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FROM NON-LIFE TO LIFE

Just over one hundred years ago, Louis Pasteur performed an experiment that should have laid to rest a problem vexing the scientific world for many centuries. The problem, however, has once more been cast into the light of scientific interest, although under an entirely new aspect, for scientists are now attempting a very interesting project in this area. They are trying to fit new pieces to the old puzzle of the spontaneous generation of life from non-life. They have a fresh approach to the theory that living organisms spring forth at times from non-living matter.

The origin of such a theory is readily understood when we reflect that in the centuries of long ago, from at least the time of Aristotle (died 322 B.C.) up to the threshold of the modern age, observers of nature lacked scientific instruments of magnification. Accordingly, in some cases where life was being generated they could not detect any seed or parent which would explain the occurrences. For example, maggots seemingly originated out of decaying flesh; plants unexpectedly sprang up in desert-like areas with no apparent cause. They concluded, therefore, that life was somehow being generated from non-living matter.

As the age of experimentation dawned, however, some began to test the validity of this theory. One of the first attempts to disprove it came in 1668 from the ingenuity of the Italian, Francesco Redi. Taking two containers of decaying meat he placed a gauze mesh over one of them, but left the other one completely exposed to the air. Within a short while the matter in the exposed receptacle was crawling with maggots, which are the early stage of a fly's development. The contents of the covered receptacle, on the contrary, showed no signs of maggots, but the covering itself was spotted with the eggs of flies. Consequently Redi demonstrated that maggots at least are not generated spontaneously, but are the direct offspring of living flies.

Later, when the microscope came into use, the theory of spontaneous generation suffered a further setback, for living generators were detected in what had been inexplicable types of generation. The microscope, however, enhanced the theory in other respects. In 1683, with the aid of this instrument, A. van Leeuwenhoek discovered bacteria. These minute forms of life were in fact found in all putrefying organisms, but the cause of their

origin remained a mystery. For this reason a tempting theory arose that only the higher type organisms are generated from their own kind, while microscopic bacteria come forth spontaneously in a suitable culture.

By the eighteenth century the controversy over spontaneous generation had grown to a pronounced degree. During this century Abbe Spallanzani performed a notable experiment in which he heated stoppered phials containing putrescible matter to very high temperatures, thus sterilizing the contents. After cooling no signs of bacteria could be detected until a phial was exposed to the air. Bacteria then occurred in abundance. This experiment, however, was highly criticized on the basis that the air in the phial was also made sterile, and ordinary air was considered a necessary factor in producing life spontaneously.

Finally, in 1861, Louis Pasteur published the results of an experiment which conclusively disproved the theory of spontaneous generation. Actually his experiment was identical with that of Spallanzani, except that Pasteur drew out the neck of the phial into a narrow S shape and left the mouth open. He heated the phial to boiling point repeatedly, then left it standing. No life appeared until the neck was broken months later. Atmospheric dust immediately fell upon the putrescible matter, and within a few hours living organisms were detectable through a microscope. Since that date all attempts to present valid cases of spontaneous generation have failed. Therefore, it can now definitely be stated that all known living organisms always arise from pre-existing living organisms.

If the theory of spontaneous generation has been so completely overthrown, why has today's scientist—specifically, the biochemist—taken a renewed interest in it? Because he has an entirely new slant on the theory. Whereas in former centuries scientists concentrated on spontaneous generation as an occasional and continual process in the world, the modern scientist looks to the theory only in reference to the very beginning of life on earth. It is part of the evolutionary theory that the first living organisms were educed from the inorganic matter of the earth as a result of strong cosmic rays coming from the heat of the sun. Subsequently these organisms reproduced their own kind, then gradually higher forms of life evolved from these. In order to substantiate this the biochemist is now attempting to produce life artificially from inorganic substances. He firmly believes he can accomplish this feat within the next twenty-five years.

At this point we might ask ourselves a couple of questions. Is it really possible that life could have originated naturally from non-life in the beginning of the world? Also, does it seem that scientists are heading up a

blind alley by attempting to produce life artificially?

In responding to the first question we can make several observations. The immediate cause of the first living organisms was supposedly some powerful rays from the sun, which is an inorganic substance. The subject upon which the sun's heat operated was the inorganic matter of the earth. The effect produced, however, was an *organic* substance, that is, a living organism. Thus a non-living cause acts upon a non-living subject to generate a living form. This is to say that the effect exceeds the cause, which is clearly impossible. An effect can be equal to its cause, as when a dog generates another dog; or it can be inferior to its cause, as when a man makes a statue. But it can never be greater than its cause, which seems at first blush to be the case here.

