Phocid herpesvirus-1, but we are also studying a second virus that is cytopathic for seal kidney cells and cells from a number of other species and which was isolated from the lungs of 20 out of 22 dead seals investigated. By negative contrast electron microscopy this virus has been tentatively classified as a member of the Picornaviridae family.

In the past three years we have applied virus isolation procedures to lungs of 20 normal seals and 15 with signs of acute pneumonia. No virus has been isolated from the former animals but 11 of the animals with pneumonia yielded *Phocid herpesvirus*-1. These data indicate that the newly isolated picorna-like virus, or *Phocid herpesvirus*-1, or both viruses, have probably caused the outbreaks of disease among the seal populations. Serological investigations on convalescent seals will be conducted in an attempt to confirm this hypothesis.

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Effect of bedslope on desert sand transport

Sir—Hardisty and Whitehouse[1] report most interesting field data concerning the wind transport of sand when this is either assisted or retarded by bedslope. We believe that these data will have considerable value in developing and testing adequate theories of aeolian transport. However, their discussion appears to take little account of some features of the process which are reasonably well established. In consequence, they attribute the effect of bedslope to a "new sand transport process", whereas it can be attributed more helpfully to the influence on known processes of a gravitational field which is not normal to the bed.

Grains are indeed dislodged predominantly by the collision of saltating grains. Much is now known about the outcome of collisions[2-4], which seem to give rise to two distinct populations of launched grains. Ricochet of the incident grain usually occurs and is vigorous enough to enter another saltation; meanwhile a small number of grains (up to twelve or so) are dislodged and undertake much smaller trajectories which Haff has called "reptations" (see ref. 5). The angle of launch has a considerable range (Fig. 1), a significant proportion of dislodged grains emerging with an upwind velocity component. The saltating grains are essentially wind-driven and follow paths which are very similar for sloping and horizontal beds. Reptating grains, however, travel at levels at which grain-laden boundary-layer flow is very sluggish, and are controlled predominantly by gravity. They account for a substantial proportion of the transport rate. It is to be expected, therefore, that a change, relative to the bed, of the direction of the gravitational field will affect the transport rate much more than is predicted by the quoted equation (5), in which internal shear stress of the grain mass is always resisting gravity.

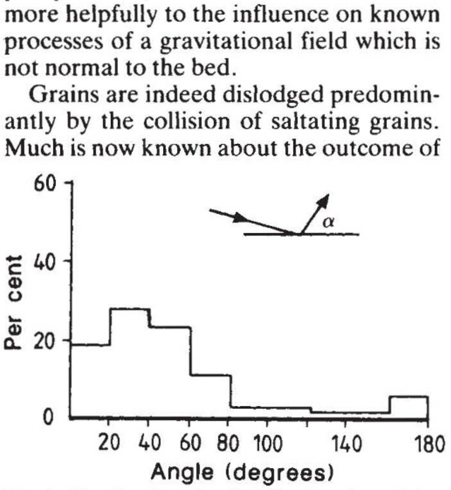

Fig. 1. Distribution, for dislodged grains, of the take-off angle, α, referred to the horizontal bed (see inset).

The effect of bedslope on transport rate can be understood only in terms of the detailed consequences of inter-saltation collision. The data obtained by the authors promise to assist the development of such understanding by extending the circumstances in which grain transport models can be tested. Models already exist (see, for example, ref. 5) which could with little adaptation be used to predict changes of transport rate with θ, such as those reported.

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Hardisty and Whitehouse Reply—Willetts and Rice raise three important points about our paper[1] on desert sand transport to which we would wish to respond. These points concern the sand transport data, the semantics of the subject and finally the source of the energy which drives the impact-induced gravity flow (IIGF) which we postulated to explain the difference between our results and traditional theory.

Dealing firstly with the data, we agree that our results should be used by ourselves and others to test new theoretical developments. To this end we have transferred all our measurements in ASCII format to PC disk. Copies of the disk will be available from the address below.

Semantically we are also in agreement with the papers referenced by Willetts and Rice, which use the word saltation for those grains moving on a trajectory above the bed which is affected by the wind. This distinguishes such grains from those which are said to be reptating; this term being used to describe those grains which are moved above but close to the bed by an impactor and are unaffected by the shearing wind. Both saltating and reptating grains will of course return to the bed at a point which is separated from their starting point by a distance which varies with the bed gradient. Such is the result of the geometry of the grain path and the distribution of jump lengths is well evidenced by, amongst others, the work of Willetts and Rice.

These considerations lead to the final and most important point, which concerns the question of whether the IIGF which we postulated is indeed a fundamentally different process or, as Willetts and Rice appear to be contending, simply reptation on a slope. Without repeating the description which we gave in our paper, we are suggesting that we have observed a different process. IIGF is more closely linked with the observations of grains vibrating about their niche positions during subaqueous initiation on a horizontal bed, which were reported by Gessler[6] and Yalin[7]. These vibrations are produced by fluid shear, whereas we postulate that impacting grains can produce a similar response. Anderson[5] (page 945) referred to such when he noted that less than 1% of the impactors' kinetic energy is transferred to the ejected, saltation and reptation grains, and that the remaining energy induced 'local transient dilation of the bed, inelastic deformation of bed grains, and frictional rotation of the bed grains'. We are suggesting that under a well-developed saltation flux, these mechanisms greatly reduce the shear strength of the surface grain layer so that a type of gravity flow can occur on non-horizontal beds. The process is different from reptation because the moving grains do not leave the sand surface and are not impelled by direct impact. It is difficult to envisage how the type of simple changes to existing, kinetic models to which Willetts and Rice refer will predict these effects. Our empirical equation (6) provides a quantitative estimate of the magnitude of the sum of all of these processes, and the next step is a more rigorous theoretical model.

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