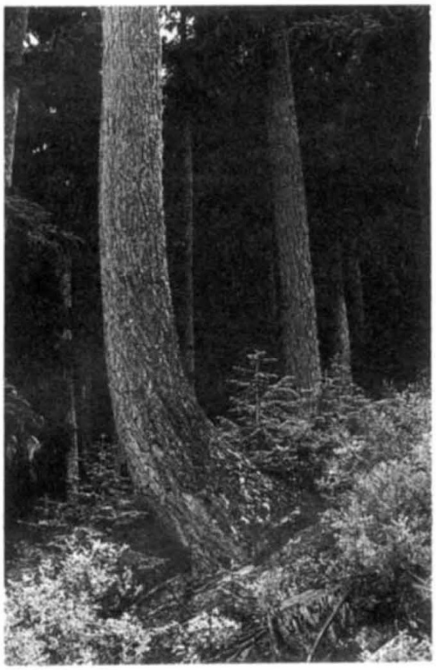

FIG. 2 Living upslope-curved 450-year-old Douglas fir at the same site. Tree diameter about 1 m (1989 photo).

sik and Woods were not Douglas fir and Sitka spruce but Pacific silver fir and western or mountain hemlock[8]. Shade-intolerant Douglas fir does not inhabit regional forest understories[8], and Sitka spruce does not grow in inland Mount St Helens forests[9].

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SIR — During a recent visit to the former coniferous forest overrun by the hot pyroclastic current (blast) from Mount St Helens on 18 May 1980, Bursik and Woods[1] noted that understory saplings were not levelled like mature trees but remained upright albeit killed. They inferred that a "consistent" pattern of downslope curvature of the dead saplings occurred by differential dehydration of compression (downslope) wood relative to regular (upslope) wood — dehydration caused by the sustained hot current. They concluded that saplings therefore cannot be used as flow-direction indicators but could be used as a proxy measure of temperature and duration of a hot particulate flow. Both conclusions are erroneous, for the premises that the curvature is consistently downslope and that the hot current directly caused the curvature are both false.

The condition of the saplings has gradually changed since the eruption. During the first 4 months after the eruption many observations were made on the timber[2], though mainly on large mature logs and stumps. The saplings either stood straight or had been tilted in the downcurrent direction. On volcano-facing slopes the bent saplings were concave upslope; on slopes away from the volcano they were bent concave downslope. This pattern persisted for some time, at least a few years. This eruption-induced tilting was independent of concave-upslope curvature within the basal 2 m which commonly occurs in saplings on steep slopes because of creep of regolith or winter snow (see the letter above from Yamaguchi).

While preparing a field guidebook[3] in 1988, I noted a curiosity of the standing saplings that had not been present in the early 1980s: many of the dead straight or concave-downcurrent saplings had become distinctly concave upcurrent. On a 10–20° east-sloping ridge just east of Spirit Lake, where the pyroclastic current running downslope in 1980 had tilted saplings downslope, by 1988 many of them had acquired a concave curvature facing upslope (upcurrent). This curvature was mostly in the upper half of sapling trunks, unlike that near the base caused by snow creep. I noted the volcano-facing concavity because it was bizarre, fairly systematic, and different from the pattern in earlier years.

The upslope concavity in the saplings on a slope facing away from the volcano is the opposite of the downslope concavity noted by Bursik and Woods apparently on a volcano-facing slope. The volcano-facing concavity of dead saplings also exists on gentle slopes. Thus the relation of curvature to a tree's downslope compression wood is inconsistent, but its relation to blast-current direction is consistent.

The pyroclastic current of 18 May 1980 had little or no direct effect on the eventual curvature. The hot current only abraded and baked off the bark and thus exposed the sapwood on the upcurrent side, whereas the downcurrent side lay protected for one or a few years beneath an attached bark strip. By 1988 much of the bark had fallen off and been scattered by wind.

The direct cause of curvature apparently was gradual drying over a few years by differential exposure of sapwood to the ordinary perils of sun and rain. Unprotected by bark, the exposed upcurrent wood shrank, while downcurrent wood remained more or less unaffected beneath bark, a process also seen on houses sided with unfinished wooden shingles or clapboards. Shingles or clapboards on the south side of a Northern-Hemisphere house directly exposed to the sun can warp, crack and shrink in a few years. Meanwhile the same materials on the north side of a house or where shaded by a porch roof remain pristine.

The bent saplings are reliable indicators of current direction: after a few years of weathering their acquired concavity points to the side that lost bark (upcurrent). Conversely, they are nearly useless as indicators of the temperature or duration of the pyroclastic current that killed them.

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Which theory?

SIR — I should like to comment on John Maddox's article[1] on the alleged elimination of divergences in quantum electrodynamics (QED) by R. Suzuki[2]. Suzuki claims to eliminate the divergences of Feynman loop diagrams by applying to QED a transformation that decomposes the basic electromagnetic current–photon interaction into two parts, each of which makes equal and opposite contributions to the loop divergences. However, the transformation in question consists of two parts, one ordinary time reversal, the other a 'light-cone rotation' of the time-like and longitudinal photon fields. (This rotation is not consistently extended to the space-time co-ordinates or the electron fields. Its physical significance, as Maddox points out, is obscure.)

QED is invariant under the former transformation, but not under the latter. Hence, Suzuki has actually demonstrated the cancellation of divergences for a different theory, not QED. Inasmuch as the divergences of QED are invariant under that theory's symmetries — Lorentz symmetry and local gauge invariance — no transformation that leaves QED invariant can eliminate the divergences.

Maddox's article also perpetuates the myth that the renormalization of divergences is a flaw of quantum field theory. In fact, the divergences have a definite physical meaning, associated with well-understood short-distance behaviour. As long as field theories have free para-