importance of bed load. I have derived[2,3] a bed load transport formula, checked it against some measured transport rates in New Zealand rivers, and applied it to many South Island rivers. The value of this (as of any bed load equation) is open to question, but it does estimate the bed load of the Waimakariri River as given by Griffiths[7] to within 15%. Dissolved loads have also been estimated in a general way[2,3] and, taken with the bed and suspended loads, suggest that for the Southern Alps the suspended load is 93%, the bed load 3%, and the dissolved load 4% of total river load.

(5) Griffiths neglects to mention that sampled river loads need not represent long-term average erosion rates. Some sparse New Zealand data[2,3] and observations in New Guinea[8] led me to conclude that in the northern part of the South Island, infrequent, earthquake-caused landslips could double the short-term erosion rate when averaged over hundreds of years.

(6) The obvious relationship between erosion rate and rainfall in the Southern Alps has been widely recognized. My thesis[2] contains data and discussion, showing that Fournier's[9] 2.65 power relationship between erosion rate and rainfall fits the estimates of erosion rate of the eastern slopes of the Southern Alps acceptably well. In contrast to the catchment averages used by Griffiths, the integral of local values of erosion and rainfall rate were used[4]. McSaveney[10] deduced a 2.92 power relationship and observed "rainfall is overwhelmingly the dominant influence on present erosion rates", a result later shown by Griffiths' multiple regression analysis.

(7) Griffiths' work is in general agreement with the published work cited above, and with the exception of the value for the Cleddau, I consider his estimates reasonable. There is an overall balance between rates of crustal shortening, tectonic uplift, river erosion, and deposition offshore for the South Island of New Zealand that indicates contemporary uplift and erosion of the Southern Alps[3]. The balance implies long-term erosion rates of up to 48,000 tonnes km^{-2} yr^{-1}, perhaps half of which occurs as catastrophic landslips. There seems little doubt that quite large catchments in the Southern Alps presently have erosion rates greater than 15,000 tonnes km^{-2} yr^{-1}.

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GRIFFITHS REPLIES—In considering Adams' points (1) and (2) the relevant work is that of Thompson and Adams[1]. These authors assert that most of the scatter in New Zealand suspended sediment concentration versus water discharge ratings results from sediment exhaustion effects. They specifically assume that for a given river discharge the concentration on the rising stage of a flood is always higher than on the falling stage. Thompson and Adams[1] support this with results[2] from a single flood on Mararoa River. Because most concentration data have been collected on the falling stage, the authors compensate for sediment exhaustion by fitting straight lines "drawn midway between the scatter of the points" so as to give equal weight to the limited amount of rising stage data. Among the more serious deficiencies in the justification and application of this methodology are: first, on nearby Shotover River[1] scatter limits in the suspended sediment concentration rating are controlled mainly by seasonal effects. Rising and falling stage data are fairly evenly distributed (D. M. Hicks, personal communication). Second, Thompson and Adams did not identify the latter data. On Waimakariri and Forks Rivers, for example, all measurements were made on falling flood stages or at low flows: yet the ratings still are drawn midway through the scatter of the points[1]. Third, Thompson and Adams[1] do not always follow their rating definition prescription. For instance, on Acheron, Ahuriri, Clarence and Rakaia Rivers their ratings do not bisect the data scatter.

Thompson and Adams have made little use of the data: the positions of their rating lines are arbitrary; their results are not repeatable. Consequently, in this context, the relevant works[1,3] were not considered as serious references. At some sites, however, the rating definition is not too sensitive and there is the stated agreement of results[5].

Referring to his point (3) for Cleddau River suspended sediment rating, Adams uses a rating line slope of 1.7, without justification[3], whereas at his other 45 sites he assumes a value of 2.3. Even using his rating equation I cannot duplicate his yield of 275 tonnes km^{-2} yr^{-1}: instead I obtain some 2,000 tonnes km^{-2} yr^{-1}, which reduces the discrepancy to a factor of 6.5. The residual discrepancy is accounted for by his arbitrary definition of the suspended sediment rating. Similar wide discrepancies arise at other sites for the same reason. For example, in Mangatu, Waingaromia and Waipaoa Rivers, Adams[5] lists yields of 28,000, 20,000, 14,000 tonnes km^{-2} yr^{-1} respectively, whereas I calculate, using the same data, values of 7,000, 17,000, 5,000 tonnes km^{-2} yr^{-1}. Adams[3] supports his Cleddau River yield estimate with sedimentation data obtained from a single borehole in Milford Sound. He assumes suspended sediment deposition, age and areal extent of deposit and size of contributing area. This does not, in my view, constitute adequate scientific evidence.

My comments on points (4) and (5) would be too lengthy; my conclusions are similar to point (3).

With regard to point (6) Fournier's[6] relationship as applied by Thompson and Adams[1] does not fit the estimates of erosion rate acceptably well. In fact, the constant E_0, in their modified equation varies from 2,000 to 160,000 tonnes km^{-2} yr^{-1} (see Table 1 in ref. 1).

On Adams' point (7), McSaveney (personal communication) estimates a long-term yield in excess of 50,000 tonnes km^{-1} yr^{-1} in Cropp River, a tributary of Hokitika River[5]. Erosion in this catchment occurs by natural fluvial processes including frequent landslips under high intensity storms.

Finally, the units of suspended sediment concentration used in Fig. 2 and in the calculation of the coefficients in my first paragraph[5] are given incorrectly as kg m^{-3} instead of g m^{-3}. This error, however, does not enter into the results or conclusions.

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Molecular clockwork

THE results of the very interesting experiment of Hartl and Dykhuizen[1] can be interpreted differently. There are three statistical problems with their conclusion that response by *Escherichia* to natural selection occurs as rapidly with generations of 5 h as with those of 2.5 h.

First, in their Table 2, basing an analysis on the last 200 h instead of the last 300, as equally justified by their own argument on the duration of the later periodic selection, would reverse the conclusion, the rate of evolution being much greater in the

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