Cole, Burn Lewis, Robert Mercer, Eva-Maria Muckstein, Arthur Nadas and Lenore Restifo join Jelinek in the work.

In the experiments an operator sits in a "quiet room" and reads the computer sentences made from the words in the 1,000-word vocabulary. After a delay, which can be quite long, the words appear on a fluorescent screen. The computer has to be trained to understand the speech idiosyncracies of a particular operator, a procedure that takes about two hours and involves the reading of 900 test sentences made out of the 1,000 words.

The vocabulary comes neither from baby talk nor Tarzan talk but from the language of lawyers submitting patent applications for laser devices. Shakespeare or Bertrand Russell might have thought 1,000 words inhibiting, but patent lawyers can produce some involved sentences out of them. Here is one of the 900 test sentences: "After a period of time, the dye in the switching cell will decay and not be as effective in its switching operation."

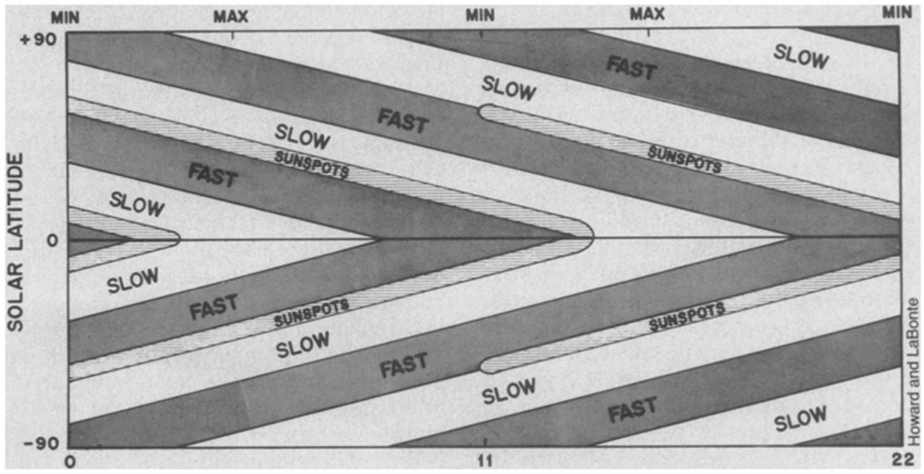
The computer can recognize more than the 900 test sentences. The probable sequences of different classes of words — articles, nouns, verbs, adjectives, etc. — according to English grammar are in its memory. It can use these rules to analyze unfamiliar sentences provided they are made up of the 1,000 words.

The machine works by using an acoustic processor to sample the wave pattern of the speaker's voice 20,000 times a second. The information in the sample is digitized. A thousand samples are collected at a time and put through the procedure called discrete Fourier transform, which involves adding, subtracting and integrating waveforms to produce a useful synthesis of the information over time. This yields characteristic patterns known as spectral time samples, 100 of them every second. The computer compares these with 200 prototypes stored in the processor's memory during the training session with the particular speaker. The processor classifies the time samples according to the sounds in the original word. As the acoustic processor puts them out, a linguistic decoder matches the classified sound patterns to the most probable sentence pattern they seem to fit.

This procedure can lead to mistakes, but they sound more like human mistakes than the gibberish that usually results from computer foul-ups: The speaker says: "Although the invention has been described...." The computer writes: "All of the invention has been described." Response time is very slow, however. A sentence uttered in 30 seconds may take the computer 100 minutes to display.

Plans for the future include increasing the flexibility of the device by lowering training time for new operators to 15 minutes, quickening response time until the response comes in real time, and increasing the machine's vocabulary. That would result in a useful dictation system. □

Solar currents and the magnetic cycle



Fast currents form every 11 years, travel to equator. Sunspots form at boundaries.

Solar observers have long noted that the sun has a 22-year magnetic cycle: Magnetic events, such as sunspots, flares and prominences, as well as reversals in the polarity of the field, appear to follow this schedule. Less clear and much debated has been whether the cyclic behavior is only surface deep or the result of a magnetic churn far below the sun's dermis.

Now, astronomers at Hale Observatories in California have evidence that such activity is due to deep motions of the sun's interior. The researchers, Robert Howard and Barry LaBonte, have observed bands of fast and slow currents on the sun's surface that originate at the poles and drift in a 22-year journey toward the equator. Furthermore, Howard told a press conference last week, the currents appear associated with the development of sunspots. "What we see is a large-scale, deep-rooted oscillatory motion of the sun that some way causes the cycle to happen....It is the first time evidence has been found for motion below the surface of the sun associated with the solar cycle."

Early astronomers observed that the equator of the sun's gaseous orb rotates from east to west faster than do its poles—once every 25 days, compared with once every 33 days. Using the Mount Wilson facility operated by California Institute of Technology and the Carnegie Institution of Washington, Howard and LaBonte attempted to see if the rate of rotation was constant at a given latitude across the sun. By measuring the shift in the wavelength of iron, the researchers charted the daily velocities of 24,000 points on the sun's surface during the period between Jan. 15, 1968, and Dec. 28, 1979. When the velocities were plotted according to latitude, the researchers found that certain zones moved about 3 meters per second (7 miles per hour) faster than the average rotation of the sun and others moved 3 meters per second slower than the rest of the sun.

In each solar hemisphere, Howard says, there are four zones of alternating speed, two fast and two slow, and the currents are arranged symmetrically about the solar equator. Like the stripe of red that seems to move down a rotating barber shop pole, a fast current originates at the solar poles every 11 years and begins a 22-year trip toward the equator. When the fast zone is about midway to its destination, sunspots begin to appear on the poleward boundary between the fast zone and the slow zone next to it. The sunspots then travel with the fast current to the equator, where both disappear. The fast and slow currents associated with the upcoming cycle of sunspot activity are already discernable at high solar latitudes, Howard said, but sunspots will not appear for eight years. "This is the first time we have been able to actually see the motions associated with the next solar cycle."

Because of the regularity and large size of the features, the global nature of the phenomenon and the identical hemispheric patterns, Howard and LaBonte conclude that the currents are driven by oscillations of a magnetic field that is deep within the sun. Previously regarded by many as the primary and possibly the driving event of the magnetic cycle, Howard and LaBonte's observations make sunspots "just the flotsam and jetsam of deep-seated oscillations." They may arise, Howard suggests, as the magnetic field lines beneath the currents are stretched by the motion of the currents, become amplified and erupt to the surface. Howard and LaBonte's work "is evidence for a magnetic field that is generated rather deeper and more regular than previously thought," says Princeton University solar physicist R. H. Dicke. The work "will constrain theorists to a model based on motions below the surface," says John Wilcox of the Stanford Solar Observatory, adding that his group is now attempting to confirm the discovery. The finding does not explain the sun's magnetic cycle, says Howard, but "we know now how to attack the solar cycle." □