

to increase the 2,3 DPG level appreciably to combat functional anaemia. Further studies are needed for elucidation of this unique phenomenon in E-B thalassaemia.

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ENTROPY MINIMIZING LANDSLIDE SYSTEMS

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LANDSLIDES are complex dissipative systems which self-create on hillslopes provided with excess relief energy. This excess energy may be generated by processes which increase stress in, or which decrease the strength of, the hillslope. The result is the same. The hillside is transformed by the emergence of a landslide structure.

Conventional theory considers landslides as systems which dissipate energy. It may be better to

examine landslides in terms of entropy dissipation and self-organization¹.

Dynamic systems exist in one of three conditions with respect to the creation of entropy. (i) They may accumulate entropy through their own operations and so rundown or decay. The behaviour of such "entropy maximizing" systems follows the second law of thermodynamics. (ii) Dynamic systems may balance entropy production during their operation by importing energy from beyond the system boundaries. This energy maintains the system and so, effectively, dissipates entropy back into the environment, (iii) A system may import so much energy that it dissipates more entropy to the environment than it creates. Entropy minimizing systems grow, reproduce, organize and evolve.

Most landslide systems accumulate entropy during their operations. Few are discrete events but their activities tend to diminish from year to year. However, some landslides do not diminish, but expand in successive seasons. The end product of each landslide event is a hillslope system which has more excess energy than before. Road engineers in the Himalaya name these features "chronic" landslides². In sum, there are two fundamental attractors in road-construction-induced landslide systems: extinction and infinite size within the limits of the environment.

In 1978, field measurements were made of the volumes of all landslide outfalls deposited along two new reaches of Himalayan hillroad. There were 257 outfalls including 6630 m³ of debris on a 6 km reach of the Mussoorie-Tehri road and 63 outfalls totalling 1880 m³ of debris on the newly completed Mussoorie Bypass^{3,4}. If measured landslide outfalls are arrayed as a ranked series it is possible to describe the relation between rank and log-normal volume as a statistically significant linear relationship. The landslide outfalls can be called self-similar (fractal dimension: about 1.6)⁵. This is consistent with the existence of a single, maximum entropy, system attractor in the landslide system.

However, this appearance is an artifact of statistical generalization. Indicative is the fact that, at Landour, higher landslide outfall volumes per kilometre are recorded on the older road-bed (1,105 m³/km) than on the newly created Mussoorie Bypass (940 m³/km), despite a similar geology and the Bypass crossing a steeper hillside. Total landslide outfall volume on the two roads is heavily influenced by a few very large landslides. Figure 1 shows the largest outfalls deviate systematically above the rank-size regression line⁵. The conclusion:

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these largest outfalls are due to landslides which are qualitatively different to the norm.

Support for this hypothesis has emerged from more recent studies of landslides along two, post-1980, hill roads in Kumaun⁶. This work involved a search for the geocological correlates of landslide activity. The objective was to discover environmental parameters which could be combined as a descriptive model for landslide prediction. The study employed a classification of landslide phenomena which distinguished rockfalling (fracturing, gravity) from slumping (rotation, creep) and debris chutes (decomposition, flow). It proved possible to define

significant correlations between rockfalls and debris chutes and other parameters of the hillslope system. Two separate studies in different geological contexts failed to discover any significant environmental correlates for slumping failure. However, the slumping failure class included most of the largest, and apparently most persistent, landslides.

Modern evolution theory recognizes a phenomenon which Jantsch¹ names "autopoiesis". This recognizes that as dynamic systems evolve they insulate themselves from fluctuations in their environment. (Thus mammals are more independent of fluctuations of temperature than reptiles.) Sys-

