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How Large Numbers Can Help You

> *Although we must keep all our confidence in our science, we must not blindly believe in its actual almightiness.*[1]
>
> —Pierre Lecomte du Noüy

SERIOUS REASONING MAY require effort. It is the delightful sort of effort that may reward the thinker with valuable insights about the nature of things.

Why Understanding Large Numbers Is Important

If one wishes to arrive at a high degree of certainty regarding the question of evolution, either for himself or in order to help others, it is vital to grasp the real meaning of the kind of numbers we are encountering.

It is easy to be careless in this regard. Many people see little difference between a billion and 10^{287}, for example. They figure some rare possibility just might actually happen, whether the probability is one in a billion or one in 10^{287}. After all, some men live to be 105 years of age. Ordinary people do win the Irish sweepstakes in spite of large odds against them.[2] So they think that, even if it is improbable, maybe life could have started by chance.

The vital difference is in the size of numbers. Let's look now more closely at a figure we obtained in the chapter just ended.

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[1] Pierre Lecomte du Noüy, *Human Destiny* (New York: Longmans, Green & Co., 1947), p. 38.

[2] A moment's thought shows that in the case of the sweepstakes, it is *certain* that *someone will win.* This is an entirely different type of situation from the kind we are studying.

The probability of one average protein molecule arranging itself by chance in correct order was first computed. Then we assumed that all the needed atoms available on earth were gathered in convenient sets. Each set was trying out 30 million billion new arrangements every second. If chance could be expected to produce one protein molecule that would function anywhere, it would be considered a success. The probability of this happening even once since the earth began was less than 1 in 10^{161}. Let's compare that figure with some large numbers we can more easily comprehend.

Examples of Large Numbers

Take the number of seconds in any considerable period. There are just 60 in a minute, but in an hour that increases to 3,600 seconds. In a year, there are 31,558,000, averaged to allow for leap year. Imagine what a tremendous number of seconds there must have been from the beginning of the universe until now (using 15 billion years, which is one of the standard estimates by evolutionists). It may be helpful to pause a moment and consider how great that number must be.

When written down, however, it appears to be a small figure: less than 10^{18} seconds in the entire history of the universe.

The weight of our entire Milky Way galaxy, including all the stars and planets and everything, is said to be "of the order of 3 x 10^{44} grams."[3] (A gram is about 1/450th of a pound.) Even the number of atoms in the universe is not impressive at first glance, until we get used to big numbers. It is 5 x 10^{78}, based on present estimates of the radius at 15 billion light years and a mean density of $1/10^{30}$ grams per cubic centimeter.[4]

Suppose that *each one of those atoms* could expand until it was the size of the present universe so that each had 5 x 10^{78} atoms of its own. The total atoms in the resulting super-cosmos would be 2.5 x 10^{157}.

By comparison, perhaps the figure for the odds against a single protein forming by chance in earth's entire history, namely, 10^{161}, is now a bit more impressive to consider. It is 4,000

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3 *Encyclopaedia Britannica,* (1967), s.v. "galaxy."

4 According to Jesse L. Greenstein, who was then head of the Astronomy Department at California Institute of Technology (personal conversation, November, 1971), 10^{78} was the figure based on a 10-billion-light-year radius. Since 15 billion light years is now the accepted view, we calculate that the number of atoms is around 5 x 10^{78}. (The earlier 10^{78} was "approximate.") Current estimates of radius range from 10 to 20 billion light years, although there is still uncertainty of measurements beyond a few hundred light years.

times larger than the number of atoms in that *super* universe we just imagined.[5]

A Number Too Big to Imagine

Try as we may, that slender probability for the chance formation of a protein is a number too large to grasp. Let's ponder it awhile. That big figure, 10^{161}, represents the odds against one protein in five billion years. We can now calculate how long a period would be required in which we could expect one success on the average.

We should bear in mind that all of the constituent atoms on the surface of the earth—on land, in air, in seas—are considered as made up into sets of amino acids conveniently available for each point on every potentially forming protein chain. In *each* of these 10^{41} sets, experiments are going on constantly at the rate of 30 million billion per second.

By simple mathematics, we discover that, on the average, a single usable protein might hook up correctly once in 10^{171} years, rounded.

The Case of the Traveling Ameba

Imagine an ameba. This microscopic one-celled animal is something like a thin toy balloon about one-fourth full of water. To travel, it flows or oozes along very slowly.

