

note; your health and that of your children is in your hands.

People's Health in People's Hands is a book by N. H. Anita, which had already been read by Robin Fox and Valiathan. It outlines the philosophy of Panchayati Raj. The MS Swaminathan Committee recommends the new principle of 'local planning, central funding'. A welcome shift from the old model of central plans

and target-oriented, rigged-figure-ridden, vertical, hierarchical, top down, inefficient, undersupervised, unweildy, inadequately funded health care system in which no one is accountable and everyone grazes the scapegoat.

Post script. Be on the look out for a forthcoming paper in *The Lancet* on A District Level Disease Surveillance System. A Model for Developing Countries.

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2. Kumar, S., *Lancet*, 1998, **351**, 1261.
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SCIENTIFIC CORRESPONDENCE

Flavour of fundamental particles and prime numbers

Earlier Ramanna and Sharma¹ had shown that prime numbers play an important role in the systematics of fundamental particles, and many aspects of unstable nuclear phenomena can be understood through the simple equation:

$$\hbar/MT = n/2^n \quad (1)$$

$$= \tau/T,$$

where \hbar is Planck's constant, M the mass of the fundamental particle in energy units, T the half-life of the particle in s, τ is the half width, and n a parameter.

Writing $-p = \log_{10} n/2^n$, we have

when $n = 6 \ 10 \ 14 \ 21 \ 28 \ \dots \ 42 \ 49 \ \dots$

$$p = 1 \ 2 \ 3 \ 5 \ 7 \ \dots$$

to within a few per cent of the values of the primes.

Denoting all the values of n derived for particles from experiment as n_{exp} , we arrange them in the order of increasing values of n_{exp} . We note, as pointed out earlier¹, that in the region between $n=22$ and $n=44$ there is only one particle, i.e. π^0 . Using the maximum and minimum values of n_{exp} , we arrange a set of equally spaced numbers but in decreasing order and denote them by n_{int} . Further, we define a function R and its derivative Q

w.r.t. n ,

where $R = (n - n_0)/(p - p_0)$ and

$$Q = \{[p \log 2 - \log n + 1 - (p/n)] / \{n \log 2 - \log n - p_0\}^2\}$$

n is either n_{exp} or n_{int} respectively, n_0 is the nearest integer to n , p corresponds to p_{exp} or p_{int} respectively and p_0 is nearest prime to p .

In Figure 1, Q_{int} is plotted against n_{int} and it is seen that it has maxima at $n_{\text{int}} = 6, 10, 14, 21$ and multiples of 7. Figure 2 gives the same plot for Q_{exp} and n_{exp} . It is remarkable that it also

