BACTERIUM E. COLI VS. EVOLUTION†

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Escherichia coli is the name of a bacterium found in large numbers in the intestinal tract of man and animals. It is usual to obtain counts of several millions of *E. coli* per gram of feces from normal healthy people.

As it does not survive very long outside the intestine (unless presented with suitable food), *E. coli* is widely used as an indicator of recent fecal pollution of our rivers and reservoirs. All water boards in this country routinely analyse drinking water for its content of *E. coli*, detecting it at the low level of one cell per 100ml water.[1]

Besides its practical uses in testing the wholesomeness of our water, food and milk, *E. coli* has been used as a research organism by geneticists and biochemists. The main reasons for this are that it has the very short "generation time" of less than an hour (this is the time taken for cells to divide once and thus double in number); it is readily available and easy to isolate; and it has very simple nutritional requirements—it only needs a sugar and a few mineral salts in solution to grow satisfactorily. As a result, the organism has come to be regarded as the "workhorse of bacteriology."

We probably know more detail about its biochemistry and genetics than about any other kind of cell. This, therefore, makes *E. coli* a most significant organism from the point-of-view of evolution. The next step backwards from bacteria like *E. coli* would be to the "rich, primitive pool" of organic matter composed of amino acids, proteins, lipids, vitamins and nucleic acids.

So the question that the evolutionist must ask himself, in the light of the information available about this bacterium, is: Could a cell as complex as *E. coli* have conceivably arisen, step by step, from a "rich pool of organic matter"—or is it more reasonable to believe that the bacterium was produced by an act of creation?

Below are presented some facts about this organism: to make the evolutionist think again, and to provide evidence that the believer in Creation has the support of scientific facts. Structural and genetic aspects of this organism will be considered in turn.

Size and Structure

E. coli is 2 microns in length and 1 micron in diameter. It is coated in three layers, each having recognizable functions. The *capsule* is composed principally of polysaccharide associated with lipoprotein.[2] In the strains of *E. coli* capable of causing disease (such as gastro-enteritis), the capsule resists the enzymic action of the macrophages.

The *cell wall* is composed of a unique substance called mucopeptide. This substance has amino acids and amino sugars arranged in the form of a cross-linked meshwork structure, having considerable tensile strength. It enables the bacterium to withstand fluctuating conditions of salt concentration in the intestine and in the primary protecting barrier enveloping the cell. If it is removed by treating with the enzyme lysozyme (a mucopeptidase) the cell will die. Its presence is essential for the life of the cell, so before bacteria could survive the rigors of the "primitive organic pool," an intact mucopeptide *cell wall* must have evolved.

The other barrier, the *cell membrane,* is 7.5 microns wide and has regulatory and synthetic roles. It is composed of lipid and protein, and some of the proteins are enzymes, involved in the synthesis of new cell wall and capsule materials. Other enzymes are concerned with the regulation of the water content of the cell and the carriage of various ions, sugars and amino acids across the membrane. For example,

E. coli concentrates potassium to give an intracellular concentration of 1000 times greater than that outside the bacterium in the intestine;[3] the entry of potassium is linked with an efflux of sodium ions. If this ion balance is lost the cell dies.

Like the *cell wall,* the *cell membrane* must be intact for the cell to have a continued existence. If it is subjected to freezing, or heating much above 50°C its integrity is broken. So, once again, doubts must be raised about the feasibility of such a structure evolving in and enduring primitive earth conditions.

The interior of the *E. coli* contains among other substances, ribosomes and nucleic acids. Ribosomes are 10-20nm in diameter,[4] composed of protein and ribonucleic acid, and are only observable by electron microscopy. Their function, as in other cells, is to manufacture proteins. All cells make their proteins with the use of ribosomes, and there does not appear to be any other method available. Each *E. coli* cell will contain many thousands of ribosomes.

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†This paper appeared originally as Evolution Protest Movement Pamphlet No. 190, July, 1971. It is published here through the kind permission of the author and Dr. C. E. A. Turner, chairman of The Evolution Protest Movement. Reprints may be purchased at 2½p per copy from Hon. Secretary, Evolution Protest Movement, A. G. Tilney, Santhia, 110, Havant Rd., Stoke, Hayling Island, Hants. PO11, OLL, United Kingdom.