This ameba is setting forth on a long journey, from one edge of the universe all the way across to the other side. Since the radius of the universe is now speculated by some astronomers to be 15 billion light years, we will use a diameter of double that distance.

Let's assume that the ameba travels at the rate of one inch a year. A bridge of some sort—say a string—can be imagined on which the ameba can crawl. Translating the distance into inches, we see that this is approximately 10^{28} inches. At the rate of one inch per year, the tiny space traveller can make it across in 10^{28} years.

The ameba has a task: to carry one atom across, and come back for another. The object is to transport the mass of the *entire universe* across the entire diameter of the universe! Each round trip takes 2 x 10^{28} years. The ameba must naturally be presumed to be imperishable and tenacious!

To carry all the atoms of the universe across, one at a time,

[5] $10^{161} = (2.5 \times 10^{157}) \times (4 \times 10^{3})$

would require the time for one round trip multiplied by the number of atoms in the universe, 5×10^{78}. Multiplying, we get 10^{107} years, rounded. That is the length of time for the ameba to carry the entire universe across, one atom at a time.

But wait. The number of years in which we could expect one protein by chance was much larger than that. It was 10^{171}. If we divide that by the length of time it takes to move one universe by slow ameba, we arrive at this astounding conclusion: *The ameba could haul 10^{64} UNIVERSES across the entire diameter of the known universe during the expected time it would take for one protein to form by chance, under those conditions so favorable to chance.*

But imagine this. Suppose the ameba has moved only an inch in all the time that the universe has existed (according to the 15-billion-year estimate). If it continues at that rate to travel an inch every 15 billion years, the number of universes it could carry across those interminable miles is still beyond understanding, namely, more than 6×10^{53}, while one protein is forming.[6]

Sooner or later our minds come to accept the idea that it's not worth waiting for chance to make a protein. That is true if we consider the science of probability seriously. Missile scientists, like Wernher von Braun, use the same multiplication rule which is the basis of these calculations.[7] It helps get our astronauts to the moon and back.

Why Some Probabilities Are So Small

Charles-Eugène Guye was one of the most brilliant thinkers of this century. This noted physics professor at Geneva called attention to the rapidity at which the number of outcomes can increase: "It is sufficient to recall that a hostess can arrange 20 diners round a table in more than two million million million ways. What would it be if it were necessary to place one thousand?"[8]

If you have 20 guests, the first one can be seated in any of the 20 places. While that one is in any one of those 20 places, the next person can be seated in any of the remaining 19, and the same way, the next person in any of 18 seats not

[6] 10^{64} divided by 15 billion (1.5×10^{10}) = 6.6×10^{53}.

[7] Wernher von Braun, *Space Frontier,* New Edition (New York: Holt, Rinehart and Winston, 1971), pp. 108, 109.

[8] Charles-Eugène Guye, *Physico-Chemical Evolution* (New York: E. P. Dutton & Co., 1925), p. 164.

occupied. The total possible arrangements in such a situation comes to 20 x 19 x 18 x 17 x . . . x 1, called 20 *factorial,* and written in this interesting notation: 20! That is why, incidentally, we have not put exclamation points after some of the amazing figures we have computed. The exclamation point would change the meaning to factorial.

In the experiments mentioned so far, it has been assumed that all of the different amino acids were available at each point. The total of equally probable outcomes is gotten then by multiplying by itself the number of the available types, to the power of the length of the chain desired. When considering only L-amino acids, it was 20 x 20 x 20 x . . . x 20. The product number soon becomes astronomical.

Consider what a great change it makes when you barely increase an exponent of 10. If you start with 10^{101} and change it to 10^{102}, you are, in effect, *adding* $10^{101} + 10^{101} + 10^{101} + 10^{101} + 10^{101} + 10^{101} + 10^{101} + 10^{101} + 10^{101}$ to the original 10^{101}.

The Laws of Chance Are Dependable

Pierre Lecomte du Noüy, noted French scientist who escaped Nazi occupation in 1942 and came to the United States, wrote,

> The so-called "laws of chance" borrow their accuracy (which is considerable on our scale of observation) from the fact that no privileged atoms exist (from the particular point of view considered) and that, on an average, they all behave in the same unpredictable, disorderly manner.[9]

In other words, we can expect things to average out according to those laws, and we are not to think anything is likely to behave contrary to the law of large numbers, if it depends on chance alone. Throughout science, engineering, and business, you find almost absolute dependence upon these laws. It is logical that the same principles which are used in planning skyscrapers can be trusted when we apply them to the probability of proteins forming by chance.

