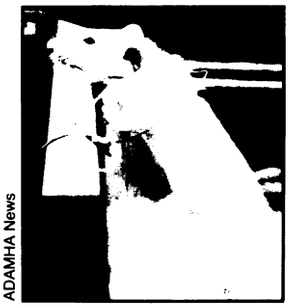
Endorphins: Up with acupuncture . . .

For many U.S. physicians and scientists, the normalization of relations with China is lifting the cloak of mystery surrounding acupuncture (SN: 10/27/79, p. 296). A number of recent studies have suggested, indirectly, that acupuncture works by stimulating production in the brain of endorphins — naturally produced chemicals believed to be involved in combatting pain and enhancing pleasure. Still, the evidence has not been convincing enough to satisfy some Westerners of a physical basis for the procedure's anesthetizing effects.

Now, however, National Institute of Mental Health researcher Agu Pert and his colleagues report what they call the first direct evidence that acupuncture affects the production of pain-killing chemicals in the brain. The results show that "acupuncture seems to activate the endorphin system," Pert told SCIENCE NEWS.

In a paper submitted for publication to the British journal NATURE, the research team describes the administration of electro-acupuncture to the ears of male rats. Following the procedure, examination of the rat's brains revealed substantial depletion of endorphins in three brain regions and a simultaneous increase in endorphin levels in the cerebrospinal fluid. Pert says this indicates that during acupuncture brain "neurons put out more endorphin"; much of the natural painkiller then appears to leave those brain areas (as indicated by the post-acupuncture depletion) and migrate to the spinal fluid. Previous studies have reported similar endorphin-like increases in cerebrospinal fluid, but this is the first finding that the brain itself manufactures more endorphin in reaction to acupuncture, Pert says.

"Although acupuncture seems to activate the endorphin systems in the brain, this does not necessarily imply that all of the analgesic actions of acupuncture are mediated by endorphins," say the scientists. Other brain peptides may also be involved in the process, they say. Working with Pert were Raymond Dionne of the National Institute of Dental Research, Lorenz Ng of the National Institute on Drug Abuse, Terry W. Moody and Candace B. Pert of NIMH and Evgeni Bragin of NIMH and Moscow, U.S.S.R. □



ADAMHA News

Ear is a common point in acupuncture procedures.

down with migraine headaches

Because migraine headaches cause excruciating pain, it wouldn't be too surprising to find that one of the major physiological events underlying this type of headache involves a decrease in the brain's own natural opioids, the enkephalins and endorphins. Such a finding has now been made by Bruno Anselmi and his colleagues at the University of Florence in Italy. Anselmi reported on the team's research this week in San Francisco at the annual meeting of the American Association for the Study of Headache. And for this work Anselmi received the Harold G. Wolff Lecture Award, which is given annually by the association for outstanding research into the causes and treatment of headache.

Anselmi and his colleagues took cerebrospinal fluid samples from migraine sufferers while they were experiencing a migraine attack, from migraine sufferers currently not experiencing a migraine and from subjects who did not suffer from migraines at all. When the samples were examined for levels of enkephalins, the mean value of enkephalins in the spinal fluid of migraine sufferers during a migraine was found to be significantly lower than the mean value found in either control subjects or in patients not experiencing migraines. These results, Anselmi and coworkers conclude, "confirm a decrease or a complete disappearance of morphine-like substances in cerebrospinal fluid during migraine attacks. This might suggest an intermittent, repetitive failing of the enkephalinergic system during the attack in headache sufferers."

If a reduction in enkephalins underlies a migraine, might restoration of them help relieve the pain caused by the migraine? Another discovery by Anselmi and his colleagues suggests that the answer is yes. The researchers took blood samples from migraine sufferers at the end of a migraine attack, from migraine patients not experiencing a headache and from control subjects. They examined the blood samples for levels of an endorphin particularly potent in analgesic powers — beta-endorphin — and found that beta-endorphin levels were significantly higher in the blood of migraine sufferers at the end of a migraine than in the blood of migraine patients not having an attack or in the blood of control subjects. Because the pituitary gland is known to release endorphins when the body is under stress, it is quite possible that a migraine stimulates the pituitary to release beta-endorphin, Anselmi and his team conclude. Beta-endorphin may then help a migraine victim recover. □

Mining heat at the hot rocks powerplant

Mort Smith's "toy" produces 60 kilowatts of electricity "from a pair of holes that probably cost us $3 million or $4 million." As the world's first hot, dry-rock geothermal power station, this small experiment "mines heat" by flushing more than 100 gallons of water per minute through a bed of fractured granite nearly two miles underground.

