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1900.

ORDINARY MEETING.*

HELD IN THE THEATRE OF KING'S COLLEGE.

THE PRESIDENT, SIR G. G. STOKES, LL.D., F.R.S., IN
THE CHAIR.

THE NATURE OF LIFE. By Professor LIONEL S.
BEALE, F.R.S.

PART I.

MR. PRESIDENT, LADIES and GENTLEMEN:—Before I pass to that very difficult problem, a part of which I hope to bring before you this evening, perhaps you will allow me to explain, in a few words, why we are assembled here this afternoon rather than meeting in our usual room.

It is because the Council thought that perhaps the room where we usually have our meetings would not be quite large enough to accommodate all who are here without inconvenience, so we applied to the authorities of King's College and they very kindly placed the large theatre at our disposal.

There must, naturally, be some sympathy between King's College and the Victoria Institute. Both Institutions have been founded upon somewhat similar principles—both are situated in a central part of London. Their portals are always open to everyone who desires to study and who

* February 20th, 1899.

takes an interest in scientific subjects. Both Institutions carry on their important work in hope, and the only wages they look for are "the wages of going on and not to die," and both discharge important functions, of benefit to the world. To me of course it is a great pleasure that our meeting should happen to be here, for this is the theatre in which I have been lecturing now for many, many years (applause), and I can only say that it gives me pleasure to return, for once, to my old home.

Let me, for a moment, recall a trifling incident, of some considerable interest to all, which happened a great many years ago, when there were 300 or 400 boys in the school in the regions below this theatre, and I can remember perfectly well, when I was one of them, there was once a great disturbance in the college. Many great people came in, and the yard was full of carriages. There were numbers of soldiers and a band was playing, and guns were firing. Presently Prince Albert arrived and was conducted to the terrace fronting the river. Some little urchins, full of curiosity, managed to make their way through the crowd to a small wooden table placed on the terrace, and there was a gentleman sitting with a little round disc before him. Round the disc were capital letters, A, B, C, D, and so on. It was moved round, one way or the other, by the finger. The operator looked anxious and, every now and then, towards the Shot Tower on the other side of the Thames. Various efforts were made. We did not, of course, know exactly what was intended; but we knew it was something very important, or the Prince would not be there. Close by, stood Professor Daniel and Professor Faraday, and a great many celebrated scientific men of that old time. Messages seemed to pass to and from the tower along the wires. This was the beginning of the electric telegraph, and the very instrument that Wheatstone used that day, is now in the museum upstairs. That day is of great historical interest, and a number of experiments were then made, and new investigations were undertaken by many scientific men, leading, at last, to telegraphy gaining the perfection which it has since attained, enabling us to communicate with our friends all round the world.

1. The problem that I wish to bring before you this evening is, perhaps, still further from solution than was the question of telegraphy at the time I mention. I do not suppose that fifty years have advanced our knowledge of the

problem of life, to the extent that the problem of telegraphy has been advanced in that time. Vitality has moved slowly compared with physics and chemistry.

The nature of life has been under discussion by the wisest and best men for, perhaps, 2,000 years, and still we do not know exactly the general views we ought to hold, concerning the nature of those wonderful changes which go on in every living organism in every part of the living world. However, it must be borne in mind that during the last fifty years new investigations have been made and new instruments have been obtained, so that we are able now to peer more deeply into the inmost recesses of living things than was possible on the part of our predecessors. We now look from an entirely different point of view; and, however much we may differ in opinion and doctrine from one another (and we *do* differ indeed on the very first principles) we can proceed further and deeper than was at that time possible.

We really see a great many things, which it was quite impossible to see only a few years ago. The improved magnifying powers of the microscope and new means of investigation, enable us to determine the actual particles which *live* and move and upon which "life" depends—particles that act vitally—*particles which alone can die*. Living particles are the only particles in the world that can die. This is not the first time that I have appealed to the members and associates of the Victoria Institute for consideration of the nature of life, and, as many are probably aware, I am on the side of *vitality*—vitality absolutely distinct and apart from all other powers, properties and forces in nature. I consider that vital power should be placed in a category by itself, quite distinct from that in which other forces or properties are included. Of course this notion is opposed, but unfortunately the various reasons I have advanced in favour of my conclusion have not been criticised as I should desire. Some will be now able to criticise my views, and if it would in any way further real knowledge, I should be quite happy to meet members of the Institute at any convenient time; and instead of expounding my views, I would ask to have my notions freely criticised, and be allowed to answer them if I could, and if I could not reply and explain more clearly, I would confess that I could not. (Applause.) In this way I think we should soon come to some valuable conclusions. At any rate that seems to me what anyone who is really interested in the matter, however

much he may cling to his own views, would desire. I must not say that no one has found fault with me, but the objections that have been raised have not touched the main issue. I have replied, but the position seems to remain much as it was.