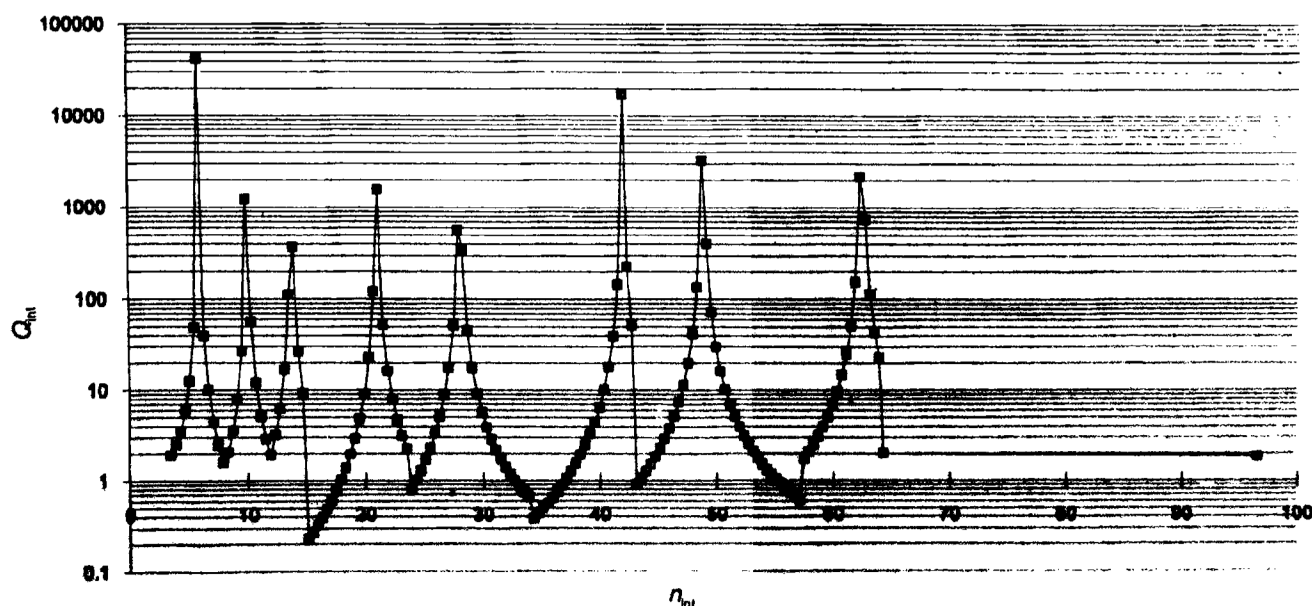


Figure 1. Plot of Q_{int} vs n_{int} showing peak at values of n corresponding to prime nos 1, 2, 3, 5, 7, 11, 13, 17 (derived purely from numbers).

shows maxima at the same numbers as in Figure 1. Figure 3 is a combination of Q_{int} as obtained from R and is derived purely from numbers and n_{exp} are experimental values derived from half lives and masses whose numbers are arranged according to increasing values of n_{exp} .

This combination plot of Q_{int} against n_{exp} reproduces an important aspect of particle physics and corresponds to flavours with their n values arranged according to (i) light unflavoured mesons (LUM), (ii) strange mesons (SM), (iii) charmed mesons (CM), (iv) charmed strange mesons

(CSM), (v) bottom mesons (BM), (vi) cc' and bb' mesons and (vii to xii) n , Δ , Λ , Σ , Ξ , Ω baryons, etc. Figure 4 shows that n_{exp} plotted against the n 's in flavour order is almost identical with Figure 3, where n_{exp} and Q_{int} are in log-log plots. This shows that primes

