FILOZOFIA I NAUKA
Studia filozoficzne i interdyscyplinarne
Tom 12, 2024

Richard Krzymowski

THE APPEARANCE OF LIFE[1]

https://doi.10.37240/FiN.2024.12.1.3

ABSTRACT

The article presents the hypothesis of the origin of life. All the basic ideas of the 20th century research program in this area can be found there: the extrapolation of Darwinism into the area of chemical evolution, the influence of solar energy, the large "chemical possibilities" of carbon compounds, early heterotrophy, the gradual increase of organic purpose as a result of natural selection.
Keywords: Biogenesis, chemical evolution, pre-biological natural selection.

INTRODUCTION

One of the issues in the natural sciences which currently differs most the opinions of scientists is the problem of spontaneous generation. It is true that in a long series of difficult experimental studies, concluded very brilliantly with the works of Pasteur, the possibility of the spontaneous generation of the organisms that we know is contradicted. Furthermore, there is currently sufficient knowledge about the morphology and physiology of the cell, in such a way that a priori the spontaneous generation of formations with a construction and operation as complex as the simplest unicellular organisms that we know seems impossible.

But we cannot be satisfied with only these negative results of scientific research, as it remains one of the priority tasks of science to continue investigating the first origins of life. If the experimental method did not shed any light, we still have the path that has already led to many beautiful results, that is, the observation of the facts that leads to the establishment and test-

[1] The paper has been published in German as: *Das Wesen der Urzeugung*, Die Natur, 1897, 47 (19), pp. 221–222; 47 (20), pp. 229–232. Translation from German by Włodzimierz Ługowski. The English translation of the work is published for the first time. The summary and keywords come from the translator.

ing of hypotheses. If at some point the correct theory is found to explain the essence of spontaneous generation, it would make itself known by putting the key to all the facts related to it in our hands.

Of course, there is no lack of hypotheses about spontaneous generation. Many researchers have endeavoured to obtain clearer images of this phenomenon through chemical and physical processes. Remember here the hypothetical explanations given in this regard by Häckel, Pflüger and Nägeli.

As is well known, from Preyer and Fechner comes the curious hypothesis that living matter is truly primary, and that dead inorganic matter should only be viewed as a product of organic activity. According to Preyer, life has always existed, the living has always taken its origins from the living, and inorganic nature should be seen only as dead matter, but that at some point had life.

By Richter, Helmholtz, and William Thomson the idea was expressed that terrestrial organisms probably did not originate on Earth, but were brought to our planet by meteorites from foreign bodies.

Of all the hypotheses postulated about the origin of life so far none has been accepted by the general public.

It is not our task to present to the reader all the different opinions about the origins of life. Those who are interested in more details can refer, for example, to the short text by O. Taschenberg *Die Lehre von der Urzeugung sonst und jetzt*, Halle 1882, where they can also find an extensive bibliography. Also in some textbooks there appear extensive paragraphs regarding the theories of the origins of life. For example, the work of Max Vervorn is recommended: *Allgemeine Physiologie*, Jena 1895.

The Darwin–Wallace theory of descendance allows us to assume spontaneous generation only in the case of very primitive and relatively simple "living things;" the emergence of the more complex organisms is then explained by the gradual phylogenetic transformation caused by the selection of the formations originated by spontaneous generation. Then the question arises of how it is possible to explain the origin of the first, of the simplest living beings.

In the year 1881, a writing by Wilhelm Roux appeared under the title *Der Kampf der Teile im Organismus*.[2] This work became very famous for the interesting explanation of the adaptation phenomena of the animal body. Roux's ideas about the importance of the competition that takes place in the organism between each of its active parts and in the existence and persistence of systems that have some use have also found great respect.

[2] This thesis was reprinted with the title *Der züchtende Kampf der Teile, oder die Teilauslese des Organismus* and was provided with comments by the author in *Gesammelte Abhandlungen über Entwicklungsmechanik der Organismen*, de Wilhem Roux, Leipzig 1895, Vol. I. Observations on our topic can also be found in volume II, for example, on pages 76–85, 218, 318.

The same cannot be said of another sequence of ideas contained in the same document. We speak of Roux's ideas about spontaneous generation, which, although he only mentions them in the appendix and with great reserve, are expressed with high precision. In our opinion, these proposals contain the correct explanation for spontaneous generation; so we will deal with them in more detail below.