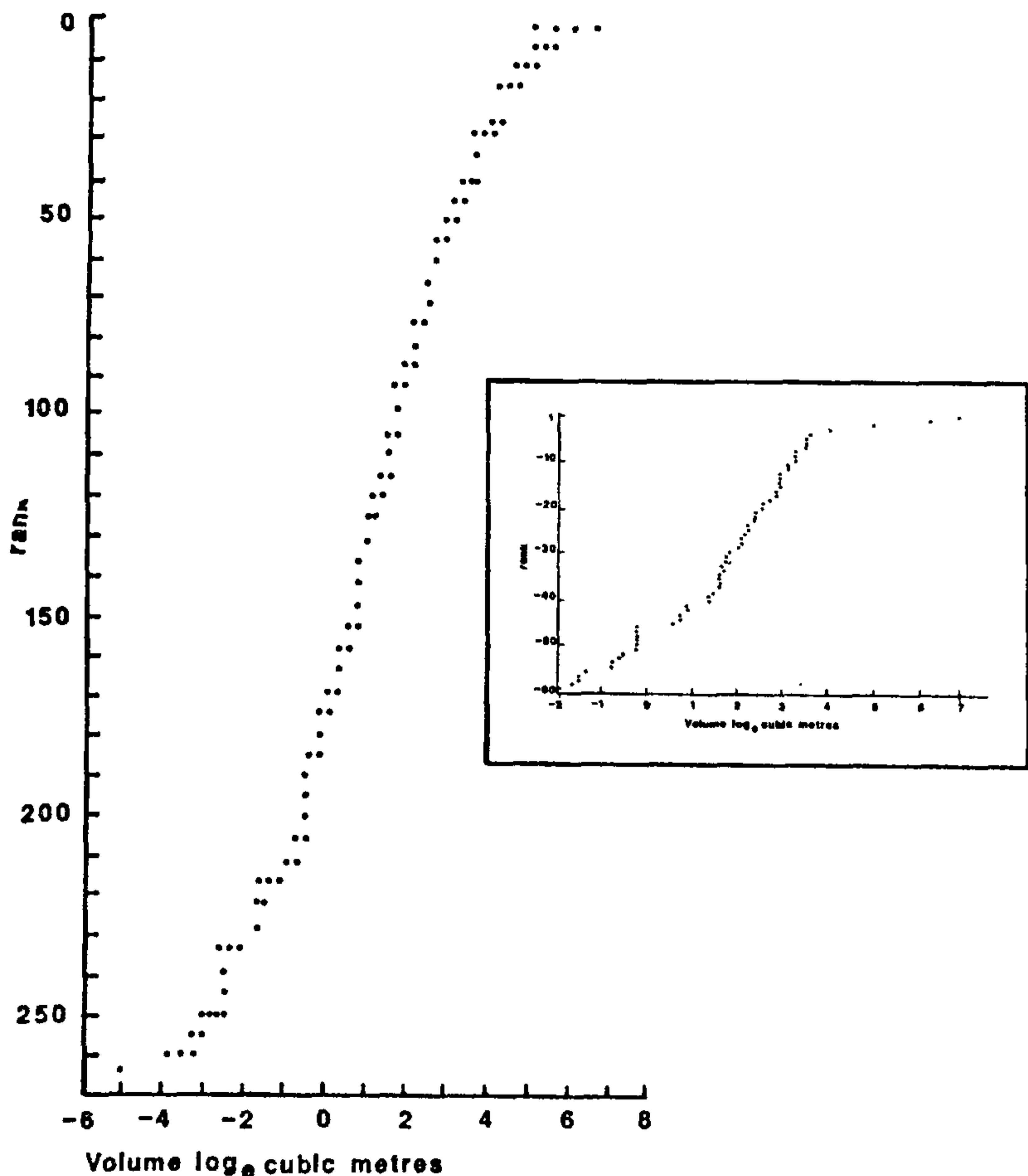


Figure 1. Range-size relationship: landslide outfalls in the Mussoorie-Tehri road (inset: Mussoorie Bypass).

tems evolve successfully by creating structures which increase their capacity to extract energy from the environment and to override fluctuations in the environment. Viewed from this perspective, it might be expected that, while entropy maximizing landslides should be strongly influenced by their environmental controls, entropy minimizing "chronic" landslides should achieve a relatively large degree of independence. In sum, self-expanding "chronic" landslides may only be identifiable through an evaluation of their own, internal, energy-generating, structures. In this case, the key structure seems to be the back wall created by a rotational slump, a feature which may be steeper and less stable than the hillside it replaces.

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NEW INSECT GROWTH REGULATORY COMPOUND FOR THE CONTROL OF INDIAN RICE MOTH *CORCYRA CEPHALONICA* (LEPIDOPTERA: GALLERILIDAE)

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In our search for plant extracts and natural products for insecticidal properties, we have found petroleum ether extracts of the aquatic weed *Eichhornia crassipes* (Mart) Solms as a source of potential juvenile hormone mimic, against certain insect pests like *Dysdercus cingulatus* and *Tribolium castaneum*¹. These studies were further extended to assess the growth and reproductive

inhibitory activity against freshly moulted fifth instar larvae of rice moth *Corcyra cephalonica*, a serious pest on stored products. Three active fractions from the crude extract were isolated chemically on TLC and these fractions were assayed against the larvae of rice moth.

C. cephalonica culture was maintained on pearl millets in the laboratory insectary at $27^{\circ} \pm 2^{\circ}\text{C}$ and 50% RH. Different fractions of the extracted materials were assayed against freshly moulted fifth instar larvae. One μl acetic solutions of different concentrations of the three fractions were topically applied to the larvae using an Agla micrometer syringe. The same volume of solvent was applied to the larvae of similar age as controls. Treated as well as control larvae were provided with pearl millets as feed and kept under observation for pupation and adult emergence, in glass bottles with mesh lids.

Of the three fractions assayed for toxicity and growth inhibitory activity against *C. cephalonica* the component from the III fraction was found to interfere with the morphogenesis of the treated insects. Immediate mortality of the larvae was not observed after treatment. Symptoms of poisoning manifested only during pupation. At $1\ \mu\text{g}$ and $0.75\ \mu\text{g}$ doses, most of the larvae became black, exuded their body fluids and ultimately died without pupation resembling the symptoms typical of chitin inhibitors^{2,3}. At all doses tested metamorphic abnormalities like formation of larval-pupal intermediates, abnormal pupae, etc. were observed. At $0.5\ \mu\text{g}$ and $0.25\ \mu\text{g}$ doses prolongation of larval period was observed. Crude extract of water hyacinth produced similar activity against red flour beetle¹. Prolongation of larval period may be due to the inhibition of moulting process caused by an increased titre of JH in the insect body. The adults emerging from such pupae always showed abnormal wing pattern. Such adults failed to reproduce and died 2-3 days after emergence. When dissected in insect ringer solution abnormal size and shape of Vas deferens and accessory glands was noticed in case of males. Likewise, female insects showed under-developed ovaries with reduced number of oocytes. In our earlier studies we have reported similar reproductive abnormalities against *Dysdercus cingulatus* with JH analogue and chitin inhibitor^{4,5}.

The per cent inhibition at each dose was calculated based on the scoring system of morphological deformities⁶. The per cent inhibition thus obtained at each dose was subjected to probit/log concentration transformation so as to draw probit regression line. From the regression line 50% inhibition dose