years seems to be certain. Still speaking very literally, Vredevoort II puts Krakatoa in the shade.

The world's weather is quite delicately balanced on the solar constant, the value of solar radiation received at the surface in clear weather. This has changed in the past. There are graphs which match the Ice Age datings of the past megayear against the cumulative effect of such astronomical changes as rotation of the axes of the Earth's orbit, precession, and so on. The resultant changes in the solar constant calculated from these effects are small; but the two graphs match with broad fidelity. Small factors, then, affect the polar ice caps and other similar matters. Our dust-veil is going to keep the Earth colder for about ten years. This is certainly time enough for the polar ice caps to grow. Even when cloud-cover has long since dispersed and the dust-shroud has settled, this growth in the polar ice will leave the planetary albedo seriously increased; more of the sun's heat will be reflected back to space.

A long, long planetary cold spell is safely predictable, despite any comparisons which are made with the cloud-cover, dust-cover, or heaven-knows-what-cover shrouding Venus. (In passing, it seems that all was not well with the estimates of surface temperature made when Mariner flew by Venus. Oh well, sailors who make brief passes at the ladies often receive equivocal replies . . .)

At first sight, the mechanical effects of the strike may seem to concern the globigerina ooze and the fish which provide an involuntary bouillabaisse. Marine quakes and seisms would not appear to concern life on land. This view neglects the matter of Tsunamis.

Commonly miscalled a tidal wave, the tsunami is normally caused by a tremor in the ocean bed: a rise or settlement of a few inches, or a jerk along a fault of a few yards or so —the type of thing which causes an earthquake on land. But on one occasion at least, the tsunami has resulted from a volcanic detonation. Right first time—Krakatoa!

Whatever the cause, an oscillation of the ocean is generated. There is no mass transference of water. Characteristically, the vibration is of low amplitude but very long wavelength. The speed of waves at sea is determined by the wavelength which in its turn is affected by the depth of the

ocean. Because of its very long wavelength, the tsunami moves very fast indeed. The low amplitude may make it imperceptible when it races past a mid-ocean vessel at four hundred fifty miles per hour. This does not prevent it from raising the purest kind of hell where it breaks on shore. Here it builds into a devastating breaker which may reach miles inland. Ocean-going vessels have been stranded miles from the beach. The Krakatoa tidal wave broke upon Indonesian coasts in rollers which reached heights well over a hundred feet. It was *visible* as far off as the Cape of Good Hope. It was clearly *detectable* in the English Channel. It was still just detectable after circling the world again.

The 4×10^{29} erg punch delivered by Vredevoort II is expected to create quite a ripple. Mass displacement of the water, submarine quakes, and the pressure wave through the ocean will all contribute to the tsunami. The energy which it temporarily absorbs before restoring it as heat is conjectural. A reasonable allotment would be about one-sixth of the total power account sheet.

This will give it a force of 7×10^{28} ergs, two orders of magnitude more powerful than the largest recorded earthquakes. As already mentioned, these were continental. They spread their effects through millions of cubic miles of crust and mantle. We just do not know what tsunamis they would have raised had they been shallow disturbances under the mid-ocean.

But we *do* know what the millionfold-weaker occurrence at Krakatoa achieved. Quite obviously, the volcano did not exert its total strength in raising the tidal wave. Even if we credit the tsunami with all the 7×10^{22} ergs of the detonation, the meteorite tidal wave is a full millionfold stronger.

The tidal wave is a very efficient vehicle for transferring energy over long ranges. Frictional losses are fairly low, right up to the point where it climbs ashore to wreck the landscape. One sees it as an *area* rather than a *volume* phenomenon; roughly speaking, the third dimension is constant.

Let us, however, credit it with a decrement of distance cubed. This is conservative, being more appropriate to volume effects, like dynamite blasts in air. This decrement will make the meteoric tsunamis work at ranges the cube root of a million times those of the volcano: that is, at one hundred times the distance of the Krakatoa tidal wave. This gives it