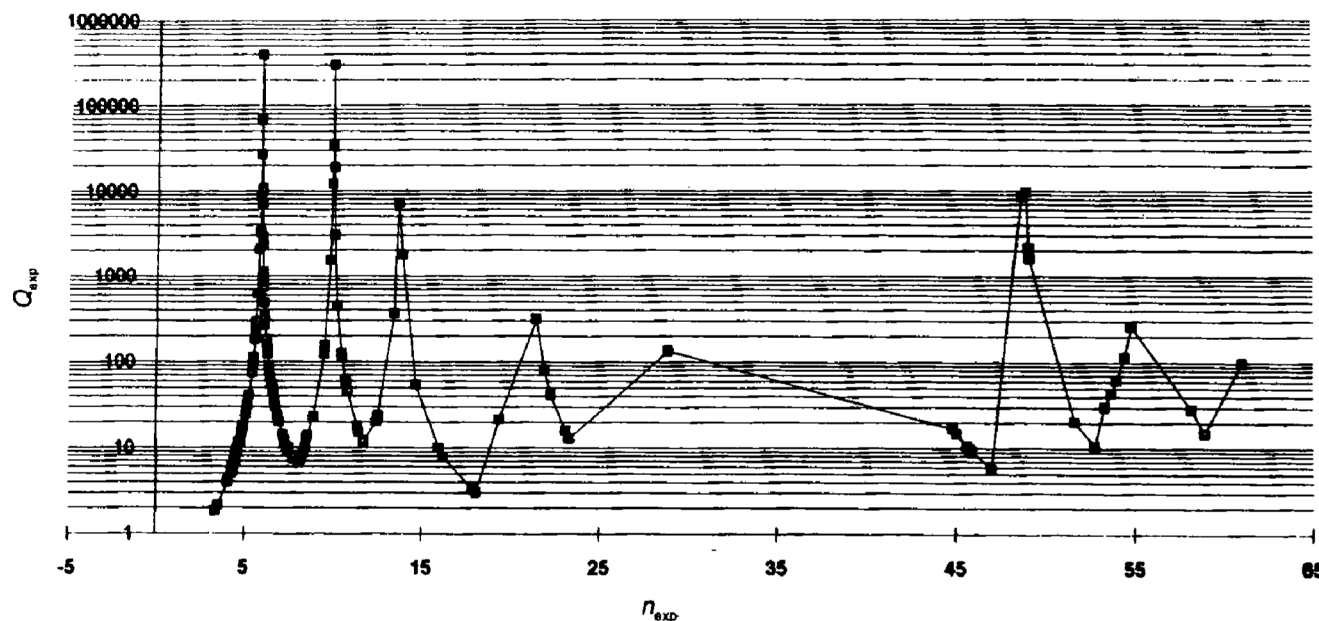


Figure 2. Plot of Q_{exp} vs n_{exp} derived from experimental values and showing the similarity with those obtained from numbers in Figure 1. There is only one particle between 24 and 44.

