a different form of the transcription factor that regulates this gene. Males have yet another form of the same transcription factor, they discovered.

Kafatos' group had previously found that the transcription factor belongs to a class of proteins known as zinc fingers. These proteins, first discovered in 1985, consist of finger-like loops held together by zinc atoms. Each finger in these transcription factors recognizes and binds to a specific region of a gene's DNA.

Kafatos and his colleagues found that the eggshell transcription factor made by fruit fly pupae has one more zinc finger than do forms of the protein made during other stages of the fruit fly life cycle. Moreover, this pupal transcription factor does not bind to the same DNA sequences as the transcription factor produced by embryos or adults, the researchers found.

"The [eggshell transcription factor] protein has a different combination of zinc fingers at different developmental stages," concludes Tien Hsu, a member of the Kafatos group. He suggests that this finger-swapping ability allows such transcription factors to control more than one gene.

Stephen C. Harrison/NATURE

The loops of a zinc-finger transcription factor (top) bind to DNA.

Nick Hastie of the Medical Research Council Human Genetics Unit at the Western General Hospital in Edinburgh, Scotland, suggests that alterations in zinc-finger transcription factors may also underlie several cancers and developmental disorders. Earlier this year, he and colleagues described studies of the gene responsible for Wilms' tumor, an inherited kidney cancer in children.

In the July 10 SCIENCE, Hastie's team reported that the gene directs the production of two slightly different forms of a zinc-finger transcription factor. An earlier paper in the May NATURE GENETICS reported that different forms of this transcription factor can also cause birth defects of the kidneys and gonads.

– C. Ezzell

Greenland ice shows climate flip-flops

If the economy seems unpredictable, take a look at records of Earth's climate. New evidence gathered from deep within Greenland's glacial cap reveals that during the last ice age, temperatures in the North Atlantic region bounced from cold to warm and back again almost a dozen times in 30,000 years.

The recognition of such dramatic wobbles raises questions about the feasibility of predicting how the future climate will evolve, suggest Sigfus J. Johnsen and his colleagues, who performed the study. "If you are working with a system that is not acting in a very stable manner, then it becomes very difficult [to predict]," says Johnsen, a physicist with the University of Copenhagen in Denmark.

The new findings come out of the Greenland Ice Sheet Project (GRIP), an eight-nation European effort to drill straight through the thickest part of Greenland and collect ice cores containing climate clues (SN: 9/14/91, p.168). After four summers of drilling, the team reached bedrock in July at a depth of 3,028.6 meters. This is the longest ice core drilled to date, and it reaches farthest back in time. Preliminary studies suggest that ice from the bottom of the hole may date back 200,000 years.

Glaciers grow incrementally, with each year's snow falling on top of snow from the year before. As the layers accumulate, pressure causes the deeper layers to turn into solid ice, locking in details about climate.

Johnsen's team studied the ice core collected through the summer of 1991. Their samples date back 40,000 years, into the middle of the last ice age. The researchers tracked climate changes by measuring the ratio of oxygen-18 to oxygen-16, which indicates the air temperature at the time the snow fell.

Three previous ice cores drilled in Greenland had suggested that several warm periods, called interstadials, punctuated the most recent ice age, which lasted from about 100,000 years ago to 11,000 years ago. But many scientists questioned those findings because the ice collected in the three cores had flowed a considerable distance from where it originally fell as snow. Some researchers wondered whether this factor could produce the appearance of warmings in the ice record. Moreover, ice cores from Antarctica do not reveal strong evidence of ice-age warmings.

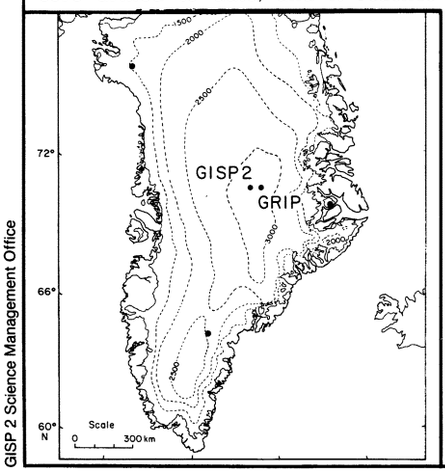
The new results from GRIP, however, provide definitive evidence that the interstadials did occur, Johnsen's group reports in the Sept. 24 NATURE. Questions about ice flow do not plague the GRIP results because this hole is at the summit of the ice cap, where there is little horizontal flow, the researchers say.

The oxygen isotope record shows that the warm interstadials developed quite abruptly, in some cases taking only a few decades to heat up 7°C. Lasting 500 to 2,000 years, the interstadials occurred at irregular intervals. The researchers suggest that the climate may have warmed when ocean currents in the North Atlantic rapidly changed direction or strength.

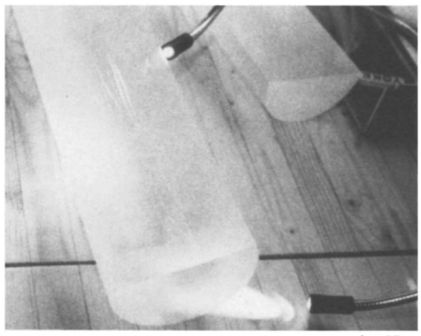
These results would seem to feed the concerns of some oceanographers, who have warned that a greenhouse warming in the next few decades could cause radical shifts in ocean currents. "If the current system of the ocean starts to change, we could have drastic changes in climate," says Johnsen.

But comparisons between an ice age and the present may be unwarranted because today's oceans may be much more stable than their ice-age counterparts, says David Peel of the British Antarctic Survey in Cambridge, who is working on GRIP. To match current conditions, he says, researchers must look at how the climate behaved roughly 110,000 years ago, during the warm period between two ice ages.

GRIP scientists will compare their findings with those from a U.S. team that is also drilling in central Greenland. The U.S. project did not reach bedrock as planned this summer because the cable supporting the drill wore out. U.S. researchers had to suspend drilling at a depth of 2,250 meters, but they plan to finish next year. *– R. Monastersky*



GISP 2 Science Management Office



R. Monastersky

Light shines through ice core from GRIP. Map shows European and U.S. (GISP 2) drill sites. Dots show past drill sites.