2. Now it seems to me the first conclusion we must come to is that the *living world is very small and limited, and the non-living world enormous and infinite*. When we think of the very small amount of matter of our own earth, I am sure that everyone must feel that I am quite justified in making this remark—that the *living world is a distinct world, and is limited, and not one with the worlds composed of matter only*.

We all know, of course, that the great part of the matter of which our world, and the whole of other worlds is made, consists of matter of many kinds of which not one kind can live. The greater part of all world-material is not of the nature to constitute a necessary part of living organisms.

The living and the non-living are, and in my opinion have ever been, *distinct*. So that when I am speaking of life, I am only speaking of the life that is known to us here, not that which *may be*. I speak of the living things which we see, and know something about. I do not intend this evening to attack, in the least degree, the question of the origin of life. I wish to consider life as it is—the living things we see and can examine, and parts of which we can place under the microscope, and see very much that we could not have expected. We can also enter into various investigations concerning them, and ascertain something of their nature.

Further I hold that all life is absolutely distinct from all non-life; and that there is no bridge, as has been asserted over and over again, between the non-living and the living. There is a gulf between life and non-life which is unfathomable, and has never been bridged, and I cannot believe that it ever will be bridged. (Cheers.)

3. All living things come as far as we know (for as I said I am not going just now to enter into the question of the origin of life), from pre-existing living things. As far as I know not a single proof has been advanced that justifies us in considering that the non-living can be converted into the living, except by the influence of existing life. This always seems to be the case. A minute quantity of matter already living may transfer without loss (and that is a most wonderful thing) its power to an enormous quantity of matter; but the matter must become part of that which is actually living at

the time. So that, as it seems to me, whatever view may be taken of spontaneous generation, which was in vogue some years ago, facts are completely opposed to it. (Applause.) There is not a fact that justifies the inference that under any circumstances, the living can come from the non-living, and the more carefully we investigate the cases supposed to favour the doctrine referred to, the more certain we feel that mistakes have been made. So that I think it may be most positively laid down that everything that has ever lived certainly came from something which lived before.

4. All living matter, of whatever nature, forms substances which differ entirely from the living matter itself. All living matter is structureless—it has no form, and the active life-power cannot be separated from the matter and examined. When any attempt is made to do so, what happens is death; and when we come to examine what remains, please remember that we are not examining the living thing, *but the products which resulted from death*, and this holds good all through nature as far as is known. Some chemists make out wonderful things; but when they conclude that the components they obtain were actually present in the living matter, they go a great deal too far and too fast, for they succeed only in destroying the life. You must destroy the life before you can chemically examine the substance of a living thing, or in any way analyse it.

5. Let us try to ascertain how life—vital power—differs from all other forces known in the natural world. Whether life began on this globe twenty millions, fifty millions, or a thousand millions of years ago, seems to me to be a matter of no real interest. We cannot conceive changes which are spread over an enormous distance of time like that. So that if elementary and other substances were originally formed, nobody can know how or when, or whether life originated in them, or in some other way cannot be reasonably considered until, at any rate, we find out what life is here.

Neither do I think it profitable to discuss whether life, as present on the surface of the globe now, resulted from life being brought here on a fragment of another world. It seems to me we cannot profitably discuss such a conjecture. Whether the organic forms would live in passing through the ether and then through our atmosphere, I do not know, and the idea cannot be submitted to experiment. They must have been very strong living things indeed, if they reached this earth alive. And then I should think that

when the supposed fragment impinged on our globe the impact would be so great that every mortal thing would be killed and its remains smashed to atoms.

6. The matter of our life-world is taken up over and over again. I mean this—that of the constituents of living organisms of to-day, many are at any rate substances formed by living things—that had formed parts of living organisms many times before; and, I suppose, there is no doubt that a great many of the substances that exist in our living bodies now will, some years hence, be among the components of other living beings.