In paragraph V (*Über das Wesen des Organischen*) of his work, Roux says:

> "It has been given to me to speak with only a few words about the much discussed problem of the origin of life, that is, of spontaneous generation. Of course, I run the risk of acting against my own conviction [...] Since I believe that with our current knowledge of the organic we are far from being able to present proof of the veracity of any of our thoughts [...] Even if it were the merit of Tyndall, Preyer and Pflüger to have pointed out the similarities that exist in the combustion process, in fire, the oldest and most useful image to explain life and vital processes, we would not be able to express a theory that be based on actual observations that the life process had been derived from fire. We know too little about the functioning of atoms in themselves and within organic configurations, to be able to assess whether the direct passage from fire to life would have been possible. It also seems superfluous to me to search in a theoretical way for the possible place of origin in the universe, since we lack any information about the necessary qualities of that place. I think that for the moment we can be satisfied with the assumption that the vital process had its beginning in some phase of the formation of the Earth, but we cannot demand, as always happens, that it be presented to us immediately ready and ordered indicating the corresponding assimilation rules. Rather, it is necessary to imagine that life for now is something more than a simple assimilation process that began in a similar way to fire. Perhaps, little by little, the formation in the appearance and disappearance of numerous variants crystallized, with the continuous increase of the characteristics with the possibility of subsisting, the quantitative and qualitative 'self-regulation' in assimilation and consumption. Reaction properties, oriented to a higher degree of order, surely arose next, in perhaps periods that included millions of years, and the reflex movement was gradually created in the form that we see in moners.
> The further development of reactions such as the movement of the fixed order and the specific perception of the senses, surely followed a long time later, and in our imagination they are already much higher, since nobody can imagine them even in the simplest stage of life. However, the much more difficult acquisition of the most necessary characteristics seems to have occurred all at once, as a game of chance [...] It is not often mentioned what it takes to form and move a *Pseudopodium*, how many others do the same when retracting in the longitudinal direction, and what it takes to acquire these faculties. (This idea of the great complexity of the simple movement of organic masses, according to the wise recent works of G. Berthold, O. Bütschli, M. Verworn and

> others, is not adequate, thus considerably reducing the difficulty of acquisition of said powers.[3])
> The reflex movement was surely followed by the development of certain heritable directions both in movements and in formations, and with it, the great principle of formation from metabolism, the basic principle of organic morphology. This does not seem easier to understand than density, or more difficult, despite the analogy that is frequently mentioned with the formation of crystals, since the latter does not occur precisely from metabolic processes."

As a further stage of development, the appearance of consciousness is presented, combating the idea that in the course of phylogenesis no new "qualities" had appeared, but that they had already been typical of the most primitive living beings. It is also noted "that physical functions may not be something so absolutely different from other events," and therefore "their phylogenetic origin is not as difficult to understand as it seems to us today."

As for the last explanations, Roux says the following:

> "Just as in ancient times it was intended to generate the Homunculus of the retort, so it is required today for the case of the moners. It seems to me that this has many similarities, as if a hurricane was expected to accidentally blow in a harmonic work of art as a whole, for example, in a Beethoven symphony, or that when ancient rocks collapsed a Doric temple would emerge from the ruins, or that a Papuan Indian happened to discover the integral calculus. If one day something could arise by chance for the origin of which a selection process of the best carried out over millennia would have been necessary, why could this not happen in some cases. Or they could be simpler than the ordering of the particles in the movement of the moners, which are not even fixed, but are constantly changing."

These are Roux's explanations about spontaneous generation. Regarding Roux's ideas about "self-regulation" as a fundamental property of the organic, we have to refer to paragraph V (*On the Essence of the Organic*); for the Roux hypothesis of spontaneous generation is not fundamental; however, the main idea is to assign spontaneous generation to a single assimilation process and the consequent cultivation of all the functions of organisms.[4] How to imagine the sequence of cultivated functions is of secondary importance, as long as it is not that of reproduction (assimilation), or even some of the more complex functions (physical functions).

It should now be our task to explain in more detail Roux's theory of spontaneous generation, to clarify to the reader the high degree of probability that it possesses. I want to note that contrary to Roux, I not only see

---

[3] This phrase in parentheses is a comment by Roux in the second reprint.

[4] Roux calls it the first emergence of life by successive cultivation and accumulation of the basic functions of life.

the hypothesis of spontaneous generation based on successive development as a "possibility of thought," for which there is no possibility of presenting evidence of its veracity, but I am completely convinced of the rightness of this explanation, and only out of extreme caution do I speak of a "hypothesis."