Calculations Can Be Scientific—a Repeatable Study

Remember that the essence of the scientific method is the repeatable experiment with the same outcome if the experiment is carried out in the same way, no matter who does it. Anyone can check on the reality of the multiplication rule and the

[9] du Noüy, *Human Destiny*, p. 41.

mathematical formulas we have used. If doubts recur, one can go back and recheck until he is assured they are correct. The principles of probability are known and unhesitatingly trusted by engineers, astronauts, and all who use mathematics.

Certainty on this subject grows as one becomes convinced of the accuracy of the law of averages, and as he then considers the things that now exist. When one goes at this from the inductive scientific route, he can then by deduction see the logic of the Bible's position in crediting creation rather than chance. But why should anyone want to improve on the Bible? It contains the truths man needs. Without it, modern man cannot find his way in this vast, mysterious cosmos.

Modern Atheism's Substitute for God

In April, 1967, the international magazine, *Réalités,* printed an interview with French philosopher-scientist-theologian Claude Tresmontant, whom we have quoted earlier. The magazine, in its introduction to the interview, referred to Tresmontant's book, *The Problem of the Existence of God Today,* using these phrases: "closely argued reasoning," and "the almost overwhelming mass of learning with which it is weighted."[10] In the interview, Tresmontant, after stating that Plato, Aristotle, and others "thought that the world was a great living being, a Divine Animal," said, "Modern atheism still maintains that the world is the only Being." He then elaborated on what that would mean as to the nature of matter:

> Since it is assumed that this matter is increate and eternal . . . it must have produced, from its own resources, everything that has appeared in the universe, both life and thought.
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> The total amorphous mass has been able to organize itself, to become animated and to endow itself with consciousness and thought. It is clear that if matter is to be looked at in this way it has to be credited with very great resources, great wisdom and positive genius, since great genius was needed for the independent invention of the large molecules which are part of the makeup of any living creature, however humble, as well as for the invention of the major functional systems that characterize higher forms of life—the digestive, circulatory, reproductive and nervous systems.[11]

With incisive reasoning, Dr. Tresmontant points out the implications of this substitution of the material universe for God.

10 *Réalités,* Paris, April, 1967, p. 45.
11 Ibid., p. 46.

In the end, the same qualities would be required as those that describe the God of the Bible. He says, if matter has thus been able to accomplish such wonders, then:

> I maintain that it must be gifted with great wisdom and incomparable genius. I would even say that matter must be credited with all the attributes that theologians specify as belonging to God: autonomous being, ontological self-sufficiency and creative genius.[12]

By this he shows that atheists cannot expect to escape the need for God—the same kind of God as described in the Bible—as the only rational explanation of the universe.

The general rule on the way things are is becoming clearer as we go on. Chance cannot create complex, orderly, operational systems. Neither can it account for beauty. To attribute to blind chance the perfume of a rose or the playfulness of a lamb is to ignore all logic.

Practical Impossibility

Speaking of large numbers, Lecomte du Noüy commented, "It is evident that exponents of over 100 lose all human significance. The nearest star is 40×10^{21} microns from us."[13] (A micron is one thousandth of a millimeter, which itself is about one twenty-fifth of an inch.)

Regarding probabilities involving numbers of large magnitude, the same author wrote:

> If the probability of an event is infinitely slight, it is equivalent to the *practical* impossibility of its happening *within certain time limits*. The theoretical possibility . . . can be so small that it is equivalent to a quasi-certitude of the contrary.[14]

We have seen that *an ameba could transport six hundred thousand trillion trillion trillion trillion universes, an atom at a time, across the diameter of the entire universe, travelling at the rate of an inch in fifteen billion years, during the time in which chance could be expected to arrange one average protein molecule.*[15] Perhaps the reader would agree that a proba-

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12 *Réalités*, Paris, April, 1967, p. 46.
13 du Noüy, *Human Destiny*, p. 32.
14 Ibid., p. 30.
15 Note that all through this chapter, the figures we used were those obtained under those tremendous concessions to make it easier for chance to succeed. Under realistic figures, the odds would have been even greater against its success.

bility so slight as this surely qualifies, in Lecomte du Noüy's phrase, *as a quasi-certitude of its practical impossibiilty.*

The logic of these words of Scripture is now more easily evident: "Thou art worthy, O Lord, to receive glory and honour and power, for thou hast created all things, and for thy pleasure they are and were created" (Revelation 4:11).