A new approach towards prime numbers

All the natural numbers > 1, comprising prime and composite numbers, can be represented by even and odd integers $2n$ and $2n + 1$ respectively, where $n = 1, 2, 3, \ldots$. As regards even integers $2n$, we know that for $n = 1$, there is a prime 2 whereas for $n = 2, 3, 4 \ldots$ there are composite numbers 4, 6, 8, ... However, we do not know any method to find the values of n for which odd integers $2n + 1$ will represent prime and composite numbers.

To answer the question raised above, we consider the set S of odd integers > 1 and form the subset of odd composite numbers $S.S = S^2$ as given below. Thus, if

$$S = \{2n + 1; n = 1, 2, 3, \ldots\}, \quad (1)$$

then

$$S^2 = \{(2j + 1)\cdot(2k + 1); j = 1, 2, 3, \ldots, k \geq j\}, \quad (2)$$

where $(2j + 1)\cdot(2k + 1)$ is taken to denote usual multiplication of odd integers > 1.

However, for getting the required expression for n, we simplify (2) and write it as

$$S^2 = \{2\,(2jk + j + k) + 1; j = 1, 2, 3, \ldots, k \geq j\}$$

or,

$$S^2 = \{2n + 1; n = 2jk + j + k, j = 1, 2, 3, \ldots, k \geq j\}. \quad (3)$$

Thus, when n is of the form

$$n = 2jk + j + k\,. \quad (4)$$

$2n + 1$ will represent odd composite numbers for $j = 1, 2, 3, \ldots, k \geq j$. Obviously, for the remaining values of n, i.e. when n is not of the form (4), $2n + 1$ will represent odd primes. It may be noted here that on putting $j = k = 1$ in (4) we get $n = 4$ and so on putting $n = 4$ in $2n + 1$, we get the smallest odd composite number 9. But, since 4 is the minimum value of n obtainable from (4), $n = 1, 2, 3$ cannot be derived from (4). Hence on putting $n = 1, 2, 3$ in $2n + 1$, we will get the first three odd primes 3, 5, 7.

However, for generating all the odd primes ≤ any odd integer N, we, from (4), will find out all the values of n in the range $1 \leq n \leq (N - 1)/2$ by assigning all the possible permutations and combinations of the values of $j = 1, 2, 3 \ldots, k \geq j$. These values of n, derived from (4), when substituted in $2n + 1$, will yield odd composite numbers ≤ N. Obviously, the remaining values of n, not obtainable from (4), in the range $1 \leq n \leq (N - 1)/2$, when substituted in $2n + 1$, will yield odd primes ≤ N.

Remark: It may be mentioned here that we cannot derive any expression of the form (4) for which n will directly generate odd primes through $2n + 1$. The reason for this is that it is the composite numbers (and not the primes) which, besides the usual operation of successive addition of 1, can also be generated by the operation of multiplication.

New definition: In the light of above remark, we can have the following definition of prime and composite numbers.

An integer $n > 1$, which, besides the usual operation of successive addition of 1, can also be generated by the operation of multiplication of at least two integers (other than 1 and n), is a composite number, and an integer $n > 1$, which is not composite, is a prime.

V. K. GURTU

A-102, Savitri Apartments,
Buty Layout,
Laxmi Nagar,
Nagpur 440 022, India

Protein profile analysis of *Listeria monocytogenes* strains from the tropics

Though *Listeria monocytogenes* has been considered as a serious food-borne pathogen in developed countries, the incidence of this organism in tropical foods has been reported to be very low[1,2]. Being an opportunistic pathogen, *L. monocytogenes* causes severe illness, mainly in pregnant women and their foetuses, the elderly and immunocompromised patients. The disease is primarily transmitted through contaminated food[3]. Though *Listeria* spp. is isolated from a variety of raw and processed food, the source of contamination is difficult to trace. Typing methods may be helpful to identify *Listeria* clones and their environmental niches that are the greatest threat to man[4]. Various typing methods like serotyping[5], phage typing[6] and random amplification of polymorphic DNA (RAPD)[7] are being used for typing of *L. monocytogenes* and to trace the source of contamination.

Protein expression is a phenotypic character, which is regulated by both genotype and environmental factors. In order to compare the homogeneity and heterogeneity among the different isolates of *L. monocytogenes*, the cell-associated protein profiles of *L. monocytogenes* isolated from clinical, veterinary and food samples in India were studied. Aeration has an effect on haemolytic activity, growth and catalase production[8]. Cellobiose is known to repress the expression of virulence factor in *L. monocytogenes*[9]. Hence, the effect of aeration and the presence of cellobiose in the medium on protein profile were also investigated.

During the period from March 1997 to June 2000, 633 clinical samples and 320 food samples were processed and four strains *of L. monocytogenes* were isolated. Among these four strains, two were from human clinical samples (from placenta) and two were from food samples