Computers

Quickly computing quarks

When IBM Corp. doesn't talk, everyone pays attention — nervously. So far, IBM has been conspicuously absent from the supercomputer market, now dominated by Cray Research, Inc., and Control Data Corp., both based in Minneapolis. However, news of at least one IBM research effort in high-speed computing surfaced at last month's National Computer Conference in Chicago. A team of physicists will soon take over a specially built computer designed to solve a single physics problem. According to an IBM official, this computer is supposed to take less than a year to solve a problem that would take a Cray-1 supercomputer more than 300 years to do.

The IBM machine, developed at the Thomas J. Watson Research Center in Yorktown Heights, N.Y., consists of an array of 576 processors, each one capable of 20 million "floating point" operations per second (equivalent to multiplying two decimal numbers 20 million times). In contrast, a typical personal computer performs 1,000 or so such operations per second. When all the processors are working in parallel, each one handling a small part of a computation, the IBM computer can handle more than 10 billion floating point operations per second.

The machine will be used to calculate the mass of a proton from "first principles," applying quantum chromodynamics theory. This year-long exercise should give physicists some clues as to the validity of their concepts about quarks and gluons. Once this project is over, the machine could be used for other purposes, says IBM's George Paul. And the computer's design team is already thinking about how to extend the ideas they developed for the original machine.

An expert harvest

The grain combine is the most complicated and expensive field machine widely used on U.S. farms. This machine cuts down the plants, separates grain from stalks, removes dust and dirt, stores the grain and dumps the stalks. Although combines can handle a variety of crops, such as corn, wheat and soybeans, they must be specially adjusted for each one. In addition, the machines must adapt to changing field conditions, sometimes several times a day. Already, on the newest models, microprocessors automatically make some of the adjustments. Soon, farmers may also have the help of an electronic "expert" to advise them on what to do out in the field.

At this week's International Computers in Engineering Conference in Boston, researchers from Texas A&M University in College Station described a prototype, computer-based system that suggests ways of handling field problems like damaged grain kernels or incomplete separation of grain and stalk. Installed on a combine, the system, using a voice synthesizer, asks the combine operator a series of questions that usually require nothing more than a yes or no answer. After going through this process, the operator finds out how to readjust his machine. This approach, the researchers report, takes much less time than looking up the information in a manual.

Taking a McIntosh to market

Beware of biting into an apple that has a hollow core. This fall, a miniature computer disguised as an apple will travel from a Michigan orchard, where it will be picked from a tree, all the way to a grocery shopper's bag. Along every step of its way, it'll record all the shocks and bangs that it suffers. The "apple" will also register temperature and humidity changes.

This computer's bruising ordeal should give researchers at Michigan State University in Lansing a better picture of when and how fruit is damaged on its way to the grocery shelf (SN: 5/12/84, p. 300). Agricultural engineer Bernie Tennes of the U.S. Department of Agriculture heads the project.

Earth Sciences

Making rain while the sun shines

Some scientists have maintained that cloud seeding — the practice of dispersing chemicals into cumulus clouds in order to make rain — is about as effective as paying someone to do a rain dance. For midwestern farmers and water managers, however, cloud seeding has often seemed to offer hope in times of drought. North Dakota farmers, for instance, have had enough confidence in the procedure to target 6.6 million acres for the "store-bought" rain at the cost of 5¢ an acre, a state meteorologist estimates.

Skeptics have never doubted that when silver iodide seeding agents come into contact with a cloud's very cold moisture droplets, ice crystals — which become raindrops in warm weather — are formed; in laboratory cloud chambers this is known to happen. But could the process work in the field — or, perhaps more aptly in this case, in the sky — where the real clouds roam? The skeptics doubted that seeding agents dispersed at the base of a tall cumulus cloud could wend their way 5,000 to 12,000 feet up, to the part of the cloud that contains moisture droplets.

Last month, in a collaborative effort, scientists from the North Dakota Weather Modification Board in Bismarck and the National Oceanic and Atmospheric Administration (NOAA) in Boulder, Colo., took to the clouds in order to settle things once and for all. The researchers released a tracer gas — sulfur hexafluoride — simultaneously with the silver iodide, and then followed in a second plane equipped with detection equipment to monitor the tracer's dispersal.

"The stuff had a bit of a climb to make," says John Flueck, a NOAA research scientist, "but our preliminary guesses are that in at least one instance the seeding agent was successful in reaching the level where the cold water is." The researchers also tested silver iodide with sodium chloride. This combination, says Flueck, "works much more quickly — because the water in the cloud doesn't have to be as cold for it to work."

A down-to-earth problem

Homeowners might have more to fear from the ground beneath their house than they do from hurricanes, tornadoes, earthquakes or floods. At least, they have more to fear if their house is built on certain types of clay known as "expansive soils."

Expansive soils cause an estimated $2 billion in damages each year in the United States — more than all the above-mentioned natural catastrophes combined. The problem, according to W. Kent Wray, a civil engineer at Texas Tech University in Lubbock, is that the clays swell or contract as soil moistures vary, which can cause the foundation of a house to buckle if it's a concrete "slab-on-the-ground" type.

Wray has been studying expansive soils at two experimental house foundations he has built in Amarillo and Bryan, Tex. Instruments attached to the experimental foundations gather data on soil surface movement, rainfall, temperature and the expansion characteristics of the clay.

Wray has found that a foundation will either "dish" (sink in) or "dome" (bubble up in the center), depending on whether the soil at the foundation's center is getting wetter or dryer.

"For expansive soils to be a problem," says Wray, "the ground moisture content has to change." Clay is particularly susceptible to moisture, he says, because clay particles have a great surface area for their size; water is able to penetrate among the particles and push them apart.

These clays are a particular problem in semiarid regions where rainfall is followed by long periods of no rain, says Wray, adding that Texas and California record the most annual damage. It's lucky, he notes, that England has such a rainy climate. "London clay," he says, "is potentially the most damaging in the world."