

Nonlinear Oscillations, Dynamical Systems And Bifurcations of Vector Fields

J. Guckenheimer and P. Holmes

"This remarkable book is based on examples that illustrate the phenomena of bifurcation and chaos in both continuous and discrete dynamical systems . . . Remarkable for its excellence in style and pedagogy . . ."

—*SIAM News*

1983/453 pp./206 illus./Cloth \$34.00
ISBN 0-387-90819-6



Springer-Verlag

New York Berlin Heidelberg Tokyo

Volume 41 . . .

The Lorenz Equations

Bifurcation, Chaos, and Strange Attractors

C. Sparrow

The first book to comprehensively survey the behavior of solutions using Lorenz equations.

1982/269 pp./91 illus./Paper \$23.50
ISBN 0-387-90775-0

Volume 38 . . .

Regular And Stochastic Motion

A. J. Lichtenberg and M. A. Leiberman

"Contains a wealth of material in an easy to read format."

—*SIAM News*

"The present work satisfies the need for a practitioner's text by emphasizing physical insight rather than the mathematical rigor and presents practical methods for describing the motion of nonlinear oscillator systems . . . An excellent graduate text and is sufficiently up to date to also be used as a reference work."

—*Journal of Statistical Physics*

1983/449 pp./140 illus./Cloth \$39.50
ISBN 0-387-90707-6

For your copy of these or other Springer-Verlag mathematics titles check your local scientific bookstore, or write: Springer-Verlag New York, Inc.

175 Fifth Avenue
New York, NY 10010
Attn: D. Emin

Circle number 65 on Reader Service Card

letters

to take pleasure in physics, even the problem-solving aspects of the course. Of course, generalizations such as I am making are dangerous because I can recall many notable exceptions, but the overall pattern is painfully obvious!

What concerns me most about Tobias's article is that she examines the attitudes of females and then ignores these expressed attitudes in considering solutions. She says the females felt compelled to memorize problem solutions because of feelings of helplessness in rigorous thinking. Tobias asserts the unverified aphorism that by giving blocks to their sons and dolls to their daughters, parents are predetermining their children's career opportunities.

Do little boys want to play with dolls? Do girls beg their parents for blocks? In preschools, which children wind up in the doll corner and which segregate themselves into the blocks corner? Despite the feminist urgings of the past decade, liberated mothers are still forced to give their children the toys that make them happy. Why are boys more comfortable with blocks than dolls? Could it be that there is an innate predisposition that determines our most comfortable occupation, and could that predisposition depend upon sex?

The evidence is that females dislike the rigorous, formal thinking of higher math and physics. Males are more often uncomfortable in the more emotive disciplines of language and art, although the pattern is not as obviously one-sided. Until someone points out an advanced civilization in which the above pattern has not occurred, I shall be obliged to suspect that it is an outgrowth of mental differences between the sexes. Indeed, recent studies in prenatal brain development have vaguely indicated gender-specific processes. Why do so many feminists persist in the face of such evidence to hold environmental influences responsible for the math-science anxiety so prevalent in females?

I am hopeful that future research into early brain growth will help us to understand why females tend to choose intuitive reasoning rather than formal logic. The sociobiologist would probably relate the differences to genetic preferences in primitive primates, wherein sex roles required females to nurture and protect their offspring while males engaged in more clannish pursuits. Regardless of its evolutionary origins, the difference is present; it is wasted effort to attempt to minimize its influence. It might be more productive to design different curricula to suit both those comfortable with concrete reasoning and those who prefer formal logic.

Finally we have come full circle. Tobias bemoans the variety of course offerings suited to different learning styles. This is the problem she sets out to solve.

JAMES F. BLAKE

New Hyde Park, New York

6/85

With reference to Sheila Tobias's article "Math anxiety and physics . . .", one is tempted to wonder what all the fuss is about.

People have been mathematically inclined or not for as long as history records—and the social pressures of our times are not likely to change the ways in which humans think. We either like math and physics and wish to pursue the study of these and related subjects, or our interests lie elsewhere.

There is, as well, the tendency to equate courses in a subject with the subject itself. I have never enjoyed English courses: Lecturers always seemed too fond of dissecting a poem or an essay—somewhat in the way in which a biologist would dissect a flower—and at the end of the dissection we are left with bits and pieces and not much more. However, that has not prevented me from getting great help and sustenance from poetry and prose. Whether or not students take physics courses probably does not prevent them from enjoying the polarized blue of a

sky, the refracted colors of snow crystals, or the products of electronic technology.

Is it not possible that well-meaning practitioners have found a source of rewarding employment in attempting to bring the gospel of physics courses to the heathen? And that the practice has become an end in itself?

Surely the "immersion" that Tobias describes was not physics. The "workout," as it is referred to, resembled nothing so much as a psychological test that could have been applied equally as well to primates as to humans. Or, with equivalent intellectual demands, the apparatus could have been knitting needles and yarn. Object: to use the apparatus to produce a piece of material formed from linked loops. The hoped-for result is the discovery of the property of tension in the wool and a feeling for the density of the material (to paraphrase).

In both Canada and the United States, the standard of our mathematics instruction is below that of some European countries, if performance in international contests may be taken as a guide. In Canada it is certain—and I gather from educational journals that it is true also in the United States—that physics undergraduates are far less well-prepared than they should be, both when they enter their studies and when they leave. It is somewhat distressing to find that so much effort is expended on a doubtful need when there are obvious and demanding requirements for skilled instructors.

H. J. HUNTER

7/85

Kanata, Ontario, Canada

THE AUTHOR RESPONDS: The table at left can be interpreted in two ways, and clearly my correspondents and I disagree:

► As demonstration that *only* an elite of males and females (but always more males than females) have the talent and the temperament to do physical science

► Or, in my view, as demonstration that there is a tragic waste in terms of student-to-subject match, as far as the physical sciences are concerned; and that the loss is as significant for physics as it is for the students who think physics is not for them.

SHEILA TOBIAS

7/85

Tucson, Arizona

Bachelor's degrees in 1981

	Men	Women	% Female
Biological sciences	5.1	4.1	44.2
Business	27.1	15.9	36.7
Education	5.8	18.1	75.0
Engineering and computer sciences	16.5	2.7	14.0
English	3.4	5.1	59.8
Nursing	0.4	11.4	94.8
Mathematical science	1.3	1.0	43.2
Physical science	3.9	1.3	24.6
Social science	12.0	9.5	44.1
Economics	2.8	1.3	30.9

From *Digest of Education Statistics*, US National Center for Educational Statistics.

Corrections

July, page 48—The subscription fulfillment statistics given in the table are for the calendar year 1984.

August, page 63—The position at IUPAP of John Klauder (AT&T Bell Labs) should have been listed as Associate Secretary-General. □