Keeping to the theory that the sun is the effective cause of these primitive organisms, the only possible solution seems to be an appeal to a living superior cause which would somehow use the sun as an instrument to generate life. This cause would either be God as the Author of nature or those pure spirits which we commonly call the angels. Indeed scholastic philosophers of the middle ages proposed this same explanation when considering the ultimate causes for what they mistakenly observed as spontaneous generation. They too spoke of the celestial bodies, such as the sun, moon, and stars, as the immediate cause of this generation. But realizing that a non-living thing of itself could not produce a living form, they soundly invoked the higher causality of God or angels as the principal agents behind the whole process. These agents would use the natural powers of the sun to produce spontaneous generation just as a physician uses the natural healing powers of medicine to produce health.

It should not be thought that appealing to God as principal agent is invoking the aid of miraculous intervention. On the contrary, the sun has its own natural energies of heat and light, and the earth its own natural chemical properties. Thus, because of His complete grasp of nature's capabilities, God would only apply the energies of nature in an intelligent and orderly fashion to bring forth living organisms. No miraculous intervention is called for in this situation.

It should be further noted that the principal agent must not only be alive, but also must have an intelligence. There are two reasons for the need of an intellectual agent. First of all, the product to be made is an organism; this demands by its very essence a certain order among its parts. But any order found in a thing is traced ultimately to some kind of intelligence giving it its order. Secondly, the principal agent is not producing

something by natural generation, but rather by way of art. For just as an artist applies the chisel to stone in producing a statue, so the principal agent applies the sun's heat to the earth in generating life. Now a work of art—as well as order in things—needs the direction of an intelligence in the last analysis. As a consequence, the principal agent of spontaneous generation must have an intellect, and God has this in a supereminent way.

To illustrate how this orderly process of generating life artificially might have taken place, let us say for example that the first spark of life on earth actually did come about according to the modern evolutionary theory. In its details the theory proposes that the earliest stage of the earth was no more than a hot mass of inorganic material. It gradually cooled off and the inorganic matter came to a certain suitable condition by reason of natural chemical activity. As yet no heavy atmosphere surrounded the earth as we have it today. Accordingly the powerful cosmic rays of the sun were not prevented from directly pelting the earth. Due to this tremendous energy acting upon a suitable condition of the elements, simple forms of plant life were generated. The plants subsequently emitted oxygen and other gases which eventually formed our present atmosphere. The cosmic rays now being deflected by this atmospheric belt, other forms of life were not prohibited from evolving from the first organisms.

This process of bringing the first signs of life to earth demands no miraculous intervention. God, having created the universe in a very primordial state, could have easily given it certain natural laws of operation whereby, it seems, life could have arisen and developed as outlined by the evolutionary theory presented here. Hence, since God would have ultimately directed the whole operation, the beginning of life could adequately be explained according to a proper cause-effect relationship.

Now that we have seen how living organisms could have been generated by the sun, let us make a brief consideration of the second question placed above: does it seem that scientists are attempting the impossible by trying to produce life artificially? In light of what has already been said about an effect needing a proportionate cause, it seems that this question is not difficult to answer. Human beings are living, intelligent agents. Obviously then they are vastly superior to any simple forms of life they might attempt to produce. Since they are intelligent beings they seem to have the necessary quality for producing an organism artificially. For as we already said, an organism by essence has an order among its parts, and also the production of something in an artificial way is a work of art. But both of these factors, order and art, necessarily imply an intelligence. Thus, from these

two points of view the human creature fills the bill.

As far as having at his disposal the proper inorganic material upon which to work, man today has greater control over chemical elements and their compounds than ever before. And this control will become more perfect as he continually increases his knowledge. Man also possesses more advanced instruments for application to inorganic material. Incidentally, since a powerful type of heat-energy may well become a necessary instrument in this application, it might be pointed out that man is already capable of a controlled use of thermonuclear energy, and this energy is thought to be the same as that emitted by the sun.

It would be up to the scientist, then, to further comprehend the laws of nature and to further perfect his control over them in order to know what instruments to apply to what chemicals. He himself would not produce the energies of nature; they are already embedded in nature itself. He would only apply these energies according to an intelligent method. Our conclusion, therefore, urges us to cheer on the biochemist's noble experiment to a successful completion.

—John Rust, O.P.