selection merely explains how horses and tigers, for example, become more (or less) numerous and not how they came about in the first place.

If Darwin's idea is accepted that by one means or another superior or more fit varieties (with respect to the environment) are continually being produced in nature, his natural selection theory is hardly to be considered a tautology. Where Darwin and modern evolutionists make their mistake is in believing that the kinds of variations which *do* occur can lead to real evolution.

Conclusion and Cautionary Note

Bethell concluded that Darwin is in the process of being discarded, though as gently as possible and with a minimum of publicity. But such a prediction may be premature. Such has been claimed before. Back in the 1920's there was much talk of the scientists' giving up their faith in Darwinism. The general public did not distinguish between scientists' faith in evolution and their faith in the Darwinian explanation of the mechanism of evolution. As a result, for several decades at least it was erroneously believed that scientists were giving up their faith in evolution. But their faith in Darwinism came back stronger than ever, as may be demonstrated by quotations from leading evolutionists.

More recently it has been said that Darwinism might be given up because of the discovery of neutral mutations, though not much is heard about this any more. Now it is said that Darwinism may be discarded because Darwin's original natural selection theory is a tautology (in spite of the alleged "quite different" interpretation of it today).

In the first place, under the terms which Darwin expressed his natural selection theory, it is not clear that it is a tautology. In the second place, it is more obvious that cases like that of the peppered moths are not evolution at all than it is that Darwin's theory is a tautology. If it does not bother evolutionists to call the case of the moths evolution, it should not bother them to accept natural selection at face value.

One thing is certain. If anyone disagrees with evolutionary theory in general and has his hopes raised by the announcement that Darwin's theory may be "on the verge of collapse," then such a person is bound to find only disappointment. Even if Darwin's theory were on the verge of collapse, and even if it did collapse altogether, this would have no more effect on evolutionists' faith in evolution now than it did in the 1920's. The fact is that evolutionists now are promoting evolution more vigorously than ever; and also they are resisting more strongly than ever those who are opposing evolution.

Added Note: The May 15, 1976 issue of *Human Events* contains an article by Stanton Evans commenting upon the *Harper's* article by Tom Bethell as well as on the article by Dorothy Nelkin on "The Science Textbook Controversies" in the April, 1976 issue of *Scientific American.* The gist of the article is favorable to creationists, and it shows that the issues raised by creationists are receiving more serious consideration in the secular press. (Added by Editor: Readers will want to give special attention to the "Letters" in the July issue of *Scientific American* in response to the Nelkin article.)

PROBABILITY AND THE MISSING TRANSITIONAL FORMS

DAVID J. RODABAUGH*

It is easily documented even from the writing of evolutionists that fossil evidence for transitional forms is missing. The purpose of this paper is to calculate the probability of this, given the assumption that evolution occurred through micromutations. The conclusion is that the transitional forms did not exist.

Introduction

By evolution is meant the molecules to man theory of evolution. The term "transitional form" is used for those supposed forms that were both intermediate and ancestral. That such forms are virtually absent from the fossil record (as discovered) is admitted by G. G. Simpson for he stated,

> . . . continuous transitional sequences are not merely rare but are virtually absent . . . Their absence is so universal that it cannot, offhand, be imputed entirely to chance, and does require some attempt at explanation, as has been felt by most paleontologists.[1]

And Simpson has admitted that nowhere is there a trace of a fossil to close the gap between the horse and any presumed ancestor, and has stated,

> This is true of all the thirty-two orders of mammals . . . The earliest and most primitive known members of every order already have the basic ordinal characters, and in no case is an approximately continuous sequence from one order to another known. In most cases the break is so sharp and the gap so large that the origin of the order is speculative and much disputed.[2]

In addition, D. M. Raup and S. M. Stanley in 1971 stated, "Unfortunately, the origins of most higher categories are shrouded in mystery; commonly new higher categories appear abruptly in the fossil record without evidence of transitional forms."[3]

That the absence of transitional forms in the fossil record, as far as it is known, cannot be attributed entirely to chance is readily admitted by Simpson in the first quote above. This paper will prove an even stronger assertion using well known ideas from probability. The consequence is that there never were any such transitional forms.

