When the glaciers go

■ Man's total span of direct observation of the Universe—in the sense of consciously made and recorded observations—covers a span of about six thousand years. The "fixed stars" are not, of course, by any means fixed . . . save in the special sense that one of the high-speed electronic flash photographs "fixes" things. A bullet, photographed at a millionth of a second, appears fixed in space, too . . . but the bullet is, of course, traveling less than one one-hundredth the speed of many of the "fixed stars."

The very vaguest sort of mythical traditions suggest that, once upon a time, long ago, there was a flood. That the climate changed somehow, and it rained, and there was a flood.

Geological studies suggest that about twenty thousand years ago the climate changed a bit, the rain-belts moved, and it might be that at that time the oceans deepened slightly as water locked up in great glaciers flowed back to the sea. In a cooler period, the relatively shallow passage between the Gates of Hercules, between the Atlantic and the Mediterranean, might have been exposed dry land—and the Atlantic cut off from the Mediterranean basin. Perhaps there was a small salt lake or two in the great basin—a Great Salt Lake or Dead Sea that represented the dried-out left-over of the sea of non-glaciated times.

Until the glaciers melted, and the Atlantic regained contact with the great Mediterranean basin area.

That would constitute quite a

flood, no doubt—one vast enough to leave traces through even a hundred generations of nomads without written records.

It's recognized now that the cubic miles of water still locked up in the great glaciers of Greenland, Antarctica and elsewhere would, if they all melted, raise the sea level some two hundred to three hundred feet, with serious effects on coastal areas . . .

But just what is a "coastal area" in the sense? When Hurricane Carla roared in from the Gulf of Mexico, people had to drive as much as fifty miles inland to get *twenty feet* higher elevation. How far up the Mississippi valley would a three hundred foot rise in ocean level push the Gulf of Mexico? My house is on the eastern slope of the Watchung hills in New Jersey, some thirty miles from the Atlantic coast. If the oceans rise two hundred feet, we'll be situated on an off-shore island, with two distinct island chains between us and the mainland, which will be about forty miles west of here! The entire industrial area of the New Jersey coastal plain will be gone.

What causes glaciation, though? It used to be held that the Earth's average temperature underwent enormous swings, such that at times Antarctica had a near-tropical climate, so that vast humid forests grew, and died, to make coal beds. That palms and giant ferns grew profusely in a semitropical Alaska. And then there were tremendous dips in temperature that sent glaciers rumbling down six thousand miles from the poles!

More recently, that's been coming under question. By careful study of the orientation of tiny particles of magnetic iron oxides that were deposited in silts washed down to ancient lakes hundreds and even thousands of megayears ago, we can determine which way was north at the time that silt formed. At least—which way was the magnetic north, and the best present hypotheses hold that the Earth's magnetic field is primarily linked to the rotation of the deep mass of the planet itself. It is *not* a surface effect, easily upset—not something that could, by accident, be an "east pole" or a "north-west pole".

The ancient sediments indicate that the north pole was, a few hundred megayears ago, located in Arizona.

Now the laws of gyroscopes being what they are, the possibility of the Earth's rotational mass being suddenly flipped over is a close approximation to zero. Any force capable of doing that would shatter the planet completely.

But the "rotational mass of the planet" is not that thin, wrinkled skin we know; that's only about thirty miles thick—thirty out of four thousand miles to Earth's center. There's nothing in the laws of gyroscopes that says that a coat of paint, poorly applied to the spinning wheel, couldn't slip around without detectably disturbing the rotation of the wheel proper. And there's nothing that says Earth's crust can't slip on the deeper mass of the planet! Since that crystal layer has as its main de-

marking characteristic that it's shallow and light enough to act like a solid, while anything deeper, under the enormous pressures generated by the overlayers, flows like hot tar.