ARGUMENT [AUSFÜHRUNG]

If we contemplate the inorganic nature that surrounds us, we perceive the continuous destruction of the weakest formations. Due to a large number of influences, formations that are less resistant from the chemical and physical points of view are continuously destroyed, while those that offer more resistance are preserved for a longer time. Thus, for example, they resist more mountain formations that consist of rock that is not influenced by climatic factors, while other mountains, whose stone degrades more easily, degrade faster under the same conditions. A granite that contains a relatively large amount of feldspar and little quartz will erode ceteris paribus more easily than a granite composed of relatively little feldspar and a lot of quartz. So, the poorer feldspar granite formations will exist longer than those with little feldspar content but a lot of quartz. Let us take a chalky rock that contains a considerable amount of carbohydrate magnesium. The carboacid lime is gradually carried away by the water, while the parts with carboacid magnesium content offer resistance for a longer time. Therefore, the parts of the rock that have a large amount of carboacid magnesium will exist for a long time, and little if they do not. Take for example two platforms, both formed by earthy masses, where one platform has a protective layer of rocks on its surface and the other does not. The latter will be more difficult to escape the destructive influence of the water that attacks, dilutes and takes away its earthy mass than the former protected by a layer of rock that is difficult to destroy; therefore, under the same conditions, the first platform will exist longer than the second. Thus, in inorganic nature a selection of the formations that are most easily destroyed is constantly carried out. Geological formations, minerals, rocks, are subjected to a selection by means of forces that preserve the most resistant among them. We have tried to clarify this with the examples mentioned, but it is certainly possible to reproduce these examples; each one, by himself, can search as many as he wishes in geology and mineralogy.

So, it is worth observing that a selection of the most resistant and therefore most suitable for the conservation of the species takes place: not only in organized nature, but also in unorganized nature. Much like organized nature, the struggle for existence allows only the most resistant living formations to survive: in organized nature, "the tooth of time" leaves only the resistant formations. Later we will return to the selection processes that occur in unorganized nature.

In inorganic nature there is no stillness, but the constant activity of various forces. Large amounts of energy are continuously transformed, passing into latency states, or on the contrary, being released from latency states. Light is transformed into heat, this heat could be used for chemical processes, from these new processes are generated; that is to say, there is a constant mobility and everywhere large amounts of energy appear that seem to disappear again. As we have seen, these dynamic processes generate, among other things, selection processes, before which the formations that are held in the most stable way before the attacking and destructive effects, persist for longer than the others.

But now we will have to ask ourselves the question: Is it true that only formations that yield very little to outside influences persist for long periods of time? If we reflect on the answer to this question, we come across a case in which "persistence" can be generated not by great passivity, but by something entirely different.

What happens when a substance captures and conducts certain sums of the energy that reaches it and this is used so that other certain substances that come into contact with the first are transformed in such a way that they are completely equal to the first substance? If this first substance modifies other substances, that is, substances of different composition, but with the same chemical elements, which are in contact with it, in such a way that these substances now form an equal substance? In other words, what if a substance used certain energies simply for its reproduction?

It seems obvious that this property is also adequate to make this determined substance continue to exist. And this characteristic also gives a ceteris paribus substance a certain preference in selection processes. Take for example two substances, both equally subject to destruction by physical or chemical interventions. But one of these substances has the ability to use a certain energy for its reproduction, while the other substance does not have this ability, but behaves passively. It is clear that the first substance gives the second an advantage in the selection processes and that, therefore, we can conclude that it is through forces of destructive action that the masses of the first are selected for their preservation.

A substance that is endowed with the ability to reproduce using certain foreign energy, under equal conditions will be selected, among other substances, as having a favourable position.

We are going to go back to a time when organisms did not yet exist on Earth. In the eternal game between the forces of nature, a substance would have been generated that had the characteristic of being able to take advantage of certain external energy for its own reproduction. This substance will continually grow and spread through reproduction. In nature, a series of appropriate influences are continually at work to destroy existing structures. These unfavourable influences will influence the substance that is being reproduced, partially destroying it. With these destructions, it will be divided little by little into different masses, which of course will continue to reproduce and propagate.

Due to these forces, only those parts of the substance that are constituted by the least lasting chemical and physical relationships are destroyed. However, the parts of the substance that chemically and physically offer the greatest resistance to destructive forces will be preserved. In this way, the substance is permanently subjected to selection processes.