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The reader must then conclude that evolution proceeded by macromutation (the "hopeful monster" concept) or that evolution is false. Evolutionists have generally rejected the "hopeful monster" idea for even they cannot imagine how such a thing could happen. While limited micromutations have been observed, no macromutation has been observed that did not destroy the organism. Thus, macromutation is not an explanation at all.

1. Distributions

The basic situation is thus: Suppose there is a probability of p that when a fossil is discovered it is transitional. Suppose further that n fossils are discovered and the k of them are transitional. There are two questions that can be suggested. First, what is the probability of this event? Second, what is the probability, given n, p and k that m of the fossils are transitional for $m \leqslant k$?

These questions can be formalized with the help of some notation.

Definitions: Define $P(n, p, x = k)$ as the probability of exactly k successes in n trials where each success has probability p. Define $P(n, p, x \leqslant k)$ as the probability of k or fewer successes in n trials where each success has probability p.

The above two questions reduce to the problems of calculating $P(n, p, x = k)$ and $P(n, p, x \leqslant k)$. If $x \leqslant k$ then $x = 0$ or $x = 1$ or . . . or $x = k$. It follows that

$$P(n, p, x \leqslant k) = \sum_{m=0}^{k} P(n, p, x = m). \quad (1)$$

To illustrate the above, consider the simple problem of tossing a coin. For each toss, the probability of having heads is ½. The probability of tossing the coin three times and getting heads all three times is $(1/2)^3$ or 1/8. That is $P(3, 1/2, x = 3) = 1/8$ in this situation. However, it is always the case that if a coin is tossed three times then it must come up heads no more than three times. That is $P(3, 1/2, x \leqslant 3) = 1$.

The situation described above is that of a *Bernoulli Trial*. It is defined as follows: If the probability of success is the same for each of n trials then the trials are said to be independent. Repeated trials which meet these conditions are called *Bernoulli Trials.*[4]

The probability of exactly k successes in n such (independent repeated) trials is[5]

$$P(n, p, x = k) = \binom{n}{k} p^k q^{n-k} \quad (2)$$

where $q = 1 - p$ and $\binom{n}{k} = \frac{n!}{k!\,(n-k)!}$. Because the right hand side of Equation 2 comes from the binomial expansion of $(p + q)^n$, the distribution determined by Equation 2 is called the binomial distribution.[6]

Substituting Equation 2 into Equation 1 gives

$$P(n, p, x \leqslant k) = \sum_{m=0}^{k} \binom{n}{m} p^k q^{n-k}. \quad (3)$$

Consider now the problem of the probability that the next fossil discovered would be transitional. Let t be the number of transitional forms (with respect to a certain characteristic or in general), and let N be the number of organisms which are not transitional. For example, if the characteristic under study is that of being a bird then N is the number of birds and t is the number of organisms transitional (possessing partial wings). The probability of the first fossil being transitional is

$$p_1 = \frac{t}{t + N}. \quad (4)$$

There is, of course, no reason to expect a non-transitional form to be more or less readily fossilized than a transitional form.

Having removed the first fossil the probability that the second fossil is transitional is

$$p_2 = \frac{t-1}{t+N-1} \text{ or } p_2 = \frac{t}{t+N-1} \quad (5)$$

depending on the first one being transitional or not.

This is, technically, the problem of sampling without replacement and the binomial distribution does not exactly represent the probabilities since $p_1 \neq p_2 \ldots \neq p_n$.

An example might help. Suppose there is a bag containing 30 balls that are identical except for color. Suppose further that 10 of the balls are black and 20 are white. The probability of drawing a black ball the first time is 10/30 or ⅓. If that ball is returned to the bag (i.e., replaced), the probability that the second ball is black is also 10/30 or ⅓. This is the situation represented by the binomial distribution.

