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sequences likely to follow the rejection of, or any opposition to, the said doctrines. He who doubts or opposes is to be numbered with the fools. Nevertheless, I beg of you to consider what you would think of a person who assured you that a watch differed from the iron and brass of which it is made only in degree, and I leave it to you to determine what you ought to think of a philosopher who tries to make you believe that a living thing differs from the non-living matter of which its body consists in degree only. If at this time you press for reasons in favour of the conjectural unity of the living and non-living, all you will get will be some dictum about primitive nebulosity and chains of causation. Anything like criticism is so disliked by the new Materialist, that he condemns those who differ from him by anticipation, and thus for a time criticism is deferred, and his conjectures and fancies may find favour ; but that people should be led away so far as to renounce their belief in any form of religion, to deny God, and to abandon their hope of a future state, is marvellous indeed.

In conclusion, let me commend to you the words of Kant. "Criticism," said he, "alone can strike a blow at the root of Materialism, Fatalism, Atheism, Freethinking, Fanaticism, and Superstition, which are universally injurious."

THE LIVING AND THE NON-LIVING.

The following remarks upon this subject were made by Professor LIONEL S. BEALE, F.R.S., during the discussion on Dr. Wallich's paper* "On the Fallacy of the Materialistic Origin of Life," read before the Institute, April 17th, 1882.

I propose to offer a few remarks on the view taken by Professor Huxley and other scientific men, both here and on the Continent, in reference to the very important question of the transition from the non-living to the living. I am quite sure we shall agree that this is really the kernel of this most interesting subject. We are constantly told of the gradual passage from the non-living to the living, and the formation of a living thing is often spoken of as if the process were something like the change which takes place in the formation of crystals. Most authorities who support the materialistic hypothesis draw a parallel between the formation of the lowest forms of living matter and crystals. Now, it must occur to every one who has at

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* As yet, ill-health has prevented this author completing his paper for publication ; but it is hoped that it may form part of No. 64 of the *Journal*. —ED.

all considered the subject of crystallisation, that although there may be great difficulty in explaining the exact nature of the process, yet, nevertheless, it is well known that when a certain material is dissolved in fluid under certain circumstances, and the solution becomes concentrated, crystals are formed. Every tyro in chemistry has, probably, performed the experiment with common salt; and every such tyro, after having crystallised common salt, has re-dissolved it, and re-crystallised it again and again; and, if he were to go on crystallising and dissolving to the end of time, he would only produce crystals of the same form and the same chemical composition. Now, let him try to do this with regard to a living organism. The living organism is there. We know that every particle of living matter has come from a pre-existing living particle; but let us endeavour to take ourselves back to the time when there existed only the non-living, the inorganic matter out of which the living had to be formed according to a method as is affirmed somewhat resembling that of crystallisation. The chemical compounds that form the living matter—oxygen, hydrogen, nitrogen, and carbon—are supposed to come together in obedience to certain attractions and affinities which these primitive particles possess, but of which we know very little; but let us suppose a living thing is formed. Let us imagine the particles brought together in the manner supposed, and that a particle of living matter makes its appearance. We examine this particle, and try to ascertain its nature, and for this purpose we try, as we have tried in the case of the crystal, to dissolve it. What is the result? We destroy it; we do not dissolve it. (Hear, hear.) It ceases to be living matter before solution begins. It is no longer what it was before, and we cannot make it so. It has gone; it has ceased to be what it was, and we are not dealing with a living particle, but simply with the material that has resulted from the death of that which was before alive. We cannot re-form it. Once dead, it is incapable of being re-produced. Therefore, it seems to me a most extraordinary thing that some of the greatest authorities in science should pretend to compare the formation of living matter with the formation of crystals. There is not the slightest analogy, nor the faintest possible parallel, no comparison between living things and crystals. There is all the difference in the world between the process of crystallisation and the formation of living particles, which are supposed by Haeckel, and others who adopt his views, to be alike. Whatever may be the marvellous changes that occurred in the first formation of living matter, they cannot resemble in the slightest degree any phenomena with which we are familiar. There are no properties of matter that have as yet been discovered that can give us the faintest conception of the nature of the changes which must have taken place when the first living thing was formed. With regard to the question of complexity and simplicity, of which a good deal has been said, I will just offer a few remarks, and will then sit down. It seems to me to have been assumed in a most extraordinary way that some forms of living matter are extremely simple and that others are extremely complex. I should like to ask what is the meaning attached to these terms "simplicity" and "complexity," when