Normally, geothermal developers hunt for underground reservoirs of hot water or for steam stored in permeable rock. In theory, tapping such reservoirs involves little more than pumping the water or steam to the surface, running it through heat exchangers and reinjecting it down a well. Instead, Smith and colleagues at the Los Alamos Scientific Laboratory scout hot impermeable rock from which to fashion a reservoir. Among the advantages of this approach is the theoretical flexibility it offers; one can drill anywhere and eventually hit hot rock.

The reservoir is created by hydraulic fracturing: Pressurized water forced down one hole will create a network of fractures radiating toward the other hole, eventually linking with it. Once that occurs, any water pumped down one well will flush through the system — acquiring heat — and exit out the other well.

Since the diffusion of heat through rock is slow, the reservoir could essentially be mined of all its heat fairly quickly — this is at best a slowly renewable resource — if the formation of the rock bed changed little after the initial fracturing. But tests at LASL's Fenton Hill in northcentral New Mexico demonstrate that mining a reservoir actually induces further fracturing.

Mike Fehler, an Oregon State University seismologist, describes the phenomenon as thermal-stress cracking. Studies he has conducted at the site during the past five years suggest that as water carries away heat from a rock's surface, that surface cools and shrinks. Since the rock core remains hot and does not shrink, stresses build within the rock until relieved by "mini earthquakes," or "mini fracturing," Fehler explains.

An increase in the number of fractures means that when the water flows through the reservoir it will contact more rock. Because heat removal is proportional to the flow rate of water and to the surface area of rock exposed to the water, "an increase in the size and amount of fractures will add to the life of the system making it more economical to operate over time," Fehler says.

Drilling costs constitute about half of the construction cost of a hot dry-rock geothermal plant. To be economically competitive for electric-power generation, it is thought that shallow deposits of rock in the 300°F to 550°F range must be

exploited. But if the goal is merely generating industrial process heat, deposits at 200°F may be sufficient, Smith told SCIENCE NEWS. "And it's my own feeling," he added "that that's where the big future for this sort of thing lies." He says, however, that since those who fund or influence the funding of geothermal research tend to be more interested in electrical-generating applications, that has been the focus of the hot dry-rock programs. In fact, just three weeks ago the first of two wells that may eventually power a 5- to 10-megawatt commercial power station was completed at Fenton Hill.

Environmentally, hot dry-rock is virtually benign, especially compared with the notorious sulfur- and brine-polluting "wet" geothermal fields out West. There remains some concern, however, that rock fracturing could induce small earthquakes. □

Antibody zeros in on interferon

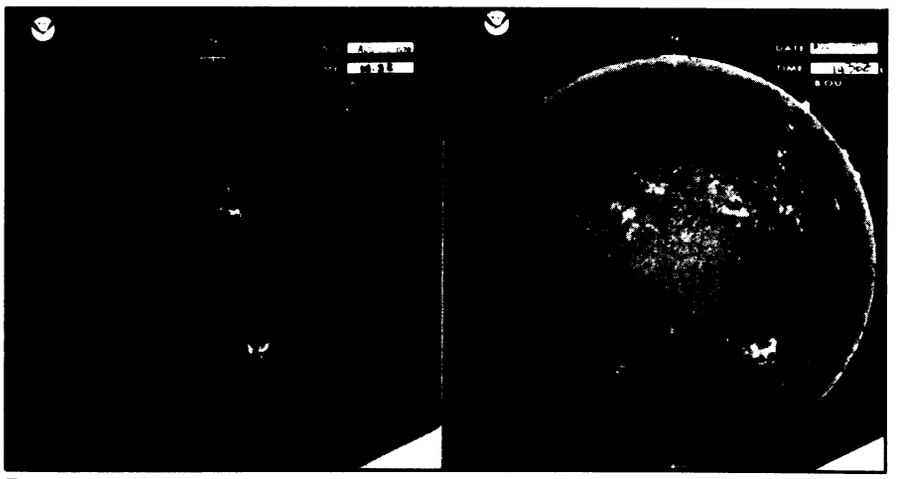
Sorting the therapeutic effects, and lack of effects, of the much-touted natural chemical interferon is a task greatly complicated by lack of the material in a pure form. The doses of interferon administered in current clinical trials (SN: 6/7/80, p. 358) are generally less than 1 percent pure. Now biologists in England report development of a tool that can clean up interferon preparations. Their technique concentrates interferon 5,000-fold in a single step.

