

SOME CALCULATIONS DEMONSTRATING SCIENTIFIC PROBLEMS OF EVOLUTION

Among several serious scientific problems facing evolutionary theory (e.g., origin of life from nonlife, rarity of transitional fossils, formation of complex organs and systems, esp. the brain), the most pervasive problem is the production of high levels of organization by random processes.

For instance, Carl Sagan speaks of the information content of a simple living cell as equivalent to 100 million pages of the *Encyclopaedia Britannica*!

Some have played down this problem by thinking that given enough time, random processes will produce any level of organization. In one popular remark: "Give enough monkeys enough time, and they will eventually type the *Encyclopaedia Britannica*." In response we ask, "How many monkeys? How much time?"

Consider the following problem: Let us have as many monkeys as we wish trained to type at 3 chars/sec on as many monkeyproof typewriters as we wish. The typewriters are simplified, with only 33 keys, consisting of 26 capital letters, a space and six punctuation marks (. , : ; ? !). Instead of typing the whole *Encyclopaedia Britannica*, we will just have the monkeys type the title in caps, "ENCYCLOPAEDIA BRITANNICA."

The job involved can be calculated (in units of monkey-years) as follows: The title, including the space between words, consists of 24 characters. For each character, one could type any one of the 33 keys. Thus there are $33 \times 33 \times 33 \times 33 \dots$ (24 times) possible combinations a monkey could type anytime he or she hits 24 keys in succession. Using logarithms, the number of combinations will be:

$$\log_{10} N = 24 \times \log_{10} 33 = 24 \times 1.51851 = 36.44424$$

Converting back to regular numbers, $N = 2.781 \times 10^{36}$

The time necessary to type all these combinations would be:

$$T = N / (\text{no. monkeys}) \times (\text{rate}) = 2.781 \times 10^{36} / (\text{no. monkeys}) (3/\text{sec}).$$

Or the job J, in monkey-years is: $J = T \times (\text{no. monkeys})$

$$J = 2.781 \times 10^{36} / 3/\text{sec} = 10^{36} \text{ monkey-sec} = 3 \times 10^{28} \text{ monkey-years}$$

$$J = 30 \text{ billion billion billion monkey-years!}$$

In the twenty billion years since the big-bang, one would need 1.5 billion billion monkeys to do the job!