applied to living matter? Let us take the monera, said to be among the simplest forms of living matter with which we are acquainted. All we can see is clear, colourless, transparent, structureless, semifluid matter. Where is the evidence that the composition of this is more simple than that of the most complex living matter in existence? Take, for example, the highest form of living matter we know—the living matter which forms part of the brain cells of man himself, for I suppose we cannot conceive anything much higher. If we were to assume gradations of complexity and different degrees of superiority, we might go as far as to suggest that at any rate the highest and most complex living matter is to be found in the grey matter constituting the outer part of the human brain. But what is the fact? The matter we find there is no more complex than the living matter of the simplest monad, as far, at least, as we know. If we take this brain matter and examine it, we find that we can resolve it into certain organic substances, closely allied to the albuminous material which Professor Huxley and others call protoplasm, although they are not able to define precisely what they mean by the term. (Hear, hear.) They are unable to tell us in what way protoplasm differs from albumen, and muscle tissue, and a thousand other things. They simply make use of a name almost without a meaning. Well, the highest conceivable form of living matter, as far as we know, closely accords in its composition with the lowest form of living matter; and, as far as regards structure, if we examine that which comes from the highest organism, and that which is concerned in the formation of the lowest, no difference whatever can be distinguished. It is not that one is more complicated, or exhibits a structure different from the other. There is no structure in either. Both are perfectly clear, transparent, and structureless, and yet one is concerned in the performance of certain functions and offices, while the other is concerned in the performance of totally different functions and offices. Are we, then, to believe that the difference in the functions discharged is due merely to the chemical properties of the substances of which the living matter is composed? We cannot do this, because, when we come to analyse the two different kinds of living matter, we find in the material which results from their death the same elements. And, if the elements are not in precisely the same amounts or in the same proportions to one another, the difference which may exist in the composition bears no relation and has no reference that can be discovered, either to the difference in action or to the different structures which may be evolved from the two different forms of living matter. Therefore the terms "simplicity" and "complexity" seem to me to be totally inadmissible, and I venture to think that not one of those who are in the habit of speaking of simple and complex forms can give a rational explanation of what he means by the phrases he employs. What is generally meant by the simplest form of living matter is that when it attains its highest form of development it is still a simple thing, and what seems to be understood by that of the greatest complexity is, that when it attains its highest degree of development certain marvellous structures are produced; but when we come to look at the living matter itself there is

no difference to be discerned by any means of examination yet adopted between the two forms. The living matter, which, at the very earliest period of his development, represents man, is, as far as I know, not distinguishable from the forms of living matter of which the simple bodies Dr. Wallich has so lucidly described to us are made up. And therefore the difference cannot be chemical. Neither can it be called physical, nor mechanical, nor can it be due to difference in machinery or mechanism, for none is to be discovered. The difference is enormous, and it is of a most remarkable kind, but it is not to be explained by any facts in physical science with which we are acquainted. All we know is, that under certain conditions one form of living matter *grows* and produces a certain kind of structure, and that under different conditions certain other forms of living matter *grow* and produce a structure that is totally different. The difference between the two is not in molecular or chemical constitution. They do not remarkably differ in chemical composition, and we may safely say it is impossible thus to explain the difference. That is the whole of the matter ; the difference in the results cannot be explained by physics or chemistry, and I do not think it ever will be so explained. The difference is one which can only be spoken of under another term altogether, and this is a word to which many object very strongly. I allude to the word "vital." The difference in question is a vital difference, dependent not on a property which belongs to matter itself as matter, or derived from any properties in connexion with the elements which enter into the composition of the living matter. Whether the generation of living matter was spontaneous or not cannot be proved, but much scientific speculation is built upon the theory of spontaneous generation. However necessary such a theory may be to the doctrine of evolution, there are no scientific facts which can at all warrant the conclusion that non-living matter only, under any conceivable circumstances, can be converted into living matter, or at any previous time has, by any combination, or under any conditions that may have existed, given rise to the formation of anything which possesses, or has possessed, life. (Applause.)