The key to the purification is an antibody that binds specifically to interferon. When that antibody is linked to a solid support column, it grabs the interferon molecules from an impure preparation as they flow by.

David Secher of the Medical Research Council in Cambridge and Derek Burke of Warwick University spent three years tracking the antibody, Secher said in a telephone interview. The researchers used the technique developed by Cesar Milstein (SN: 12/23/78, p. 444) in which immune system cells and tumor cells are fused so that the resultant cells grow continuously in laboratory culture, each cell and all its descendants pumping out a specific (monoclonal) antibody. Secher and Burke chose a clone of cells making antibody that prevented interferon from protecting other cells against viral infections.

In two sets of experiments fusing immune system and tumor cells, the scientists found only one antibody specific to interferon. Secher has been using this selective antibody to concentrate interferon from human white blood cells, but he expects the same technique could be applied to purify interferon produced by recombinant DNA (SN: 6/14/80, p. 372). Secher's goal is to analyze the many molecules of the white blood cell surface. □

A prominent cause for magnetic storms



NOAA/SESC

Filament (left, upper left quadrant) may have caused Aug. 1978 magnetic storm.

A long-discarded theory for a source of geomagnetic storms—disturbances of the earth's atmosphere that are visible as auroras and that disrupt radio transmissions and electrical circuits — was revived recently at the meeting in Toronto, Canada, of the American Geophysical Union.

Geomagnetic storms, which are caused by pulses of charged particles from the sun, have long been associated with solar flares (explosive brightenings on the solar surface) and more recently with coronal holes (low density regions in the sun's corona), but these phenomena account for only a small percentage of the storms. A third solar event — prominences or filaments — may be "equally as important as flares" in triggering pulses of solar particles, suggests Jo Ann Joselyn of the National Oceanic and Atmospheric Administration in Boulder, Colo.

Prominences (called filaments when seen against the sun's face) are masses of gas that arch hundreds of thousands of kilometers above the sun's surface and appear to follow outpockets of magnetic lines in the corona. A certain class of filaments is not associated with sunspots and do not, as many do, re-appear repeatedly in the same spot. It is these features — called disappearing filaments — that were originally proposed in the 1930s as a source of geomagnetic disturbances and that Joselyn now suggests could be responsible for at least 25 percent of all geomagnetic storms. (The idea died when filaments failed as a candidate for M-regions — "magnetically active" and "mysterious" sources of recurrent storms.)

While studying a very large storm that originated from the sun on August 22, 1978, Joselyn noted, "There were no flares for a week, no coronal holes, so it had to be something else. And there was this disappearing filament." Moreover, she said, Skylab results showed a strong correlation between outward moving coronal disturbances — which could initiate particle pulses — and disappearing filaments. Studying solar activity from June 1, 1976, to June 30, 1979, Joselyn found that of 65 geomagnetic storms, 10 could be attributed to coronal holes alone, 3 to flares, 12 to disappearing filaments, 11 to filaments and flares, 5 to coronal holes and flares, 11 to coronal holes and filaments and 8 to all three events. Five storms are still unexplained. □

Mt. St. Helens: Dome, but no relief

As though yearning to rebuild its once beautiful face, the gaping crater of Mt. St. Helens began last week to ooze forth a plug of lava—the much-touted lava dome. But, made cautious by earlier misplaced enthusiasm and the volcano's third major blast in a month on June 12, scientists stressed that the presence of the dome does not lessen the hazard or the likelihood of many years of eruptions.

The dome was first spotted three days after a major eruption spread ash to the north, south and west — areas previously untouched. Before the 9:11 p.m. (PDT) eruption, University of Washington seismologists noted an increase in harmonic tremor (continuous rhythmic movements) and small earthquake activity during the afternoon, a decrease about 8:00 p.m. (PDT) and a sudden increase at the estimated time of eruption. Though not of the magnitude of the May 18 blast, the June 12 eruption produced an ash cloud that reached more than 50,000 feet and pumice and ash flows as hot as 600°C. The lava dome — the top of a "largely degassed column of lava" with a "bread crust" like appearance — emerged without seismic activity and measured about 650 feet wide and 130 feet high when last observed. □