The quantity of matter in the world of course can never change, but the matter on the surface is always changing. Things are coming into the living world, living for a while and dying, and other organisms take up the products of their decay. In the course of time the matter of the dead takes other forms which may be of advantage to lower forms of life which grow and multiply exceedingly. This process, I imagine, has been ever going on since life appeared on the earth. In all living things the material changes in the living matter seem to be governed by vitality, and life exists, in any given particle of Bioplasm or living matter, as we know, for only a short time. In all the food that we eat, or the food that is taken into an organism, *there are certain constituents which are very soon taken up by living matter and which, themselves, become part of the only living stuff, the Bioplasm.* Some Bioplasm is always dying in different parts of every living organism, and the products resulting from death may be, and generally are, especially in early life, taken up by other living particles of Bioplasm; a portion of these die, and the products resulting are taken up by other living particles. This is the way in which the process of *nutrition* goes on—the particles of bread or meat which we take into our stomachs, after being altered by digestion, are at length so changed that they become fitted for the “food” of, say, muscle and nerve Bioplasm before they can become converted into these structures, or, as the case may be, into other constituents of our tissues or organs. It is at this time certainly reasonable to conclude that these processes of Bioplasm living and dying, go on over and over again in all living. Thus are the particles of food, milk for instance, or other substance at last, so to say “appropriated,” by the Bioplasm of the tissues of our bodies, before any “tissue” or lasting structure can result.

7. All vital power is invariably associated with matter. There is no question of "vital force" resident in matter generally. Any such notion is absolutely untenable. Every living particle, however minute it may be, is unquestionably matter; but, as it seems to me, *the matter of this living particle is controlled, governed, caused to act in a certain way, by the life or vital power, vitality, briefly associated with it.* That one living particle may be detached from others is certain, for a few living particles can be easily killed, while their immediate neighbours may live, and grow, and form.

What becomes of the life is another matter. It seems to me when a living particle dies, better to say, that it ceases, for there is no evidence whatever that life power, vitality, is transformed into anything else. *No one has brought forward any proof to favour the view that when living matter dies the life power becomes converted into any other form or mode of force.* I conclude that if it were possible to get a quantity of matter actually living, and to place it under circumstances which ensured its sudden death, it would weigh exactly the same the moment after death as it did the moment before death when it was living. The dead matter would of course soon change. Evaporation would go on and this loss would necessarily cause a difference in weight; but I imagine in the same matter, alive or dead, there would be no difference in weight. Neither, in any experiment, as far as I know, has it been shown that when living matter dies any force or energy or any other form or physical agency or factor is set free and can be identified—from the highest to the very lowest living creature—from a particle of living matter however "crude" or imperfect, or in a condition "about to become living,"—anything that can be seen, weighed, measured or touched, thrown on a screen, or separated from the matter with which it was in life, associated, or in any way isolated. *Vital power* is, no doubt, well expressed by a distinguished philosopher of our day as "*a factor which no physical research whatever, can disclose or identify, or get the remotest glimpse of.*" This is the very vital power, the existence of which I claim to have proved and the absence of which from any form of living matter now existing or capable of being caused to exist is impossible. I challenge proof—I hold this view as more than an opinion—as a fact of nature. I challenge the author, or some of his friends, to publicly condemn me, to criticise me as they like, for I venture to think I can defend my view. Let anyone, if he can, show us another way

out of the vital difficulty, and say, to what the peculiarity of all life is to be attributed. That there is no difference, or that there is only a difference of degree and not a difference of kind, between the living matter and the same matter dead, and every form of non-living matter, is an opinion, which I do not believe any reasonable being will now defend. The living thing is in one state and the dead thing is in an *absolutely different* state. There can be no analogy whatever between the living condition and the non-living condition. In other words *the distinction between living matter of any kind, however minute—whatever may be the quantity—and the same matter, dead, is absolute.* No gradual change can be proved when a living particle dies. The actual matter involved passes from one state to another, suddenly—not gradually. and the difference between the two states, I think, must be, admitted to be truly expressed by the word *absolute*. The identical matter of the *living particle that dies never lives again.* The matter of which it was composed of course may be, and almost universally is, taken up by other forms of living matter belonging to living things; but the same material particles which during life held certain definite relations to one another in the living state, cannot possibly exhibit those same relations again. The death of a particle, like its life, is once only. The products which result from its death are another matter altogether. The life is lost for ever and can never be restored; and although we are told of many cases of prolonged dormant vitality, and so on—such cases prove nothing. A thing dormant is not dead. Some of the lower creatures may be dried and moistened again, and come to life, apparently, but who has proved that all the matter of which those bodies were composed was dead? Can any living matter be dried? Can any living matter exist which does not contain water? No properly desiccated living thing survives, or can be revived. Everything living of which we have actual knowledge and experience must absolutely die.