Often the parts of the substance that (at first by chance) have more favourable structures will be spared from destruction. It is quite possible that there are certain structures in which the substance offers more resistance to unfavourable influences, and that these structures are selected in this way. Selection could be avoided only if every substance was simultaneously destroyed, or if the substance was equally destructible in all its parts (an unlikely assumption), or if the substance were totally indestructible (a less likely assumption). Otherwise, the selection seems inevitable. In its growth, its division and its propagation, the substance will finally go to different regions and localities. In one place or another it will come into contact with other substances, which are possibly favourable for the substance itself. Also these parts of the substance, which accepted new substances favourable to themselves, will be favoured by the selection ceteris paribus. The substance will also develop differently in different places, according to their conditions and needs.

In addition, there will come a time again when the different masses of our substance enter into competition with each other, perhaps due to a lack of material-supplying substances (food), or due to lack of space, which would generate a fight or competition. With this competence the selection would be extraordinarily sharpened, so it will be important that the substance is developed in the most convenient way possible. For the sake of simplicity, of course, we speak here of a single substance. In reality, as we have already mentioned, the substance will adopt in different regions and under different circumstances also different characteristics.

The original activity of the substance is nothing other than direct reproduction. The substance uses certain energies for its direct reproduction; that is his only activity. The substance, through variation and selection, develops increasingly useful, more durable and more complex structures. But the activity of the substance is also becoming more complex, also because of the processes of selection of chance modifications. While originally energy was used exclusively for direct reproduction, it is now being used more and more for other activities that indirectly favour the reproduction and conservation of the substance.

Then, in addition to reproduction, many other functions appear in the substance that are gradually acquired through selection, until it acquires over time all the functions that we can observe today in protoplasm.

Of special importance is the first appearance of physical functions. I think there is no doubt that these functions could have arisen at a very advanced stage of development. Physical functions are a clear example of how another application of energy can indirectly favour the reproduction and preservation of organized substance. It is clear that an organism in the struggle for survival will be in a more favourable position if it can perform under the conditions of the outside world and if it can regulate its activities according to circumstances and changes. This is what physical functions serve. It is understood that the appearance of these functions in the same way as the appearance of the other functions of the protoplasm, are due to selection processes. The physical functions must originally have been of a very primitive type, and with the selection process they were carried to another stage of development.

The scientist must grasp the physical functions in the same way as the other functions of protoplasm. Organisms arose from a substance that used energy to reproduce, but did not perform other types of functions. The functions gradually became more complex, the movement processes more varied, and finally, from these movement processes, the physical functions branched off as certain types of movement processes, if I may here allow this expression.

At the moment that we assume that physical functions are not only complex movement processes, everywhere we find contradictions in nature, and we are forced to interpret physical phenomena as processes of movement. If we do not consider thought as movement, there is, for example, no law of conservation of energy. How can the muscles of my arm respond to impulses of the will, if my thinking, my will does not have the power to trigger certain processes in my nervous and muscular systems? And if energy is required in this disengagement, and if thinking did not involve movement, then, according to the law of conservation of energy, it would not be able to generate anything either.[5]

What is characteristic of the Roux's hypothesis of spontaneous generation is that it is due to selection. By selection, the formations least subject to destruction, which prevail longer than the others, are favoured on Earth. But not only are the substances that behave passively selected, but also those

[5] As for Du Bois Reymond's opinion that thought is a transcendent problem for human reasoning, I have so far failed to present a definitive opinion. These ideas can be affirmed or denied, but this does not change Roux's theory of spontaneous generation. I pray that it is taken into account. If some scientists think that Du Bois Reymond denies the mechanical idea of life processes, it is due to a misunderstanding. Compare the presentations by Du Bois Reymond: *Über die Grenzen des Naturerkennens*, 7a edition, Leipzig 1891, and *Die Sieben Welträtsel,* 3rd edition, Leipig 1891.

that take advantage of a certain energy for their reproduction, and that therefore, under equal conditions, have an advantage over them. Selection favours some substance that reproduces; by selection, it becomes more useful for its conservation and reproduction; by selection, it arises from the substance that reproduces, the kingdom of organisms.

