S Shape May Help Predict Solar Storms

Space scientists are calling it the other Y2K problem.

Sometime next year, the sun is expected to reach the peak of its 11-year activity cycle. For the next several years, this volatile cauldron of gas will have more frequent temper tantrums than usual. As the sun continues to rage, it will hurl more magnetized clouds of electrically charged gas into space.

Some of these solar storms, known as coronal mass ejections, may wreak havoc if they plow into the magnetic cocoon surrounding Earth. The blobs of solar material sometimes induce large electric currents on Earth, harming satellites and knocking out power grids (SN: 3/6/99, p. 150). Researchers reported this week that they have uncovered an important clue that may help them predict many of these storms hours to days before the sun spews them out. Once it erupts, an outburst takes about 4 days to reach Earth.

After analyzing daily X-ray images taken over 2 years by a Japanese-U.S.-British satellite called Yohkoh, Richard C. Canfield of Montana State University in Bozeman and his collaborators found that S marks the spot. Within active regions on the sun—places that show intense magnetic activity—those areas that exhibit an S-shaped pattern in their X-ray emissions are the ones most likely to erupt.

"We've found that the S-shaped regions are the dangerous ones," he says.

Found in the sun's outer atmosphere, or corona, the S's are believed to trace the tightly twisted, helical magnetic fields that power many solar outbursts.

The new study follows up on a 1998 report by Hugh S. Hudson, based at the Institute of Space and Astronautical Science in Sagamihara, Japan, and Alphonse Sterling of Computational Physics in Fairfax, Va. They found indications that some coronal mass ejections correlate with an S pattern. The new analysis puts that preliminary finding on a surer statistical footing, Canfield notes.

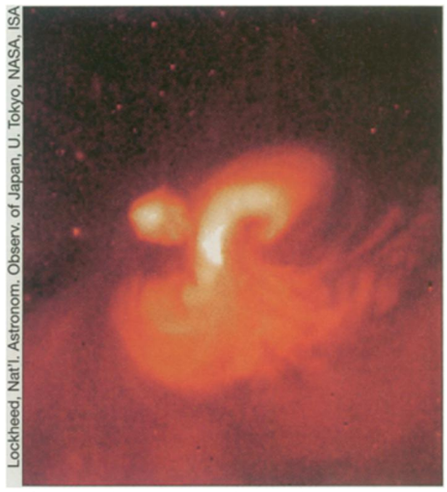
He announced the findings at a NASA press briefing in Washington, D.C. Canfield, Hudson, and David E. McKenzie of Montana State also describe their results in the March 15 GEOPHYSICAL RESEARCH LETTERS.

Planetary scientists do not yet know how soon after the appearance of an S pattern an active region will erupt. Moreover, the S shape does not indicate the speed and direction of a coronal mass ejection or the orientation of its magnetic field. Such information is critical for forecasting which of the many solar eruptions could pose a danger to our planet (SN: 2/1/97, p. 68).

Nonetheless, the new findings "are a harbinger of great things to come," says Ernest Hildner, director of the National Oceanic and Atmospheric Administration's Space Environment Center (SEC) in Boulder, Colo. "This is a potential milestone," says his SEC colleague Joseph Hirman.

Hildner says that he's excited about the results because computers can be trained to recognize the S pattern in solar images and to track regions that show the telltale shape. A successor to Yohkoh's instruments, a device installed on a weather satellite scheduled for launch in 2001, will generate an X-ray image of the sun every minute, he notes. Scanning the multitude of pictures for an S pattern could prove invaluable for forecasting geomagnetic storms, Hildner says.

Canfield notes that not all coronal mass ejections are associated with the S pattern, and J.T. Gosling of the Los Alamos (N.M.) National Laboratory points out that not all outbursts come from active regions. Canfield and his team "have a decent result, but we've not completely understood what produces coronal mass ejections, by a long shot," says Gosling. —*R. Cowen*



S-shaped pattern in the sun's corona.

Enzyme disables excess amino acid

Phenylalanine, an amino acid that is essential to the body, requires precise control. Children who get too little phenylalanine in their diet fail to grow properly. Retaining too much can cause brain damage. Most people can dispose of any surplus phenylalanine, but those with a genetic disorder called phenylketonuria (PKU) lack the enzyme that breaks down the excess.

Scientists have now engineered bacteria to produce an enzyme that might replace the one PKU patients lack. In the March 2 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, researchers report that injections of the enzyme reduced blood concentrations of phenylalanine by roughly half in a dozen mice unable to break down the amino acid. The scientists then achieved similar results by giving the mice the substitute enzyme in food, says study coauthor Charles R. Scriver, a geneticist and pediatrician at Montreal Children's Hospital and McGill University.

A half century ago, scientists were thrilled to discover that the neurological risks of PKU could be avoided if children adhered to a diet devoid of meat, fish, dairy products, breads, nuts, and many other foods. Maintaining such a diet is difficult, however, and PKU children also must consume an unpleasant-tasting food additive to get adequate protein.

To develop an alternative approach, the scientists added a yeast gene to *Escherichia coli* bacteria. The *E. coli* then manufactured an enzyme that breaks down phenylalanine in a simpler manner than the process directed by its human counterpart.

"How to move forward with clinical development of the enzyme is still a question," says study coauthor Robert Heft, a molecular biologist and president of IBEX Technologies in Montreal. "The mice data predict a dose which would be too high in humans to be commercially feasible." The researchers also don't know whether effective concentrations of the enzyme could have harmful side effects, he says.

Moreover, the substitute enzyme "might be seen by the human body as a foreign body . . . and might induce immunoreactivity," says Harvey L. Levy of Children's Hospital in Boston.

The genetic disorder affects roughly 1 in 12,000 babies born in North America. For 35 years, U.S. newborns have been screened for PKU. Those with the enzyme deficiency are put on the special diet. Once PKU patients reach adolescence, some go off the diet with few ill effects, Scriver says. However, some adults with PKU begin to lose the ability to concentrate well, have trouble planning, and may even show short-term memory loss, he adds. —*N. Seppa*