

## Easy navigation

As anyone who's had to rely on a mechanical sextant can tell you, celestial navigation is not easy. It requires siting a number of stars visually with a sextant, and then using the data to solve a battery of equations. But Fred Leuchter Jr. of Malden, Mass., has developed an "average digital sextant" that provides an automatic, digital readout of one's position within seconds. Powered by camera-type batteries, it integrates the functions of a mechanical sextant, computer, chronometer and stop watch.

Leuchter claims it provides better than the fifth-of-a-mile error allowed under Navy specifications and is far more accurate than a mechanical sextant, which he says can be miles off in determining one's position. In addition, "You don't have to know where you are, as is the case with a mechanical sextant," he said in an interview with the Boston Herald American.

The Navy has offered to fund development costs. Leuchter's one-of-a-kind prototype cost him \$100,000 to build, but he expects a production-line version could retail for about \$1,500.

## Fingerprinting water

Two Florida State University researchers are mapping the route, flow rate and mixing characteristics of groundwater with a technique they call fingerprinting. It measures the concentration of two uranium isotopes in the water — U-238 and one of its daughter products, U-234 — together with the ratio of the radioactivity of one isotope to the other. Ken Osmond and Jim Cowart found that these two pieces of information are usually sufficient to characterize groundwater originating from a particular region, and that the characteristics remain relatively constant through time.

Water from the mix of two groundwater systems will bear the characteristics of each; the new isotope ratios and concentrations and their variance throughout an aquifer will indicate the flow rate and mixing rate of each contributing source. Cowart told SCIENCE NEWS that their technique has determined the origins, route, flow rate and mixing ratios for dozens of wells, rivers, sinkholes and springs in Florida, Texas and Nevada. But they were limestone aquifers; sandstone ones are another matter. Because of the oxidation potential of the water in sandstone reservoirs, the uranium tends to precipitate out, he said.

Knowing flow patterns of water can aid decisionmakers in siting such things as toxic-waste disposal sites by indicating to what extent the wastes can be expected to leach into the water and where such leached contaminants will eventually end up.

## ... and your signature

Small accelerometers and a pressure detector built into the barrel of a pen (which is linked to a computer) compare the direction, speed and pressure — as well as reveal hesitations — that can betray forgers attempting to copy a signature. The system relies on the fact that rapid handwriting of familiar patterns, such as one's name, become a habit to the extent that the timing of pen movements "are consistent and beyond deliberate control," according to its designers at IBM. What's more, as it compares signatures, the computer measures similarities in fine detail but ignores gross differences that often occur, such as missed strokes or stylistic variations. In tests using 248 would-be forgers, the system scored 98.3 percent accuracy in verifying signatures and 99.6 percent accuracy in detecting forgeries. It's the best performance by an automatic signature-verification system, and is probably more accurate than human examiners, says Noel M. Herbst, one of its inventors. He says it may one day be used to control unauthorized access to such things as credit and sensitive information.

## Windy city weather effects

One of the most extensive studies of the urban "heat-island" weather effect (SN: 3/5/77, p. 152) showed that St. Louis affects weather as far as 25 miles across the Mississippi River into Illinois. Among other effects are significant increases in the amount of rainfall and in the frequency and duration of storms. Preliminary results by the same researchers on an area of similar size surrounding Chicago show that the "St. Louis results are in a large sense transferable... and the effects are about the same magnitude," says project leader Stanley M. Changnon of the Illinois State Water Survey.

Changnon and colleagues chose Chicago, in part, to see if a "lake effect" exists and how it might temper the urban influence. So far, the researchers have found that, though the lake might decrease local temperatures somewhat, its influence is "not very important" compared with the overwhelming urban effect.

One "clear finding" based on radar tracking of storms and rainfall measurements, Changnon says, is that the average rainfall from storms originating northwest of Chicago increases as they move over the city and into northern Indiana. The increase can be tracked as far as La Porte, Ind., about 50 miles from Chicago.

Noting that increased rainfall is detected *past* St. Louis, but *over* the much larger area of Chicago, Changnon suggests that the urban effect "appears to require an area of particular dimensions where there is little vegetation." The team plans two more years of data collection in the Chicago area.

## More on sun-weather correlations

The trouble with finding a nice correlation between solar variability and weather events is that somebody always spoils it. One of the most convincing connections was shown by John M. Wilcox and colleagues of Stanford University (SN: 12/31/77, p. 423). Using data from 1963 to 1973, they showed that the amount of large-scale rotation (measured as the vorticity area index, or  $v_{AI}$ ) in the Northern Hemisphere's atmosphere dropped one day after the earth passed through the boundary between two oppositely polarized sections of the sun's magnetic field. Accepted as a statistically sound piece of research, the results formed the basis of many other studies.

Now, however, data from 1973 to 1977 may force a reinterpretation of Wilcox's findings. According to Edward J. Gerety and R. Gareth Williams in the Sept. 21 NATURE, the characteristic  $v_{AI}$  response has disappeared in more recent years. While studying a related measurement called eddy kinetic energy ( $\kappa E$ ), Gerety and Williams noticed that it, too, responded to crossing a solar magnetic field boundary from 1963 to 1973. However, in the years 1974 to 1977, the response vanished. Because  $v_{AI}$  and  $\kappa E$  are derived from some of the same wave components of the jet stream, the researchers wondered if the  $v_{AI}$  response might be similarly diminished. Using Wilcox's techniques, they found that although the  $v_{AI}$  is still at an absolute minimum one day after a boundary crossing, "the magnitude of this response, at best, is greatly reduced" during the period 1974 to 1977. Though he concludes that "our work weakens the evidence for this particular sun-weather correlation," Gerety says he would "like to see  $v_{AI}$  prove to be the real thing," and is giving the phenomenon every benefit of the doubt, including the possibility that the 1974 to 1977 data may be anomalous.

Wilcox's team is taking a more optimistic view. According to one member of the group, the researchers saw the diminished response begin to appear in data they plotted two to three years ago. Noting similar dips in  $v_{AI}$  response during the 1930s and 1950s, they believe the effect may be part of a longer-term fluctuation.