with Cu Kα radiation (1.54 Å) were undertaken in 1912 by B. Walter and R. Pohl.[3] They repeated a Young's double-slit experiment attempted earlier[4] (also at 1.54 Å) and believed their work to be unsuccessful. However, a later study of their plates with improved densitometry revealed the predicted variation of optical density across the image. As the wave nature of *Röntgenstrahlung* became firmly established, researchers in Germany and Sweden began to sense the usefulness of short-wavelength interferometry. In 1931 H. Kiessing published[5] creditable interferograms obtained at wavelengths between 1.39 Å and 1.66 Å. He used x-ray interferometry to measure the thickness of films deposited upon polished surfaces, as well as to characterize the index of refraction of known film thicknesses.

In 1932 x-ray interferometry matured with the publication[6] of Gunnar Kellström's doctoral thesis, "Experimental investigations of interference and diffraction with long wavelength x-rays." Kellström fabricated a Lloyds mirror and a Fresnel mirror interferometer with which he measured the wavelengths of C Kα, Cu Lα, Al Kα, and Mo Lα characteristic radiation. One of his interference patterns can be seen in *Fundamentals of Optics* by Jenkins and White.[7] The fringe visibility was excellent, aided by the use of a 0.5-micron slit following his Coolidge-type x-ray tube. I am sure that Kellström would be surprised and amused by claims to the invention of x-ray interferometry in 1965.

Such inaccuracies poorly serve the needs of a creative scientific community. They inhibit further searches into work of the past, where one may often find long-unseen gems.

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PAUL D. ROCKETT
KMS Fusion
Ann Arbor, Michigan

4/84

THE AUTHORS COMMENT: In using the phrase "invented x-ray interferometry," we did not intend to imply that Bonse and Hart were the first to observe or to demonstrate the phenomenon of x-ray interference. Accounts of such demonstrations appear much earlier in the literature, as Paul Rockett has pointed out. A discussion of this work, much of which required exceptional experimental skill, would be appropriate in a comprehensive review article unlimited in permissible length or in the number of references. However, if "invention" in the scientific sense means the origination of a novel, versatile device or technique that enables important measurements to be made and new lines of research opened up, then Bonse and Hart may legitimately be referred to as the inventors of x-ray interferometry.

J. H. UNDERWOOD
D. T. ATTWOOD
Lawrence Berkeley Laboratory
Berkeley, California

4/84

Monopole skeptic

Thank you for April's excellent summary of the status of magnetic monopole search. As an old-time gauss-trap operator, I feel induced to make a few observations on the subject.

The concept of the isolated magnetic pole preceeds Dirac by many years, because Maxwell carefully pointed out that full symmetry of the magnetic field equations required magnetic charges, of *both* polarities. However, in the past hundred years no phenomena have been found that would be unequivocally explained by such charges. It is all very well to speculate concerning problems that might be explained by magnetic monopoles, if they exist. But such problems are as conjectural as magnetic monopoles. As you said, magnetic monopoles are not neutrinos. These had to exist to provide energy and momentum conservation in beta decay. Yet, as late as 1938 Arthur Eddington "did not believe in neutrinos."

For the above reasons I consider magnetic monopoles to be members of a null set. For the past seventeen years I have seen many megatons of various industrial products stored and retrieved by our automatic Hartman AS/RS machines, whose positioning was controlled by sensing heads detecting the magnetic field of "Null track," so the gradiometer trick is very "old hat" to me. (The Null Track/Sensing Head positioning system has been rendered obsolute by the development of optical readers for bar code, which enabled us to combine its bin center and height function with our Bin Location Indicating Device, so the gradiometer trick really is "old hat"; but the old systems still run well.)

Also, any self respecting monopole should have sufficient prescience to shear off from a good superconducting and *u*-metal shield. Bait the trap! Don't hide it!

Has anyone checked the Stanford

seismometer for 14 February 1982? Also, the weather bureau records for hot sunshine? When I was checking core loss of Hypersil at 1.1, 2, and 3 cycles per second I had to wait for cloudy days to avoid drift of the special high inertia galvanometer used with the synchronous motor driven graphite/graphite commutator.

I like Joan Cartier's cartoon. It reminded me of the one illustrating Robert Benchley's 1931 sketch in the old *Liberty*, whose caption was "If we can split the atom, we are going to find a lot of little things." Also if one in the 1937 Caltech humor magazine showing a demolished Caltech cyclotron and a badly bruised staff member whose comment was: "Toughest damn atom I ever saw!"

ROBERT B. GRAY
Hartman Material Handling Systems
4/84 *Victor, New York*

Science, yes; weapons, no

I object strongly to the editorial opening statement in "Washington Reports" (April, page 55). You say "It would be churlish of physical scientists to complain about the budget for fiscal 1985 that President Reagan sent to Congress on 1 February . . ." and you explain this by detailing how ". . . the budget favors the 'hard' sciences . . ."