Metals don't have to be melted to make them flow—as witness any cold-rolling mill. Granite, too, will flow without being heated—Dr. Bridgeman and his associates in extreme pressure physics demonstrated that decades ago. Glass can't break when it's bent in a 90° angle—if it's locked in a space that maintains a pressure of, say, 2,000,000 pounds per square inch. It doesn't have room to crack!

Did Earth have such violent temperature swings that at times Antarctica was subtropical, and at others it is as we know it? Or . . . did the Earth's crust simply slip, like a badly applied and wrinkled coat of paint on the immense gyroscope underneath?

Surely the rotational axis of the Earth couldn't have wandered all the way down to Arizona! But . . . maybe Arizona wandered all the way down from the pole . . . ?

Right now, the north pole is stuck in a land-locked sea, with very narrow and quite shallow channels connecting it to the great heat reservoirs of the planet—the great oceans. The south pole, just now, is stuck in what appears to be a cleft continental landmass—which, of course, is a very poor heat reservoir, as compared to an ocean like the Pacific. If the Pacific wandered up to the north pole, the vast currents of water flowing to and from the Equatorial zone would make an ice-locked pole impossible. Look what the Gulf Stream does for Eastern Europe and the British Isles! There are palm trees growing along the streets of Galway on the west coast of Ireland—but, while I can't testify from direct knowledge, I do not believe palm trees are common in Labrador, which is somewhat south of Ireland!

Then there remains one other factor to consider. It's a very uncomfortable fact, because it has such disquieting implications.

In Siberia they have, for decades, been finding mammoths frozen in the icy gravels—mammoths preserved in deep-freeze since the ice-age descended.

These mammoths, though, died of cold, not of starvation. They're full-fleshed, not emaciated, and still preserved in their stomachs are the green vegetation they ate at their last meals.

This raises some highly interesting questions as to how fast the climate of an area on this planet can change. How long does it take to go from a moderate temperate-zone type climate, in a land that can support considerable numbers of gigantic herbivores, to a sub-sub-arctic climate with temperatures that must have been down around —75° or lower?

A mammoth is a huge mass of protoplasm. They had wool, a thick hide, and many tons of warm flesh, and if we imagine that, somehow, the temperature dropped one afternoon from, say, 40°—they were eating

green vegetation, which hadn't been killed by frost when the catastrophe occurred—to say —100° in the course of one hour, how long would it take a mammoth's stomach to get down below freezing? For at least a time, the huge beast's metabolism would fight the terrible cold—they were mammals, and all the heat-generating mechanisms available to a giant mammal would start stoking up the furnaces full blast. No mild cold would kill so huge a creature; even animals as small as the Arctic hare readily survive temperatures below −40°, despite the problems of large skin area in proportion to heat-generating body volume.

But when the terrible cold finally overcame the mammalian heat-mechanisms—it would still take many hours for that vast carcass to cool down to freezing all the way through to the stomach.

And the vegetation is *still green!*

An elephant isn't a mammoth—but it would be interesting to know how long it would take an elephant, suddenly shoved out into an Antarctic mid-winter blizzard, to freeze solid all the way through.

How cold *did* it get? And how fast? So cold, and so fast, at least, that between the time a mammoth became uneasy about the strange things happening, and stopped eating as he began restlessly seeking some more secure place, and the time he froze solid, was not long enough to digest the greenness out of his last meal.

Seemingly cold can hit that fast.

Can temperature increase come that fast, too? That, by its nature, wouldn't leave permanently frozen evidence behind!

There is, though, the interesting fact that that business about the Atlantic flooding into the Mediterranean basin would account for the flood legends our Mediterranean-based culture has.

The flood-legends, however, are world-wide.

Those Siberian mammoths weren't quick-frozen by having Siberia skid a couple of thousand miles poleward in an afternoon, either. The deep layers of Earth are fluid . . . but not *that* fluid!

If the temperature can drop like that . . . can it also rise just as violently? And what happens if the glaciers melt not over the course of a century or two—but in a month or two?

We haven't the faintest idea what causes or ends a glaciation period . . . and we haven't any real knowledge of how fast it happens! ■