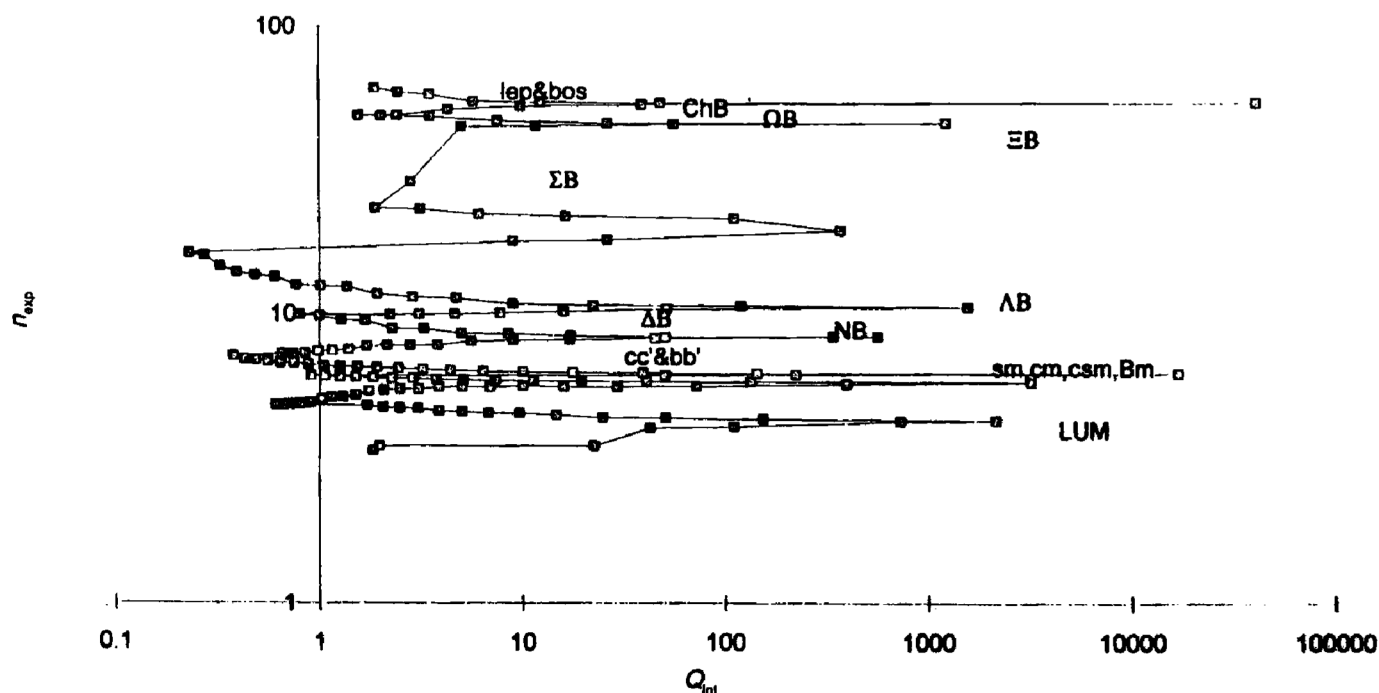


Figure 3. Log plot of Q_{int} vs n_{exp} showing the distribution of flavours from purely experimental $m\pi$ data.

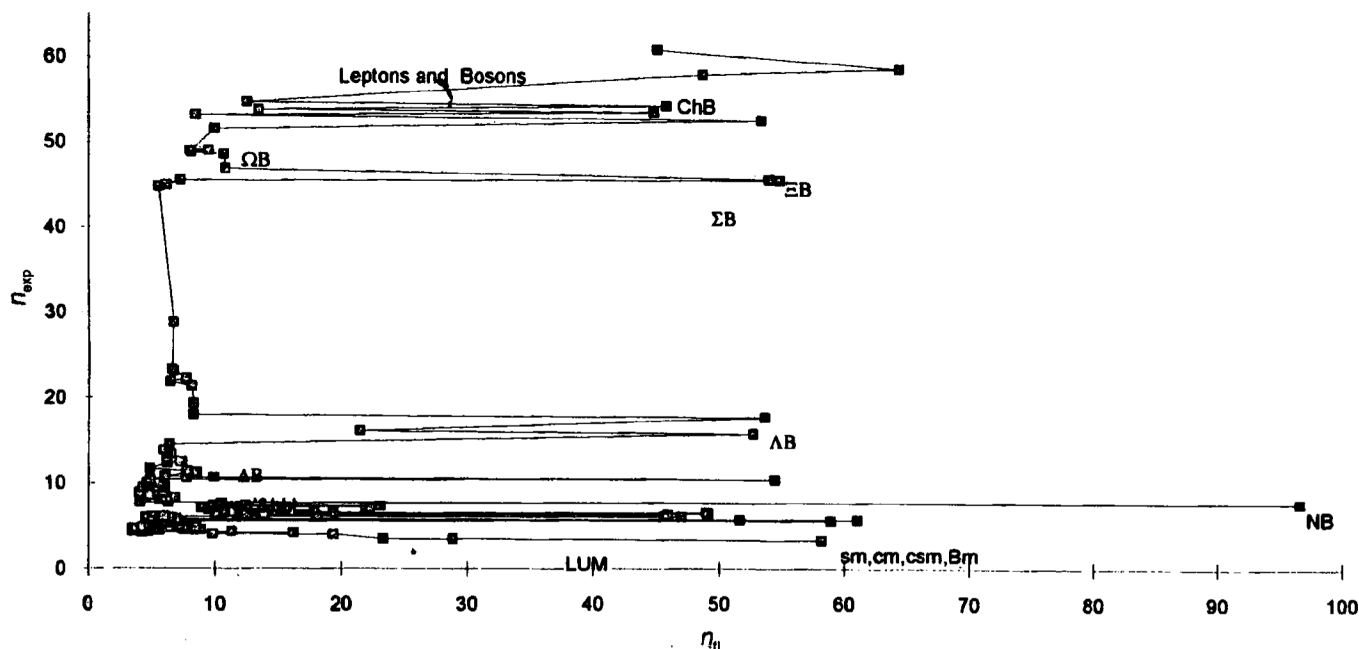


Figure 4. Plot of n_{exp} vs n_l obtained from published data is given in comparison with Figure 3.

play an important role in particle physics as referred to in the earlier publication¹. All this can also be obtained with the function R itself, but the results are not as clear as those obtained with the Q 's.

