Correspondence

Poly-I : C

SIR,—As much as anyone, I look toward the advent of specific therapies for viral diseases. Unfortunately, the data reported under the heading "Good News on Poly-I:C" (*Nature*, **225**, 1103; 1970) do not merit the optimistic tone of the title or the article.

One can use Fisher's exact method to calculate the probabilities that the incidences of cold and influenza were the same with placebo as with poly-I:C. The values are $P > 0{\cdot}1$ and $P > 0{\cdot}2$ respectively. We really need more encouragement than that.

Possibly Baron *et al.* mentioned this in their presentations (I do not have ready access to copies). If so, this, in all fairness to the authors, should have been stated in the report.

Yours faithfully,

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Scientific Bibliography

SIR,—Naranan[1] claims to have provided a mathematical model which exposes the mechanism underlying Bradford's law of scatter of articles relevant to a given subject among scientific journals. In particular he claims that "a frequency distribution $J(p)$ of the number of journals with p articles, of the form

$$J(p) \propto p^{-\gamma} \qquad (1)$$

with $\gamma \approx 2$, reproduces the salient features of Bradford's law". Naranan's model certainly reproduces some salient features of the growth of scientific literature on the reasonable assumptions that numbers of journals and of papers in journals are both growing exponentially. But the frequency distribution (1) is only an asymptotic approximation to Bradford's law which others have also considered from time to time. A critical review of recent bibliographic work on the distribution (1), which has arisen independently in several taxonomic fields and which bears several names, has recently been published by Fairthorne[2]. No one has yet succeeded in deriving Bradford's law precisely, in a form which generates the geometric series which Bradford explicitly specified[3], from any frequency distribution of the form $p^{-\gamma}$.

However, Naranan's analysis needs only slight modification to provide a model of another empirical law of scientific bibliography first enunciated by Lotka[4] and based on analysis of entries in a 10-year cumulative index of *Chemical Abstracts*. Lotka found that $A(p)$, the number of *authors* who contribute precisely p papers, is proportional to $p^{-\gamma}$ with $\gamma \approx 2$. This distribution, it can be seen, is identical with (1) above. If for Naranan's assumption that the number of journals is growing exponentially we substitute the assumption that the number of contributors is growing exponentially (which is equally valid), then Naranan's analysis (with suitable verbal amendments) provides a plausible model of Lotka's law.

Lotka's law, like Bradford's law, is also remarkably stable though the conditions under which it can be expected to apply are as yet less well understood. This "inverse square law of scientific authorship" has hitherto been regarded as an inexplicable and useless statistical oddity. Naranan's model of it is therefore welcome. And, together with other measures of scientific productivity, Lotka's law has recently been applied by Dobrov and Korennoi[5] in determining the optimum size of research institutes in the USSR.

Yours faithfully,

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[1] Naranan, S., *Nature*, **227**, 631 (1970).
[2] Fairthorne, R. A., *J. Doc.*, **25**, 283 (1969).
[3] Bradford, S. C., *Documentation* (Crosby Lockwood, London, 1946).
[4] Lotka, A. J., *J. Washington Acad. Sci.*, **16**, 317 (1926).
[5] Dobrov, G. M., and Korennoi, A. A. in *On Theoretical Problems of Informatics* (F.I.D. 435, Moscow, 1969).

Fitting Boulders

SIR,—Since the publication of my note[1] on fitting boulders in New Zealand, Hills's descriptions[2] together with correspondence I have received make it clear that the phenomenon is very widespread. Examples from the north Yorkshire coast had been noted by C. Simms, curator of natural history at the Yorkshire Museum, and the following extract from a poem he wrote in 1966 well describes them

"Notice how these sea-shored boulders pack,
not all-sprawled as spate rivers leave them,
but crazy-builded, seamed by crablined crack.
With age they wear closer to one another."

Hills[2] disagrees with my suggestion that salt or ice crystallization is a principal agent involved, and he ascribes fitting boulders to wave action. In my note, I was careful not to rule out wave action as a contributory process: nevertheless, I believe the evidence argues against it being the prime force involved. Hills pointed to examples of fitting boulders at mean sea level where they never dry out, but he is mistaken in believing this necessarily precludes salt crystallization. In the presence of a hot dry wind the rate of evaporation could be such that continual wetting merely leads to replenishment of salt solution, salt crystallization being increased rather than retarded.

Hill's statement that there is a relationship between wave force and the maximum size of fitting boulders needs proper exemplification before it can be accepted. As he indicates, the situation is complex, the maximum size depending not only on wave force but also on height above sea-level. I would add to this the following complexing factors: the size of the original boulders, since clearly the maximum size of fitting boulders cannot be greater than that of the source material; whether or not the piles of boulders are on firm bedrock or shifting fine material; the fabric of the boulders; the resistance of the various lithologies to weathering processes in general. The maximum size of fitting boulders at all the localities at which I have observed them has simply been the maximum size of the boulders present at those localities.

The ideal location to test the relative importance of salt/ice crystallization and wave action in the production of fitting boulders would be a freshwater lake where ice crystallization is unknown or rare and salinity always low.

Yours faithfully,

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[1] Shelley, D., *Nature*, **220**, 1020 (1968).
[2] Hills, E. S., *Nature*, **226**, 345 (1970).