reemission microscope, in which positrons filter through the sample and come out the other side, while the Michigan team has developed a microscope that measures positrons that penetrate a sample's first 10 or 20 molecular layers and then are *reflected* back out the same side they entered. Both groups announce their findings in the Aug. 1 PHYSICAL REVIEW LETTERS.

The reflecting reemission microscope has the advantage of being able to scan thicker samples rather than the ultra-thin sample-wafers the transmitting microscope must use. But because of inherent design limitations, the reflecting microscope cannot get as high a resolution as the transmitting microscope, says Van House. The University of Michigan's reflecting microscope now has a resolution of less than 1 micron, while the Brandeis-AT&T microscope has a resolution about three times better. It eventually may be possible to push the transmitting reemission microscope's resolution into the atomic range by using a type of positron holography, Canter says.

Van House speculates that the positron's positive charge may allow chemists to spot the similarly charged hydrogen ions in chemical reactions. And because positrons interact with the electron "holes" that are central to the workings of semiconductors, positron reemission microscopes may also give computer engineers the opportunity to look into an operating integrated chip, he says. *— C. Vaughan*

Neural networks: The buck stops here

Neurocomputers are a breed of rapidly developing hardware on which artificial neural networks are trained to solve problems. Because these systems sort through immense amounts of information and pick out patterns from the onslaught of data, they may become useful tools in complex financial decision-making, according to computer scientists who presented reports in San Diego last week at the IEEE International Conference on Neural Networks.

One such neurocomputer-driven neural network, developed by Edward Collins and his colleagues at Nestor, Inc., in Providence, R.I., accurately makes decisions on mortgage risks commonly evaluated by mortgage underwriters.

Mortgages are usually underwritten by both a mortgage provider and a mortgage insurer, says Collins. A variety of information is considered before a mortgage is granted or denied, and disagreement is not uncommon between provider and insurer.

The researchers designed a neural network with three internal layers of processing elements. The strengths of connections that transmit messages between elements are altered as the system trains itself to achieve a desired output. In this case, the network was given information from 5,000 mortgage applicants; decisions on the applications made by a mortgage underwriter served as a training signal. Data fed into the computer covered each applicant's background and financial history, as well as the type of mortgage required and the property being sought.

Each layer of the network analyzed a piece of the complex financial input and determined the riskiness of granting a loan. A "controller" built into the neurocomputer then determined whether there was significant agreement between the three layers and, if agreement was reached, rendered a response.

When the statistical rules followed by the controller allowed for agreement in each case, the resulting decision agreed with that of the mortgage underwriter 82 percent of the time. When the statistical criteria for agreement between the three layers were tightened, says Collins, a response was obtained for one-third of the cases with 96 percent agreement.

Furthermore, notes Collins, the neural network was better than the mortgage writer at predicting who was a good loan risk and who would default. The system's three decision-making layers appear to enhance human judgments on loan applications, he maintains.

A similar neural network, designed by Shashi Shekhar of the University of California at Berkeley and a colleague, trains itself to rate the quality of bonds purchased by investors. Ratings reflect the probability of making a profit on a bond from a particular company. Financial information on a company is evaluated by ratings authorities who use standard mathematical equations to aid in their decisions.

When fed detailed, publicly available financial information on companies issuing bonds, the neural network predicted established bond ratings better than the typical mathematical procedures used by bond raters, says Shekhar.

"Neural networks provide a more general framework for connecting financial input about a company to an output, the bond rating," he asserts.

The stock market, however, is a tougher nut to crack. Economist Halbert White of the University of California at San Diego recently provided a neural network with daily rates of return on IBM stock over 500 days in the mid-1970s. The network did its best to extract predictable fluctuations in the stock's worth, White says, but so far only random jumps and dips are evident.

"It won't be easy to uncover predictable stock market fluctuations with neural networks," he remarks, "and if you succeed, you'll probably want to keep it secret." *— B. Bower*

Newton's gravity law may take a fall

Preliminary results from a gravity experiment conducted deep within the Greenland ice cap may lend support to the existence of a much-disputed fifth force of nature.

In the summer of 1987, investigators lowered a sensitive meter into a 2-kilometer-deep borehole in the ice and found gravity to be about 3 percent stronger than expected, says experiment coordinator Mark E. Ander of the Los Alamos (N.M.) National Laboratory (LANL), who collaborated with colleagues from several U.S. and British universities. Ander reported his findings to colleagues this week at Los Alamos and will discuss them next week at a conference in Australia.

In the experiment, the researchers compared their measurements with predictions based on the standard Newtonian law of gravity. The standard theory is called the inverse square law, because gravitational attraction is thought to depend on the square of the distance separating any objects. However, the results indicate "there is an *apparent* violation of the inverse square law," says Ander, who is still analyzing the measurements.

If the measurements are correct, says LANL theorist Richard Hughes, "it is telling us either gravity is more complicated than we ever thought before, or there is a new force of nature."

The Greenland experiment is the latest in a series of sensitive tests over the last two years that have reportedly found violations of Newton's law of gravity (SN: 12/19&26/87, p.388). Theorists have proposed that the minute departures from standard gravity may be manifestations of a fifth force — one that works over distances ranging from a few meters to several kilometers. Of the four traditional fundamental forces, gravity and electromagnetism act over infinite distances, while the strong and weak forces operate on the atomic and subatomic scales.

In design, Ander's project resembles a test conducted in Australian mine shafts two years ago. But the earlier experiment found gravity slightly weaker than predicted, an effect completely opposite that seen in the recent test. Ander says the Greenland borehole allows for greater accuracy because gravitational measurements depend on density and ice's density is more uniform than that of rock. He and others are planning further gravity tests in the Antarctic and in the ocean.

For now, physicists are not rushing to amend the inverse square law or declare the existence of a new force. Says geophysicist David Rubincam from NASA Goddard in Greenbelt, Md., "I think we're all waiting for more definite results since the Earth is a very dirty laboratory." *— R. Monastersky*