If, however, the first ball is not returned (i.e., not replaced) then the probability that the second ball is black is not ⅓. It is 9/29 if the first were black and 10/29 if the first were white. The hypergeometric distribution represents this situation.

However, when the total number is large, though the sampling is without replacement, the binomial distribution can be used as an approximation.[7] In the study of fossil finds, the total number of organisms $t + N$ is at least in the billions so the binomial distribution represented by Equation 2 and Equation 3 is an excellent approximation.

Another distribution of use in this type of problem is the Poisson probability distribution defined by[8]

$$f(x) = \frac{\lambda^x e^{-\lambda}}{x!}. \quad (6)$$

When p is small and n large the Poisson function approximates the binomial. In this case $\lambda = np$ and[9]

$$P(n, p, x = k) \doteq \frac{(np)^k e^{-np}}{k!}. \quad (7)$$

(The notation $\doteq$ is used for an approximation.)

Putting Equation 7 into Equation 1 gives

$$P(n, p, x \leqslant k) \doteq \sum_{m=0}^{k} \frac{(np)^m e^{-np}}{m!}. \quad (8)$$

2. Some reasonable values for *n* and *p*

The rest of this paper is concerned with the application of the binomial and Poisson distributions to finding $P(n, p, x = k)$ and $P(n, p, x \leqslant k)$ where n is the number of fossils discovered, p is the ratio $t/(t + N)$ which is the probability of finding a transitional form and k is the number of transitional forms discovered. (The reader is reminded that, in this paper, transitional means both intermediate and ancestral.)

It is fairly difficult to get reliable information on the total number of fossils discovered or even the total number in particular categories.

However, Pierce Brodkorb states that there are 1760 species of fossil birds.[10] Assuming an average of six fossils per species, this implies over 10,000 fossils of birds—all of which are fully winged and have feathers. Yet, to date not one fossil has been found with a wing only partly developed. Thus, for a very special characteristic (one not possessed by many organisms), 10,000 is a very conservative figure for n.

Actually, for the property of flight, a much larger figure is justified. For, there are many flying insects as well as flying bats and flying reptiles.

Other characteristics worthy of investigation are eyes, lungs, sexual reproduction, etc. In addition, there is the problem of the admitted missing evidence for transitional forms between each of the 32 orders of mammals and presumed ancestors, which were mentioned by Simpson.

Thus, it is most reasonable to assume $n = 100{,}000$ or $n = 1{,}000{,}000$.

In this paper, probabilities are calculated for $n = 10{,}000$, $n = 100{,}000$ and $n = 1{,}000{,}000$. Even larger values are justified but, as the reader will discover, the situation resulting from examining these figures is sufficiently embarrassing for the evolutionist.

What is a reasonable value for p? The standard evolutionary theory is that micromutations (minute changes) account for all the variation that is observable. Thus, the number of transitional species must be exceedingly large.

Indeed, to account for birds via the supposed process of micromutations would necessitate the postulation of vast numbers of species that are both intermediate and ancestral. Furthermore, each species must be reasonably viable in order to survive long enough to give rise to some "evolved" descendent. Consequently, it would be the expectation, based on *evolutionary theory only*, that $p \geqslant .9$.

However, the calculations contained herein will be based on figures that are less demanding of evolutionists. The function $P(n, p, x \leqslant k)$ will be computed for $p = .5$, $.1$, and $.01$. The reader is reminded that $p = .01$ implies that there was only one transitional organism for every 99 nontransitional organisms—completely contrary to the prediction based on the evolution model. Even this, as will be seen, leads to nothing but headaches for the evolutionist.

Before closing this section, some comment should be made about values for k. Though *no transitional forms* have yet been found, the probabilities will be calculated based on $k = 0$, 5 and 10.

To summarize, $P(n, p, x \leqslant k)$ will be calculated for $n = 10{,}000$; $100{,}000$; $1{,}000{,}000$: $p = .5$; $.1$; $.01$: $k = 0$; 5; 10. At times $P(n, p, x = k)$ will be calculated.