Another way of looking at the problem of flavours is by converting the representation of $n/2^n$ from an infinite series into a binary series.

Writing

$$n_{01}/2^{n_{01}} = a_{00} + a_{01}/2 + a_{02}/2^2 + a_{03}/2^3 + \dots a_{0m}/2^m + \dots \text{to } \infty$$

$$n_{11}/2^{n_{11}} = a_{10} + a_{11}/2 + a_{12}/2^2 + a_{13}/2^3 + \dots a_{1m}/2^m + \dots \text{to } \infty$$

...

$$n_{m1}/2^{n_{m1}} = a_{m0} + a_{m1}/2 + \dots a_{mm}/2^m + \dots \text{to } \infty$$

...

$$n_{n1}/2^{n_{n1}} = a_{n0} + a_{n1}/2 + \dots a_{nn}/2^n + \dots \text{to } \infty$$

and using the experimental values of n , the binaries of $n/2^n$ can be obtained where each of the 1's is an acceptance of the corresponding coefficient in the infinite series and the 0's are the rejections. Since $n/2^n$ is always less than 1, there will be many zeroes preceding any

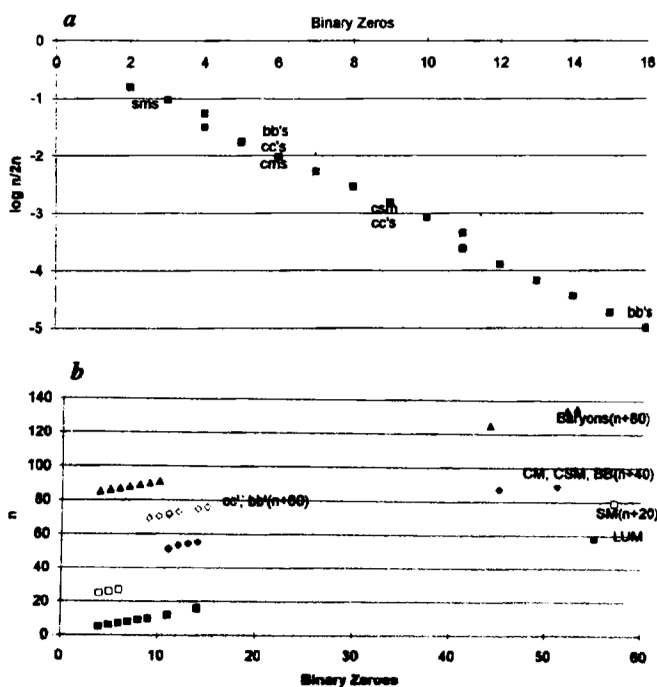


Figure 5. *a*, Plot of $\log n/2^n$ against binary zeros showing that n 's of different flavours are clustered around the primes. *b*, A plot of binary zeros against n 's of different flavours.

1 or a combination of 1's. If m is the least integer such that $2^m \geq n$ then the number of binary zeroes after the decimal is $n - m - 1$. If we plot the number of zeroes against the $\log_{10} n/2^n$'s, it is seen

from Figure 5*a* that the flavours for mesons are clustered around primes¹. If the zeros are plotted against the n 's of different flavours (Figure 5*b*), it is seen that they are distributed differently. It is

possible to show that by plotting $(n' - n)/(\log n'/2^n - \log n/2^n)$, with n_{exp} in appropriate order will give a distribution similar to Figure 3, where $\log n'/2^n$ are primes, i.e. $n' = 6, 10, 14, 21$, etc.

In an earlier publication² it was shown that the parameter n is related to the strength of interactions and that $\log_{10} n/2^n$ is related to prime numbers. These two aspects of the present model are brought together to allow for a wider interpretation of the experimental results.

