PHYSICAL SCIENCES

Dietrick E. Thomsen reports from Washington, D.C., at the meeting of the American Physical Society

Gravity theory: Moffat 2, Einstein?

An X-ray burster is an object in the sky that emits sharp bursts of X-rays from time to time. The theoretical model for such a thing begins with a binary star system, one member of which is a neutron star. The neutron star draws matter from the companion star orbiting around it, and this matter settles onto the surface of the neutron star. When the accreting matter, which is hot ionized gas, accumulates to the critical mass for a thermonuclear explosion, the explosion occurs, emitting a blast of X-rays.

Paul C. Joss of Massachusetts Institute of Technology points out that these X-rays are a means of studying the effects of gravity under the extreme conditions of the very strong field of a neutron star. Gravitational theory sets a limit, the so-called Eddington limit, to how much radiation can be emitted — that is, how strong the explosion can be, without blowing away part of the star itself. Joss says observation shows X-ray bursters emitting two or three times their Eddington limits. "Things don't seem to fit with [Einsteinian] general relativity," he says. A theory that does fit, according to Joss, is one being worked out by John William Moffat of the University of Toronto. Moffat's theory provides neutron stars of a given mass with stronger gravitational fields than Einstein's does, and so allows them to withstand stronger explosions. Moffat's theory was also invoked to account for the motions of the planet Mercury in the light of recent findings that the sun is oblate (SN: 4/17/82, p. 260). Einstein's theory accounts for Mercury's motion only if the sun is a perfect sphere.

Phase transitions and human diseases

In physics a phase transition is a sudden shift in the structure of a system, a change from disorder to order or vice versa, under the influence of some change in ambient conditions.

Investigation of phase changes in biological systems shows that they play a critical role in the onset of several diseases. Among examples discussed at one session of the APS meeting are sickle cell anemia, ventricular fibrillations of the heart and gallstone disease. In each case the physico-chemical process involved is different, but the common factor is that some threshold level of the relevant ambient condition triggers a sudden shift between order and disorder.

In sickle cell disease, as Judith Herzfeld of Harvard Medical School points out, the victim's red blood cells have an inherited chemical difference from normal ones. This difference favors polymerization of the cells' hemoglobin molecules at the moment they give up the oxygen they carry. Polymerization means that they assemble themselves into long, thick cylinders and distort the shape of the cell so that it cannot get through small blood vessels and deliver oxygen.

Ventricular fibrillation is a crisis in which the smooth beat of the heart goes over to a random twitching. Richard Cohen and associates of the Harvard/MIT Division of Health Science and Technology have been experimenting to show that the onset of fibrillation is related to a change in the shapes of electric waves that pass through the heart muscle. If these waves encounter inhomogeneities from place to place in the electrical conduction properties of the ventricular myocardium, they won't move completely smoothly. Eddy currents form, and if they build up can lead to fibrillations.

In gallstone disease the trigger is an imbalance of the three chemicals present in the gall bladder, bile salts, lecithin and cholesterol, says Norman Mazer of MIT and Harvard Medical School. If the cholesterol reaches a certain level compared to the other two, instead of forming micelles, which are normally excreted, it begins to crystallize, forming stones. Mazer says some doctors are giving patients bile salts in an effort to manipulate the chemical balance and prevent stones.

TECHNOLOGY

In computing, FIRST is fast

"When I use a word," Humpty Dumpty said in Lewis Carroll's *Through the Looking-Glass,* "it means just what I choose it to mean — neither more nor less." This idea of defining commands and other words when they are needed is the basis of a new computer language called FIRST. Physicist John Scandrett of Washington University in St. Louis says his language considerably reduces programming time and gives a small personal computer like an Apple the capability and speed of a higher-priced, more sophisticated minicomputer.

Instead of creating a comprehensive language that can do all things for all people, Scandrett's approach was to invent a language that turns the act of programming into devising the most appropriate language for the problem at hand. "Simply describing the problem in the most relevant and well-focused way means that you've already solved the problem by the time you've done that," Scandrett says. If the problem involves statistics, for example, the language is not cluttered with words more useful for other operations like image processing.

A special command allows new words to be defined in terms of previously existing words, thus building the language in a pyramid-like fashion. If an application often requires averaging numbers, then the programmer can define a word that represents the most convenient method for entering the data and getting out the results. These words represent subroutines. Using the newly defined words, a programmer can write short, fast programs to do exactly what is needed. "It's so quick to extend the language in one direction and then wipe it all out and extend it in another direction," Scandrett says.

At present, Scandrett has his system running on an Apple computer and is "in the midst of bringing the same language to life on the IBM personal computer." He has provided his "FIRST is Fast, Inc." floppy disc, which replaces the Apple operating system instructions, to several research laboratories to demonstrate the new language's usefulness for experiment control and data acquisition. "An Apple computer with FIRST can do it very handily," Scandrett says. The more commonly used personal computer language BASIC is usually too slow for taking measurements and running experiments. With the FIRST compiler and a special floating-point number processor for the Apple, the computer runs faster because computer instructions are executed as a direct result of the created language and the commands given. FIRST has also proved to be useful for making up new languages for special purposes.

"What I've done so far is to wipe out all the things that used to bug me about computer use," Scandrett says. "In its present form, I can get things done maybe ten times faster than before. I really measure progress by how rapidly I can make mistakes. I've found a way I can make mistakes and get over them faster than ever before."

Silver bugs and sulphide ores

A British researcher has shown that some bacteria can accumulate silver in large quantities, although silver is extremely toxic to a wide range of bacteria. F.D. Pooley reports in the April 15 NATURE that small silver sulphide granules grew on the surface of bacteria present in experimental sulphide leaching systems. These particles, which seem to form whenever sulphide and silver ions are present, sometimes made up as much as 25 percent of the bacterial mass recovered after the leaching of a silver sulphide material. Pooley writes that the finding has "interesting practical applications for the recovery of silver from sulphide ore minerals." It may also indicate how silver was released, concentrated and relocated in surface ore deposits, which previously had been affected by bacterial action.