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Function and Genetics

The details of protein synthesis have been worked out, and it is a highly sophisticated process. A good account is given by Rose.[5] Again we must ask the question: How was it possible for the first primitive cell to evolve elaborate ribosomes and the associated materials to carry out protein synthesis? No cells are known which thrive without producing protein.

Evolutionists can only assume that there was a profusion of mutations occurring within minutes of each other. There can be no other explanation on the basis of evolutionary theory.

When we consider the genetics of *E. coli*, evolutionary theory is faced with even more difficult problems. The hereditary material in *E. coli* has been shown to be in the form of a circular paired strand of DNA[6]. It has been estimated[7] that this strand contains 3×10^6 pairs of nucleic acid "bases."

On the assumption that the average protein contains 100 amino acids, and that three nucleic acid "bases" form a code for one amino acid, this means that it is possible for *E. coli* to make 10,000 different proteins. Even if one assumes that the first primitive cell contained only 10% of this number, this still means that it had a code for 1000 different proteins. It would seem difficult to believe that random mutation, chance collisions and aggregations of precursors could produce an intact cell of this complexity.

Furthermore, it has been shown[8] that the total time taken for the replication of DNA in *E. coli* is 40-50 minutes at 37°C; and this therefore means that DNA synthesis is done at the rate of 1000 base pairs per second. This is an extremely rapid process which must be done by only one enzyme molecule and so shows a high degree of organization and control.

E. coli and DNA Code

As DNA appears to be the universal hereditary material, and DNA polymerase the enzyme responsible for its replication, are we to assume that the first primitive cell evolved all of this from the "primitive pool" of nucleic acids and amino acids? The "Genetic Code" was largely worked out using *E. coli* and recently Marshal *et al.*[9] showed that the code was the same in the South African clawed toad, the guinea pig and in *E. coli.*

It is remarkable that the code is the same in three organisms differing so greatly: showing that the code is almost certainly universal. It also implies that the code was established very early in evolutionary history, and has remained substantially unchanged.

Therefore we would ask the questions: Why has it remained unchanged; why has it not been improved or extended down the ages? A more credible explanation of the universal code would be that living things were created by a single Being who has produced variety on a basic theme.

A similar degree of organization and complexity was shown by Dr. Kepes[10] in his experiments on the breakdown of lactose (milk sugar) by *E. coli.* The principal enzyme involved in this process is called galactosidase and Kepes showed that it took 25 seconds to synthesize this enzyme.

Galactosidase contains about 1,200 amino acids, and he therefore calculated that the messenger RNA used in the process of enzyme synthesis must have been made at the rate of about 22 nucleic acid bases per second. This showed how rapidly an enzyme can be made and how quickly the gene which codes for it can be switched on.

In the fluctuating primitive conditions such a rapid system for producing enzymes would be essential for survival. Can evolutionists offer a plausible explanation as to how this system developed?

Finally, in an interesting chapter of his book, *The Life Processes,* Prof. J. A. V. Butler, F.R.S. says:

> Even the simplest complete organisms we know of today are almost unbelievably complex. It is difficult to visualise the steps by which they may have originated, because the various processes which occur in them are interdependent, none can function without the others. . . . It is not easy to see how these different parts of the life process could have been elaborated separately.

And after reviewing the evidence for primitive life and the hypotheses built upon it, he concludes that this is "highly speculative and the gap between a rich organic environment with all the necessary precursors, including even polypeptides and nucleic acids, and the simplest organized life remains immense." We would suggest that this "gap" will become even more immense as knowledge accumulates about single-celled organisms like *E. coli.*

Modern scientific facts do not refute Creation: they support it.

References

[1]Health, Dept. of. 1969. Bacteriological examination of water supplies. H.M.S.O.
[2]Rose, A. H. 1968. Chemical microbiology. Butterworth. pp. 9-12.
[3]*Ibid.,* p. 88.
[4]Mandelstam, J. & K. McQuillen. 1968. Biochemistry of bacterial growth. Blackwell. pp. 130-132.
[5]Rose, A. H. *Op. Cit.,* pp. 155-159.
[6]Cairns. J. 1963. *J. Mol. Biol.,* 6:208.
[7]Butler, J. A. V. 1970. The life process. George Allen & Unwin. p. 53.
[8]*Ibid.,* p. 54.
[9]Marshall, *et. al.* 1967. *Science,* 155:820.
[10]Kepes, 1969. *Prog. Biophys. Mol. Biol.,* 19:201.