Courant and Robbins³ had shown that for any set S which has n elements, there are 2^n elements consisting of the set $[T]$ of all sub sets T of S , and as n tends to infinity 2^n implies continuity, i.e. cardinality 2, though n is discrete. Cantor⁴ in 1893 had considered the possibility of using discreteness and continuity in the description of physical laws.

He believed that while masses were discrete, the continuity between them was caused by 'aether'.

From the above studies using equation (1), and some aspects of number theory that discreteness and continuity as described by the ratio of the discreteness of the n 's and the continuous spread of $n/2^n$, which is directly connected with the width and lifetimes of fundamental particles, the flavours of fundamental particles can be directly obtained. As we have seen earlier¹, we can also predict the behaviour of beta decay and the energy levels of light nuclei. The appearance of primes also seems to suggest that further application of reductionism to fundamental particles is not possible.

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Carboxylesterase activity associated with organophosphate resistance in *Helicoverpa armigera* (Lepidoptera: Noctuidae) in Tamil Nadu

Helicoverpa armigera is a serious pest of several economically important crops, including cotton and legumes, in most regions of the Indian subcontinent. Consistent use of insecticides for the control of this insect has resulted in the development of resistance to a number of these¹⁻³. This resistance has been characterized as being due to target site insensitivity, penetration resistance, and enhanced metabolic detoxification⁴⁻⁶. The enzymes involved in metabolic resistance include three major groups; mixed function oxidases, glutathione-S-transferases, and esterases. Several reports indicate that carboxylesterase is the major enzymatic factor for organophosphate resistance⁷⁻⁹. The present study was undertaken to examine the relationship between carboxylesterase and organophosphate resistance in populations of *H. armigera* collected from different areas of Tamil Nadu. Such information could be used in the management of *H. armigera* control programmes enabling development of strategies for overcoming resistance to insecticides.

H. armigera larvae were collected from bhendi fields at Coimbatore, Erode,

Dindigul, and Madurai districts of Tamil Nadu state. These larvae were cultured in the laboratory on bhendi fruits for two generations. Bioassay and enzyme activity were carried out from these larvae.

The resistance levels were estimated by determining the LC_{50} values of monocrotophos and quinalphos for different populations separately by standard bioassay methods¹⁰ and then comparing the LC_{50} values of the most susceptible population with those of other populations (LC_{50} of Erode-Dindigul-Madurai population/ LC_{50} of Coimbatore population).

Fourth instar larvae of same size and age taken from different populations were homogenized individually with 20 mM phosphate buffer (pH 8.0), using a homogenizer and centrifuged at 10,000 g for 10 min. The carboxylesterase activity was spectrophotometrically assayed by the method of Van Aspern¹¹ and Devonshire¹² with some modifications from supernatant solution. A standard reaction mixture consisted of 100 μ l of enzyme, 125 μ l of α -naphthylacetate solution (1 mM) and 1.15 ml of 20 mM phosphate buffer (pH 8.0). The mixture

was incubated at room temperature for 30 min. The reaction was stopped by addition of 125 μ l of coupling reagent (mixture of Fast blue B salt and SDS), and the absorbance was taken at 605 nm after 15 min using a spectrophotometer. The amount of α -naphthol released by carboxylesterase was calculated using standard graph. Protein was measured by the method of Markwell *et al.*¹³.

The LC_{50} values indicated that, the Madurai population was highly resistant to both insecticides compared to the Coimbatore population (Table 1). This might be due to the frequent application of these insecticides by the farmers of this area, regardless of the pest intensity and also perhaps due to the adaptation of the insect to sublethal doses. Similar results were reported by several workers¹⁴⁻¹⁶.

The carboxylesterase activity was also observed to be highest (3 fold) in the populations collected from Madurai and it was at a moderate level in the populations collected from both Dindigul and Erode areas. The difference between the recorded values is statistically significant (ANOVA at 5% level) and this may