3. Computational Difficulties

A modern high-speed digital computer (such as the IBM 360 or IBM 370) can be used to work with nonzero numbers and absolute values within the range

$$16^{-64} \leqslant x < 16^{63}. \tag{9}$$

The range on the Hewlett-Packard electronic calculators (as well as some others) is

$$10^{-99} \leqslant x < 10^{100}. \tag{10}$$

This range is sufficient for most purposes. However, the following is easily verified using logs (all logarithms in this paper are base 10):

$$P(10{,}000, .5, x = 10) = 10^{-2976.862}. \tag{11}$$

If $P(n, p, x = k)$ were all that was desired, Equations 7 and 2 could be easily evaluated by logarithms.

Unfortunately, for $k = 5$ and $k = 10$, it is necessary to evaluate Equation 3 and Equation 8, each of which is the sum of numbers too small (in most cases) to be represented on any known computer or calculator. The problem is to evaluate a sum

$$S = \sum_{x=0}^{k} T_x \tag{12}$$

where some, or perhaps all of the T_x are not representable on either calculator or computer. Equation 12 can be rewritten as

$$S = \frac{1}{a} \sum_{x=0}^{k} aT_x. \tag{13}$$

No matter what the value of S, an a can be found so that

$$B = \sum_{x=0}^{k} aT_x \tag{14}$$

is representable on the machine. The value of $\log S$ can then be found by

$$\log S = \log B - \log a \tag{15}$$

since $a\ S = B$.

Furthermore, the logarithm of each term aT_x can be computed using logs and then converted to the value aT_x before being added to the partial sums of B.

The above procedure was employed on a programmable Hewlett-Packard 25 to obtain the values in the next section.

4. Applications

In this section the values $P(n, p, x \leqslant k)$ are tabulated for the values indicated at the end of Section 2. These values are so small that it is a considerable convenience to only list the logarithms.

Although the Poisson distribution is only an approximation, values based on it are listed in Table 2.

The reader will notice that when $p = .01$ the values in the two tables differ only slightly.

It will be recalled that when the logarithm is -4557.60, for instance, the number is $10^{-4557.60}$, about 2.5×10^{-4558}. So the probability would be indicated by a number, a decimal, having 4,557 zeros after the decimal point, and then a two. Surely that is small enough to convince anyone!

5. Conclusions

Emil Borel, the famous mathematician, said,

> We may be led to set at 10^{-50} the value of negligible probabilities on the cosmic scale. When the probability of an event is below this limit, the opposite event may be expected to occur with certainty, whatever the number of occasions presenting themselves in the entire universe.[11]

Table 1. LOG $P(n, p, x \leqslant k)$ based on the BINOMIAL DISTRIBUTION

	P	n = 10,000	n = 100,000	n = 1,000,000
.5	.5	−3010.30	−30103.00	−301030.00
k = 0	.1	−457.57	−4575.75	−45757.49
	.01	−43.65	−436.48	−4364.81
	.5	−2992.38	−30080.08	−301002.07
k = 5	.1	−444.42	−4557.60	−45734.34
	.01	−35.68	−423.54	−4346.86
	.5	−2976.86	−30059.56	−300976.56
k=10	.1	−433.68	−4541.85	−45713.59
	.01	−30.12	−412.99	−4331.32

Table 2. LOG $P(n, p, x \leqslant k)$ based on the POISSON DISTRIBUTION

	P	n = 10,000	n = 100,000	n = 1,000,000
	.5	−2171.47	−21714.72	−217147.24
k = 0	.1	−434.29	−4342.94	−43429.45
	.01	−43.43	−434.29	−4342.94
	.5	−2155.06	−21693.31	−217120.83
k = 5	.1	−421.37	−4325.02	−43406.53
	.01	−35.49	−421.37	−4325.02
	.5	−2141.04	−21674.29	−217096.81
k=10	.1	−410.85	−4309.50	−43386.01
	.01	−29.94	−410.85	−4309.50

In another book, he stated, "Events whose probability is extremely small never occur.[12]

Let E be the event described as follows: Assume that n fossils are discovered and no more than k (i.e., k or fewer) are transitional. Assume further that the number of transitional forms divided by the total number of organisms is p.