To make use of a simple expression to name the substance that reproduces or assimilates, and that forms the starting point of the phylogenetic development of protoplasm, we will use the expression "substance of spontaneous generation" (*Urzeugungssubstanz*). However, it should not be understood as a substance in the chemical sense, that is, with a unitary chemical body. If the spontaneously generated substance had such a body or if it was composed of several different chemical substances, it is not something that we are concerned with in this work.

Reproduction is then the only function of the spontaneously generated substance. It is time that we present the proofs about the probability of this thesis. For this, we are going to think about what the organization in the most developed organisms is really due to. Where do all the myriad adaptive differences that we find in developed organisms come from? Darwinism provides us with an answer: it is due to selection among variations. In the reproduction of primitive organisms a permanent selection of the most capable organisms or strains was carried out, a constant selection of the most suitable specimens in their form and their functioning. Over the course of endless periods, the characteristics acquired by selection gradually added together, became increasingly complex, and thus more developed organisms emerged from the most primitive organisms. From the relatively simple mass of protoplasm arose in the course of a long phylogenesis, for example, the human body, so complex in forms and functions.

Now we are going to derive from selection all the useful functions that we find in the protoplasm of the protist. We often find in them useful developmental locomotion, convenient reluctance to light, pressure, etc. All these characteristics were acquired at some point by selection; that is, they did not exist at one time. Thus, we can imagine one after another useful functions of the protoplasm of the protist, until there is only one function left: reproduction. We must always presuppose this function; without reproduction we cannot imagine any species of organisms. Even any improvement caused is impossible. Reproduction is the necessary condition for a species of organisms to acquire other useful functions by selection. Since all convenient functions except reproduction—as we are assuming here—are acquired by selection, we conclude that protoplasm must always have had that capacity.

This idea leads us to suppose for the spontaneously generated substance only one function: reproduction. Thus, according to Roux, not only were developed organisms generated from primitive ones by selection, but the entire kingdom of organisms was thus formed from organized nature. Just as spontaneous generation itself is based on selection processes, so the phylogenetic transformation of a species of organisms branches into several subspecies.

According to the most well-known hypotheses of spontaneous generation, it could be assumed that the adaptive advantage of spontaneously originated configurations was given in a very different way to those adaptive advantages of more developed organisms. According to the Roux hypothesis, the origin of the adaptive advantages of spontaneously originated configurations can be explained in the same way as the adaptive advantage of more developed organisms, in such a way that it is a continuous series.

I consider this continuity in the explanation of the formation of organisms as a beautiful example of probability of the hypothesis of spontaneous generation. The developed organisms were generated by selection from the most primitive organisms; likewise, the emergence of organisms from inorganic nature is explained in the same way.

The formation of the entire kingdom of organisms is based only on avoiding destruction. One more point must be mentioned. We have seen that the only function of the spontaneously generated substance is reproduction. We have endeavoured to show that this reproductive capacity should be viewed as a function favoured by selection. Possibly, from the beginning the spontaneously generated substance has had a great reproductive capacity, possibly—and this is most likely—this capacity to reproduce has been gradually increased by means of selection, in such a way that it is doubly clear that also playability can be considered as a selected function.

Also worth mentioning here is a demonstration experiment that Roux conducted in relation to selection. He put different flames under a glass funnel. The wax flame inhibits a gas flame at a point where it held up well before when it had been alone. The wax flame can in turn inhibit a stearin flame. Likewise, the inhibition of the growth of a weaker flame by a strong one was manifested, placing at the same time a strip of paper soaked with oil and one without this liquid and lighting both under a funnel. The first grew rapidly, the other remained low; the latter grew after the oil flame had consumed its material.

With this successful experiment we have penetrated into this field, and it is still necessary for a scientist to present, in well-thought-out synthetic experiments, assimilation procedures of longer duration than those of the flame, organic assimilation processes, to prove similar properties.

In the presentation of the spontaneous generation we have started from the selection processes that exist in inorganic nature. We are now going to try to contemplate the relationship that exists between these selection processes of inorganic nature and those of organic nature. In unorganized nature, selection processes cannot manifest as markedly as in organic nature. This is easy to understand, since in organized nature all the adaptive advantages are carried out by selection in the course of phylogenesis, which is not possible in unorganized nature, if we exclude the case of spontaneous generation. That is precisely what is characteristic of organisms: that they are substances that multiply, in which adaptive advantages add up from generation to generation. Such a sum is precisely impossible in the selection that takes place in unorganized nature. Of course, in unorganized nature the most resistant formations are selected, but these behave in a very passive way, they do not continue to reproduce, and even when at one time or another they have some useful structure or chemical composition, in such a way that this structure gives them existence, this composition cannot be made more favourable by selection, since substances do not reproduce in such a way that they inherit that resistance.

