# Cutting Off the World's Roof

BY KEN HOWARD

*The tremendous heights of mountains have fascinated humankind for ages. Geologists, however, wonder why mountains aren't even taller, and they have formulated theories to explain why peaks have not reached greater heights.*

*The mighty Himalaya would be higher were it not for a buzz saw made of ice.*

Now that everybody is climbing peaks in the Himalaya, this so-called Roof of the World is starting to seem a lot closer to the ground. After all, Ramaposhi, Nanda Devi, and Nanga Parbat (mountains) are just five miles up. K2 and Everest reach five and a half, give or take a few hundred yards. You probably drive farther than that to your local multiplex.[1] Jaded thrill seekers must be wondering why there are so few really tall mountain ranges on Earth, and why the ones we have aren't even taller.

**Three Theories**

Geologists wonder about that, too. Some of them think that the problem lies on the supply side—that tall peaks are fast-rising peaks, and to make more of them Earth would have to shove its crust skyward faster than it actually does. Others say the important thing is how fast mountains are coming *down*: as mountains rise, they scrunch down under their own weight. Or

[1] **multiplex:** a movie complex with multiple theaters

perhaps they get their tops lopped off by erosion. So far, however, no one has had good numbers to support any of the various theories.

Now a team of California geologists say they do. And the numbers favor erosion. As the Himalayan mountains come up, glaciers shear off their tops like a buzz saw. In a younger, warmer, less glacier-friendly world, these peaks may have been much taller.

**Evidence for the Erosion Theory**

The geologists took five million satellite measurements of elevations in the northwest Himalaya and Karakoram ranges, where summits soar to heights of more than twenty-six thousand feet above sea level, and fed the numbers into computer programs designed to tease out slope angles, the amount of land at every elevation, and other features. The results showed that the snowcapped Himalayan peaks, the mountains that launched a thousand wall calendars, make up only a small percentage of the total ground area—like pins sticking up through a piece of paper. The landscape as a whole lies thousands of feet closer to sea level.

The average elevation varies from place to place, but the statistics show that it corresponds to the elevation at which glaciers start to form. That's also where the sheer mountainsides start to level off. In other words, the rocks stop where the ice begins. In the Himalayan mountains, at least, it looks as if it's glaciers that are wearing the heights down.

"Landscape is trying to get higher, but surface processes are trying to erode it," says one of the researchers, Nicholas Brozović, a geomorphologist[2] at the University of California, Berkeley. "Glaciers effectively form a limit."

**Evidence Against the Other Two Theories**

Of course, a statistical match between glaciers and elevations doesn't prove that glaciers are *controlling* the elevations. To strengthen their case, the researchers had to deal with the other possibilities. The faster-is-higher hypothesis was easy to eliminate. Because rocks of similar ages appear at different heights in different mountains, geologists know that some of these mountains are rising faster than others. In the area Brozović and his colleagues studied, the rate of rise changes from east to west. If speed were king, the sizes and shapes of mountains ought to vary from east to west, too. But the numbers showed that was not the case. So much for the supply side.

What about trickle down—the possibility that the mountains are collapsing under the force of gravity? When rock piles up so high that its weight exceeds its strength, the rock cracks, forming faults. Along those faults (which can be as much as forty miles long and several miles deep) huge blocks of rock may slide back toward the sea.

[2] **geomorphologist:** a person that studies the shapes or features of the earth

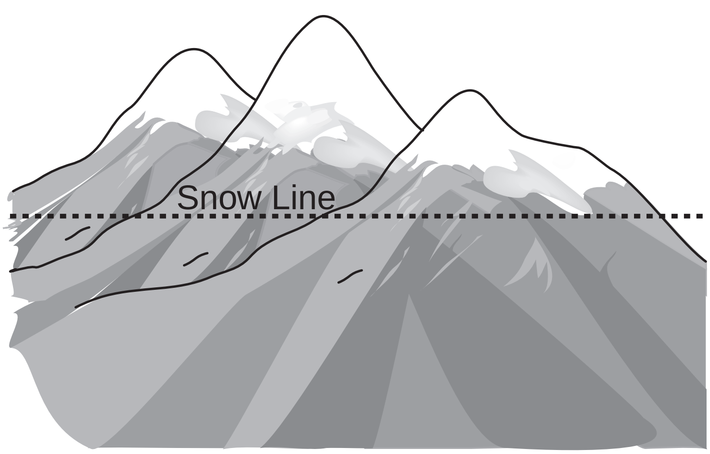
Faults like that are known to exist in the mountain-and-valley regions of the Himalaya, but they have been inactive for about twenty million years. That's too long to have affected the heights of the mountains today. And in any case, Brozović points out, it's unlikely that faults would turn up in just the right places to make terrain taper off right above the snow line.

**How Glacial Erosion Works**

Glaciers, however, are in the right place. They start to form after a mountaintop pokes up past the snow line. The faster the mountain rises, the more of its surface there is for the ice to cover; the more ice, the more erosion. High peaks are especially prone to glacial erosion because they tend to catch clouds that might otherwise drop snow onto lower mountains nearby. That turns the peaks into what Brozović calls "topographic lightning rods"—catalysts for their own destruction.

But if that's so, how can snowcapped peaks exist at all? Because glacial scouring isn't perfect, Brozović says. It's bound to miss a few parts of a few mountaintops, or at least work too slowly to keep them down. When it does, the survivors may grow so steep that ice slides off their sides before it builds up enough weight to do any damage. Or they may get so cold that they freeze to the rocks and stop sliding altogether. Motionless glaciers don't wear down mountains. The tallest, pointiest peaks, then, can become glacier-proof. Their height really does depend on the strength of the rock.

If Brozović and his colleagues are right, it may be no coincidence that the highest mountains in the world lie within thirty degrees of the equator. At higher latitudes (for example, in Alaska) the air




**As this simplified diagram shows, glaciers are formed above the snow line. The snow line represents the altitude at which precipitation always falls as snow instead of rain. As glaciers move down a mountain, they erode its top, acting as a kind of "buzz saw."**

is colder, so glaciers form at lower elevations, and mountains can't get as tall. It may also be true that mountains rise and fall along with long-term global temperatures. For most of the past two million years, Himalayan glaciers probably formed more than a thousand feet lower than they do today and may have covered almost twice as much area. If the "glacier buzz saw" theory is correct, mountains should have been wearing away faster during the cold spells.

Warmer, drier climates, on the other hand, ought to produce fewer glaciers and taller mountains. If so, the Himalaya should have been taller fifteen to twenty million years ago, when Earth was hotter, and it could grow again if the planet heats up for a million years or so in the future.

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