Why is this not reason to rejoice? Increasing the NSF budget is a good idea and the activities proposed under NSF auspices are worthwhile. But your article glibly mentions the enormous sums proposed for Trident II missiles, MX missiles, B-1B bombers, ballistic missile "defense" and other dangerous, ridiculous items. Each of these items will cost an amount comparable to or greater than the entire NSF budget. You also report on DOD's share of funding for basic research and related projects such as the Strategic Defense Initiative ("Star Wars"), command, control and communication systems for air–land battles in the year 2000, and so forth, as if it were all just various and sundry pure and applied physics.

It will be much worse than churlish if we do *not* complain about funding these dangerous and foolish weapons systems. The real impact of your opening statement is that physical scientists should not be critical of the President's policies and programs (as implemented by the budget proposal) because we have been generously treated by the President.

People have often asked me what is wrong with accepting DOD money if the research you are doing is good basic research and they are willing to pay for it. One reason is that by funding such research, DOD "buys" your complicit silence, not explicitly, but effectively. Your editorial in the guise of news makes this explicit.

Clearly the physical sciences are treated well this year by the President also because these areas of basic research are deemed important to support the military plans for "Star Wars" and a greatly worsened arms race. The recent DARPA Strategic Computing proposal makes this point. If you doubt the Administration's intentions, look at the fact that the National Institutes of Health are asked in this budget to accept "zero growth."

I support the proposed NSF budget. I demand also a corresponding 13% increase in the NIH budget. The weapons systems mentioned above and the military projects in the DARPA Strategic Computing proposal should not be funded at all. These weapons and the "Star Wars" projects are of no military value. They increase the risk of nuclear war at a time when we should be cutting back nuclear weapons and concluding treaties to stop the insane worldwide arms race.

IRA J. KALET
5/84 *Bothell, Washington*

Math phobia—squeeze play?

Many thanks for publishing Ya. B. Zeldovich's letter on mathematics as an obstacle to understanding physics (May, page 15). And I had thought things were different in the Soviet Union. May his suggestion be adopted by school districts all over the world!

I have often thought that if average citizens had a mathematical vocabulary equivalent, say, to their baseball or football vocabulary, my job in trying to popularize physics would be many percentage points easier (and I wouldn't have to bore those of my readers who *do* know with frequent repetitions of the same old elementary definitions).

The schools tend to teach multiplication tables and, on a higher level, symbol manipulation. Told that this is boring, they come up with the "new math," which is symbol juggling in binary form or on a computer terminal. Rarely are the spirit, essence and meaning of mathematics taught. (I did not encounter such a course until I was in graduate school.) Yet these things can be taught almost without numbers. Such an approach should be able to reach those who suffer the famous mathematical phobia. These phobics seem to be mainly people who lack the native facility with numbers and symbols that makes lightning calculators and engineers who can integrate the differential equations of a stress analysis in their heads. It seems the ordinary citizen should be able to understand something of the ideas of mathematics, just as he or she can understand the plays of a football team without necessarily having the 100-kilogram body or the motor skills required to play.

One final note: Bourbaki was a real person, a general in the Greek war for independence in the 1830s. A monument to him was erected in Nancy, France, where the Bourbaki school of mathematics began. The story is that these mathematicians, unwilling to risk their reputation in the very rigid French academic world on such wild ideas, picked the name off the statue and signed it to their first paper. After it became famous they had to keep on using it.

DIETRICK E. THOMSON
Senior Editor
5/84 *Science News*

Memories of Bloch

I was saddened to read the obituary of Felix Bloch (March, page 115). In addition to being a great physicist, he was a man of profound wisdom and wit whom I was privileged to meet on various occasions.

I still have a vivid memory of a visit he paid to St. Andrews in 1967, when he gave us a marvelously clear and lively colloquium on "Flux quantization." My memory is helped because since I came to St. Andrews in 1947 we have kept a colloquium book in which all visitors have inscribed the titles of their talks and appended their signatures. The book is of great and increasing value to us.

Following the colloquium, as we were wending our way to the pub, I said how much we had enjoyed the talk, and that I had particularly like one part, of which I already had a little knowledge. He made a very profound and memorable reply: "Never underestimate the pleasure you give an audience by telling them something they already understand." These words of wisdom should be borne in mind by all who plan to deliver colloquia or special lectures in the future.

J. F. ALLEN
University of St. Andrews
5/84 *St. Andrews, Scotland*

No iodine on campus

One of the facets of concern for man's environment includes the safety of personnel and students in an academic setting.[1] A striking example of recognition of the potential impact of chemicals in the academic environment was given[2] in 1982. With regard to radiation hazards, it is easy to overlook the fractions of a curie in a physics laboratory experiment, especially when considering the millions of curies involved