It is clear then that the growth of crystals cannot be equated with the growth of organized substances. By this we do not mean that the emergence of a spontaneously generated substance would necessarily lead to the formation of complex organisms. On the contrary, a great series of coincidences is always required for the spontaneously generated substance to lead by selection to the formation of complex organisms. And it will always be a favourable coincidence if from a spontaneously generated substance, during very long periods, corpuscles of functioning as complex as the protoplasm of the now known protists originate. This in no way contradicts the assumption that the self-generating substance always undergoes a selection process if it reproduces long enough. The property of carbon to establish bonds with other elements in an immense number of combinations has been repeatedly pointed out to the world of organisms. It is precisely because of their variety that carbon compounds are especially suitable as constituents of organized matter.

This point has been stressed many times. We only want to mention here that precisely this variety of carbon enclaves lends itself to forming a substance with the characteristics of the spontaneously generated substance. Said substance must be constituted in such a way that it can use certain foreign energies for the reproduction of itself. This ability to reproduce appears to be a very complex function. The probability that the almost innumerable bonds of carbon lend themselves to the formation of said substance seems feasible; this probability is greater than between the combinations with the other elements, since they do not have as many possibilities of combination as carbon. Among the molecules of the carbon bonds we find the most varied architectures and it is more probable that among these architectures there are those that lend themselves to the formation of the spontaneously generated substance. In addition, carbon is a very widespread element, and this point is of course of great importance.

In the introduction we mentioned the meteoric hypothesis of Richter, Helmholtz and William Thomson, according to which terrestrial organisms reached our planet through meteorites. If this hypothesis were to be shown to be true, it would be clear that it would not change the Roux hypothesis of spontaneous generation at all, since it would then be organisms that had been generated spontaneously by selection of unorganized nature in one or more celestial bodies.

As for the place where the earthly organisms occurred, we can distinguish three cases:

— the spontaneous generation of all organisms took place on Earth itself;
— the spontaneous generation of all earthly organisms took place in other celestial bodies;
— spontaneous generation of earthly organisms occurred partly on Earth itself, partly on other planets, from which organisms were brought to Earth.

There are no more possibilities than these three. The reader should not forget that there is so far no indication of the transmission of organisms from foreign planets to Earth by means of meteorites, and that this idea has only been able to arise because there are still great unknowns about the spontaneous generation of organisms, on Earth.[6]

ABOUT THE AUTHOR — (1875–1960) was born in the Swiss town of Winterthur, where his father found refuge when he was forced to leave his homeland as a participant in the Polish uprising (1863) against the tsarist authorities. Krzymowski lectured at universities, among others, in Strassburg, Tübingen and Wrocław. He specialized in the geography of agriculture, as well as the history and philosophy of agricultural sciences. His most important work in the latter field is *Philosophie der Landwirtschaftslehre*, Verlag Eugen Ulmer, Stuttgart 1919 (it has been translated into Russian (Moscow 1927) and Japanese (Tokyo 1932; second edition: 1954). As a convinced Darwinist, already in 1897 (at the age of 22) he tackled the issue of biogenesis, which he considered (contrary to the prevailing opinions at that time) one of the most important problems of evolutionism. He also later referred to the principle of natural selection ("eines der wichtigsten und fruchtbarsten aller philosophischen Prinzipien") in his works on the philosophy of agriculture.

[6] The article appeared again in the collection: R. Krzymowski, *Kleine Abhandlungen aus dem Gebiete der Landwirtschaft und Naturwissenschaft*, Ludwigsburg 1900 Ungeheuer & Ulmer, pp. 30–43. The author has given it (at the beginning) the following footnote: "This article was published in 1897 by Prof. Dr. Taschenberg in the popular journal "Natur" in numbers 19 and 20. It is not only to be regarded as a simple reproduction of Roux's original hypothesis of *Urzeugung*, but some points that I believe are important for the theory of spontaneous generation come from me. Namely the conclusion that it is a necessary consequence of Darwinism to only assume the one function of assimilation for the primordial substance (*Urzeugungssubstanz*), if one assumes that all appropriate facilities have been acquired through selection. Furthermore, the explanation why selection in inorganic nature cannot produce the great degree of purposefulness. [Footnote by Krzymowski.]