Now, the probability of E, denoted by $\pi(E)$ is given by

$$\pi(E) = P(n, p, x \leqslant k). \quad (16)$$

To date, the value for $k = 0$. That is, there are *no partly winged creatures*, etc. However, for the sake of argument, allow $k = 5$ or $k = 10$.

A consequence of the two tables and Borel's assertions is that E cannot occur.

In fact, if $n = 10{,}000$ then

$$\text{LOG } P(10{,}000, .5, x = 1000) = -1040.11. \quad (17)$$

Now,

$$P(10{,}000, .5, x \leqslant 1000) = \sum_{m=0}^{1000} P(10{,}000, .5, x = m)$$
$$< (1000)P(10{,}000, .5, x = 1000). \quad (18)$$

Thus

$$\text{LOG } P(10{,}000, .5, x \leqslant 1000)$$
$$< \text{LOG}(1000) + \text{LOG } P(10{,}000, .5, x = 1000)$$
$$= 3 - 1040.11 = -1037.11. \quad (19)$$

Even this event can never occur. One is thus led to the inescapable conclusion that, if transitional forms ever occurred they were exceedingly rare. Consequently, either the present biological world got here by macromutations ("hopeful monsters") or by special creation.

Since the "hopeful monster" concept is rejected by nearly all evolutionists, the unprejudiced mind must conclude that special creation is the only model that fits the facts.[13]

Another remark is that the figures contained in this paper made the figures in a recent paper by this author[13] far too kind to the evolutionist. The probabilities $P(n, p, x \leqslant k)$ for $k = 0$ should be substituted for $P[G|E]$ in that paper.

References

[1]Simpson, G. G. 1944. Tempo and mode in evolution. Columbia University Press, New York, p. 105.
[2]*Loc. sit.*
[3]Raup, D. M., and S. M. Stanley 1971. Principles of paleontology. W. H. Freeman, San Francisco, p. 306.
[4]Hickman, Edgar P., and James G. Hilton 1971. Probability and statistical analysis. Intext Educational Publishers, Scranton, Pennsylvania, p. 89.
[5]*Ibid.*, p. 90.
[6]*Ibid.*, pp. 89-94, especially p. 91.
[7]*Ibid.*, p. 98.
[8]*Ibid.*, p. 100.
[9]*Ibid.*, p. 101.
[10]Farmer, D. S., and J. R. King, Editors. 1971. Avian biology, Volume I. Academic Press, New York. See chapter by Pierce Brodkorb, "Origin and Evolution of Birds", p. 21.
[11]Borel, Emil 1962. Probabilities and life. Dover, New York, p. 28.
[12]Borel, Emil 1965. Elements of the theory of probability. Prentice-Hall, Englewood Cliffs, New Jersey, p. 57.
[13]Rodabaugh, D. J. 1975. Mathematicians do it again, *Creation Research Society Quarterly* 12(3):173-175.

PANORAMA OF SCIENCE

Some Observations on Observation

Observation is vital to natural science, for it is the facts, as determined by observation, which must be discussed and interpreted. It is of some interest, then, to see what actually occurs during observation. A recent study, which was critical of geologists, concluded that: ". . . what geologists perceive in, and remember of, rocks is not necessarily the same as what is actually there. For example . . . professionals . . . tend to remember cleavage fans as they ought to be rather than as they are."[1]

In other words, observations, or what is recorded of the observations, may be affected by preconceptions. In this, it is likely that geologists are no better and no worse than anyone else.

It is also to be noticed that there is no question of intentional deceit here; the observers really believed that they were recording what was actually there.

The importance of this point to creationists is obvious. There are few (if any) observations which really support evolution more than creation. So the creationist, if he should come across such an (alleged) observation, is entitled to ask for a reexamination, to see whether what was recorded corresponds to what was actually there.