8. Now all living matter has certain definite powers and may therefore be referred to under one particular name, and it does seem to me that the most convenient word to indicate living matter, by which to distinguish it from matter in any other state, is bioplasm. It is a Greek word, and for thirty or forty years there has been a tendency to find fault with Greek; but it is difficult for many of us to understand this, as we can hardly read a page of chemistry or botany without

Greek—or even physics, without finding Greek words; and, if we study medicine—why the father of medicine was a Greek, and there is hardly a disease we can name without talking Greek. It is indeed mysterious why people oppose the introduction of Greek into our schools. If a boy is to be taught science his difficulty is much increased if he has not been taught a little Greek. I know this by experience, for I have been teaching all my life, and students of pathology or medicine get on but slowly if they are quite ignorant of Greek. A little Greek is a great help, for we are saved the trouble of looking out many words in dictionaries, and the memory retains the word with ease—almost by instinct if the student understands its meaning and knows its root. How many a gardener recollects the enormous number of names of plants is wonderful, as he depends solely on memory.

9. During the last forty or fifty years, microscopical investigation has vastly improved, for we are able now to use very high magnifying powers. We make careful drawings of what we see, and we can distinguish, in many instances, the difference between *living matter* and *matter which is formed from the living matter*. The difference is made very clear by tinting the living matter just after death, as indicated in many of my published drawings.

I will not attempt to go into a description of even one of these enlarged drawings; but I beg you just to notice the red circular or oval spots in each, indicating living matter; many of these are the so-called nuclei of the tissue, and called by some cells, by others corpuscles, the adjacent bodies or cells in some cases also consist in part of living matter. These tissues are all coloured artificially by staining with an alkaline solution of carmine immediately after the tissue or organ is taken from the body of a recently dead animal. You see then in all of these diagrams the living particles I have spoken of as *Bioplasm* coloured red. The matter round this, which forms the *tissue*—the matter, for example, which constitutes fibrous tissue, gristle, tendon, cartilage, and so on, is situated between or around the living particles of living matter. If you take a small very thin section of ordinary cartilage, this is the appearance you get. The diagram shows a very important point, that the material upon which the character of the tissue depends is *really produced by these little particles of living matter*. If you take a thin section of the cartilage of a kitten which contains the

living matter and is not itself living; you observe a certain proportion between the two—between the *Bioplasm* or *living matter* and the *tissue* or *formed matter*. In a kitten somewhat older you will find the cartilage tissue has considerably increased, and the little particles of living matter are separated farther from one another by the increase of the tissue; and at a later period of life, the same thing is shown in an advanced degree, and so on till the adult stage is reached. We learn these important points not only from cartilage, but from muscular, fibrous, and other tissues of our bodies. From the brain and ganglia, nerves, vessels, epithelium, we obtain like evidence. In every living organism as it advances from early age to maturity, the same lesson is taught, to any one who will observe the facts and think them over.

10. Further, it must be borne in mind that living matter alone has this power of producing the formed material or tissue. All the properties which distinguish the several tissues are due to the influence of "vitality"—the living power of the Bioplasm acting upon the matter in solution brought to the Bioplasts—passing into the very substance of the living, and receiving from it, vital power. I cannot see how we can accept any explanation other than that I have brought under your notice. Indeed, having thought well over the question after prolonged investigation on organisms widely differing, I can come to no other conclusion, and do not believe the facts are open to any other interpretation without doing violence to fact and reason.

It comes to this—that every part of every living organism was once in a state of perfectly clear, transparent, structureless material which contained a very large percentage of pure water. Take a small portion of bioplasm from any department of living nature, and while it is growing and active, you will probably find as much as 90 to 95 per cent. of water, and in some cases even more. The powers of this clear, transparent, and structureless material are something quite extraordinary. The wonderful structure and properties of all the tissues that exist throughout the living world come from Bioplasm, and every kind of Bioplasm comes from Bioplasm particles that existed before it. All our Bioplasm particles are descendants of the original germ particles which existed at the very beginning of each individual organism—from the lowest, to man the very highest. However complicated the mature organism may be, the same remarks apply, and, I believe, must be accepted as true.

11. Years ago, our courses of physiology, attended by medical students, included such matters as those I have brought before you, bearing as you must perceive, in an important degree, upon the nature of man, his growth and action; but some years ago physiology was caused by teachers to assume more and more a physical aspect, and physics and chemistry have at last almost replaced every physiological idea. The living body becomes a physical laboratory. In fact one may almost say that physiology is gradually being caused to take the position of a mere department of physics and chemistry. The chemist and physicist examined the constituents of dead organisms, and so the lifeless compounds obtained, were promoted to life, as if they had been there when the body was alive. Physiological investigation becomes the investigation of the substances resulting from the death of the Bioplasm and the lifeless tissue of a dead thing, by physics and chemistry. Perhaps some of my friends may think it a little hard to put it in that way. We have, however, raised a new biology on the ashes of a dead physiology, and it is to be hoped that a vital philosophy will soon follow.

