Let me first briefly refresh the memories of those who have studied math and perhaps enlighten those who have not. Let us assume that we have n elements. Then we see that there are a total of n possible arrangements (called combinations and permutations) which contain only one element. There are $n(n-1)$ arrangements containing two elements, $n(n-1)(n-2)$ arrangements containing three elements, and so on, until we reach the number of possible arrangements containing *all* n elements. (There are $n!$, read n factorial, which is equal to $n(n-1)(n-2)\ldots(1)$, arrangements containing n elements.) Hence, the total number of arrangements (N) possible for n elements is the *sum* of the above terms. Or mathematically:

$$N = n + n(n-1) + n(n-1)(n-2) + \ldots + n!$$

For example, if we want to know how many arrangements are possible when we have 4 elements (a, b, c, d), the solution is:

$$N_4 = 4 + 4(3) + 4(3)(2) + 4(3)(2)(1) = 64$$

Now to continue. We can use this expression not only to calculate the number of possible arrangements of n elements (N), but also to find the number of them that are affected by erroneous quantities. If *one* quantity of the n is wrong, the number of arrangements which do *not* contain the erroneous element is simply the number of arrangements which can be formed from the sum of all possible arrangements of $(n-1)$ elements. The number of arrangements containing false information is merely N minus this number of arrangements possible from $(n-1)$ elements. Similarly, the number of arrangements containing false information as a result of two erroneous quantities is N minus the number of arrangements possible from $(n-2)$ quantities. An example makes this clearer.

> If $n = 4$, and 1 element is incorrect, then the number of arrangements in N which contain erroneous information can be calculated as follows:
>
> Number of arrangements containing error $= N_4 - N_3$
> $= [4 + 4(3) + 4(3)(2) + 4(3)(2)(1)] - [3 + 3(2) + 3(2)(1)]$
> $= 64 - 15$
> $= 49$ arrangements containing error

The following table contains a few numbers which indicate the advantages of correct information to the problem-solver. The first column represents the number of elements available to combine as Mr. Koestler would like us to. The second column indicates the number of arrange-

ments available from the n elements. The third column gives the number of arrangements which contain erroneous information if one of the elements (a) contains error. The fourth column gives this number if two of the elements (a and b) contain error.

n	Possible arrangements	Erroneous if a is wrong	Erroneous if a and b are wrong
1	1	1	
2	4	3	4
3	15	11	14
4	64	49	60
5	325	261	310
6	1,956	1,631	1,892
7	13,699	11,743	13,374
8	109,600	95,901	107,644
9	986,409	876,809	972,710
10	9,864,100	8,877,691	9,754,500

These simple-minded numbers are not intended to be a model of conceptualization. I merely throw them in to demonstrate how rapidly combinations containing erroneous information build up as incorrect elements are introduced.

During the solution of a problem correct and adequate information is, of course, extremely important. An intellectual block which may prevent the problem-solver from acquiring well-balanced and pertinent information can be disastrous. Mechanical engineers with a block against electrical engineering or electrical engineers with a block against mechanical engineering may design strange things, such as mechanical television sets or complex electrical power transmission systems where simple mechanical ones would be cheaper and more reliable. People who consistently resist utilizing mathematics limit their problem-solving abilities by being blocked from useful quantitative data. Just as people who are blocked against considering aesthetic, emotional, and qualitative inputs in their decision-making also limit their problem-solving capabilities by refusing to acquire often useful information. Engineers who are uncomfortable with aesthetics can make outstandingly inhumane and ugly devices which may, as a side issue, not even sell well. Environmentalists who ignore the use of quantitative facts and statistics cannot be very productive in designing effective solutions to environmental problems.

There is, however, disagreement as to whether information is universally valuable at all phases of problem-solving. One school of thought maintains that one of the worst enemies of innovation is the