of laser implosion, it seems, may be by the use of beams of electrons or protons to compress the pellets. Work of this sort was described by M.J. Clauser of Sandia Laboratories. It promises to avoid some of the reflection and other energy-coupling difficulties of laser implosion and uses larger targets (several millimeters across), which make irradiation easier. The targets have metal shells filled with deuterium and tritium. At first the metal was gold; then the experimenters found that adding some carbon helped, so they wound up with the exotic combination of diamond on gold. They have been working with electrons of one million electron-volts (MeV) and 10-MeV protons. Clauser figures that break even—getting as much energy out of fusion as you put in to make it go—could come with 300 megamperes of 1-MeV electrons or 10 megamperes of 10-MeV protons.

Certain magnetic-confinement devices also implode the plasma (thus heating and condensing it) by sudden increases in magnetic field strength. These are called pinches. The most famous pinch in the United States is the Scyllac project of Los Alamos Scientific Laboratory. It will be a torus 15 feet in diameter, and is being assembled out of short sections. Tests of the sections indicate they are working well.

Another, unusual kind of pinch, is the belt pinch at the Max Planck Institute for Plasma Physics at Garching, West Germany. This is a pinching tokamak, which differs from other tokamaks by having a noncircular, racetrack-shaped cross section. According to R. Wilhelm, first experiments went well, reaching a Lawson number of about 2.8×10^{10} seconds per cubic centimeter, but at a temperature of 3 million degrees.

A pinch that uses a physical implosion, an imploding liner in the cylinder, is the U.S. Naval Research Laboratory's Linus project, reported by A.E. Robson. Major problems involved in designing such a thing were to avoid destroying the outer magnet coil and to provide for recovery so that the plasma could expand back for another shot. A lead and lithium mixture that provides a rotating implosion may prove best. The method of compressing a magnetic field by spatial implosion is borrowed from ultrahigh-field experiments in magnet laboratories, where there's usually no worry about destroying coils or using the apparatus for more than one shot. The method should produce megagauss fields and a dense hot plasma. Whether the idea can be scaled to practical reactor size depends on the fields that can be achieved and how well specially configured fields can prevent plasma loss through the ends of the cylinder.

Finally there is a mixture of a number of ideas now current in the experiment called LITE at United Technologies Research Center, described by D.H. Polk and several others. This uses laser irradiation of lithium hydride or lithium deuteride particles to make a dense, warm plasma in the field of a magnet shaped like the seams of a baseball. The plasma is then further heated and contained by injection of a beam of neutral atoms. Lawson numbers greater than 10^9 are claimed so far. One plasma physicist, hearing of this device, remarked that this sort of combination of most of the current ideas might prove the way to go for the future. □

Math in the schools: What's wrong?

Recent reports of falling mathematics scores have added new fuel to the public debate over the effect of two decades of major change in school mathematics curricula. A natural inference, which many parents have drawn, is that "New Math" programs are responsible for declining mathematics test scores. But a new nationwide study of content and achievement in school mathematics contradicts this common assumption.

The study, called "Overview and Analysis of School Mathematics," was commissioned by the Conference Board of the Mathematical Sciences—a consortium of 11 mathematics-related professional societies—and carried out over an 18-month period by the National Advisory Committee on Mathematical Education (NACOME). Its major conclusion is that mathematics education in the United States today is incredibly pluralistic. What is true in one school is likely to be false in another; indeed, the committee says, contradictions may often be found in different classrooms of the same school or in the same classroom on different days.

The decline in test scores, for instance, reflects this kaleidoscopic pattern. While the committee did find considerable evidence of a decline of computational ability, it also found some evidence of an increase in comprehension and understanding. Moreover, declines in mathematics test scores, where found, paralleled a general pattern of decline in all scholastic areas. The committee found no evidence that linked changes in mathematics test scores to particular changes in mathematics curricula.

Indeed, the committee said it could hardly recognize the presence of any clearly defined mathematics curricula. Instead of finding some schools using "New Math" and others using "Old Math," it found in most schools an eclectic pattern that severely compromises the curricular reform of the past two decades. The distortion of objectives and the transformation of means into ends—described by one observer as the serving of the icing rather than the cake—has, in the committee's view, been so extensive that the label "New Math" no longer carries any meaning. "New Math versus Old Math is a non-issue," says Ross Taylor, director of mathematics for the Minneapolis public school system. "The real story in mathematics education is the vast difference in perception of the problem between the public and the professional."

One such difference concerns the use of hand calculators in the classroom. Even though many people worry that a massive introduction of calculators will undercut what little remains of students' computational ability, the NACOME report advocates that at least from eighth grade and on, a hand calculator should be available for all work, including all tests, "for each mathematics student for each mathematics class."

Although admitting that injudicious use of a calculator could turn it into a computational crutch, the NACOME mathematicians and educators argued that a properly used calculator will enhance motivation for the learning of arithmetical skills. But Clifford E. Swartz of the State University of New York at Stony Brook reacted with skepticism:

"I'm worried about this because the report also recommends that a lot of research be done on what happens when you have hand calculators in the classroom. We are getting into a situation once again where something is being put into the schools and we don't really know much about what the effect will be. What I am afraid of is that those calculators are going to get out there and will be used in exactly the ways that we don't want them used. All that we will get is the icing again."

Expressions of distress over the lack of coordination between tests and curriculum objectives permeate many aspects of the committee's report. Too often, it says, the content of tests determines the nature of the curriculum. That, noted NACOME chairperson Shirley Hill of the University of Missouri, is really putting the cart before the horse. The committee strongly advocates that both programs and student evaluations be based on tests that are matched to the goals of the curriculum. "This sounds very sensible," commented Hill, "but it isn't always done."

The committee does not advocate any major shifts in curriculum content. Its report agrees with the direction and thrust of the earlier reform programs—that logical structure be the framework for the study of mathematics—but goes on to stress the need for relating mathematics to its applications at all levels in the curriculum. In particular, the report recommends that basic statistical ideas be introduced throughout the school mathematics curriculum. Statistical literacy, the report argues, is more vital to consumer education than, say, elementary algebra or geometry, because it reduces the individual's vulnerability to onslaughts of fancy sounding numbers. □