12. Everybody knows that Biology is from that little expressive word *βίος*, life. *Bios* means life; and I doubt whether the meaning of the word will ever be changed. We may alter the meaning of *physiology* and indeed the meaning has been altered more than once as physical investigation advanced. *Bios* is an old word. We find *bios* in biology and bioplasm, which I trust will take the place of the vague "protoplasm" which may be living or dead or roasted, but *Bioplasm* is *living only*. As soon as the life, the *bios*, has ceased, what *was* living only remains—no longer *Bioplasm*. Although we do not know exactly what *βίος* (life) is, at any rate it is perfectly distinct and different from any force or power or property that we know of in nature. *No machinery, or mechanism, or apparatus has ever been shown in the living matter which I have spoken of as bioplasm.*

13. Now I had hoped to have been able to say something about the heart and one or two other matters, but my excellent friend, Captain Petrie, our Hon. Secretary, hinted to me, as I was coming up, that I need not finish my remarks to-day, so that if you are not utterly tired of vitality, I shall be very happy to say more on some other convenient occasion; and, as I hope will be the case, if any friends wish to ask any questions and will kindly promote discussion

on the subject I have brought forward, it will be a pleasure to me to enter into it; and, as I have previously remarked many times, if it be shown I am wrong, I would give up my views. But I do not mean to do so unless it be proved that my views are erroneous. I am ready to be beaten; I am getting old and do not mind. But above all things it is most important the question of vitality should be settled, and soon—if it can be settled.

Allow me now to break off for to-day, and I trust enter upon discussion, and I feel sure the members of the Institute will be glad to hear any observations members and visitors will be kind enough to offer on this widely interesting subject. (Applause.)

Dr. SHETTL.—I am much obliged to Dr. Beale for giving us this able address on his views of life, and also for his kind promise to further investigate the matter.

I quite concur with Dr. Beale as to the origin of life—in fact, life is something that has been handed down from the very first to now; but I cannot accord with his view that life is not physical. I think it is just as much physical as any other creation of the Almighty's.

Now I would just state the points on which I think the discussion might be opened with profit.

- (1) My point is that matter, in whatever form it was created, was the direct outcome of the Creator's Divine power—so that I do not take animal life away from the power of God. I entirely concur in that.
- (2) Animal life in man is the highest development of that Divine power.
- (3) The earth and the celestial bodies in general all show that the first motion (of life) existed in the form of axial rotation in which the central and centrifugal forms of force were essentially marked. Dr. Beale has commented in his book on the central and centrifugal forces as having the power of life as distinct from other things.
- (4) The shape of the human blood corpuscles, which are the agents by which animal life is carried on, shows that they have been formed and have acquired their magnetic

characters whilst subject to axial rotation. This fact is further proved by their forming rouleaux, like unto piles of money, when they have been brought to rest, *i.e.*—polar attraction. If I understood Dr. Beale rightly, he said there was no evidence at all of any physical force being given out at the time of the cessation of life. These corpuscles, which contain the life of the living animal, collect together and form piles like coils of wire, and when we go into the physics of the question we see that the form has been acquired by rotation, and their physical properties maintain the life of the living animal by their motion through the tissues.

- (5) The stress which the blood corpuscles exercise upon the nerves originates the nerve current, under which all work done in the various processes of life is effected. No doubt, according to the condition of the blood, with regard to oxygen, so are the powers of life. Thought even is governed by the oxygenated condition of the blood, and as soon as it loses that condition it loses the power of sustaining life. I do not at all detract from the view that life is handed down, but simply that it is maintained by these physical processes.
- (6) My sixth point is that as the stress which the blood corpuscles exercise has a direct relation to their material conditions, purity of blood is one of the great factors for ensuring a healthy body and a well-balanced mind. There is no getting out of that, I think—in fact, these are all facts that you can prove or disprove. I believe them to be all positive facts, and I think the importance of this question of animal life cannot be exceeded by any other question which occupies men's minds.
- (7) A due recognition of the relations which exist between animal life and its material basis is of enormous consequence to the well-being of the human race, and it is because of its consequence to animal life that I think this is a matter that should be gone into even by the State itself, seeing what is going on in the world—the vitiated appetites of the present generation, and seeing how morbid appetites are being fostered and kept up. We should then see what has taken place in the material body—what changes are effected in it, how impure it has become, and how impossible it is that the brain, and

everything else, can carry on its work under such conditions. This point interests me very much, for I have been associated, as far as my professional career has permitted, with animal life as a physiologist. It is not a personal matter with me; but I am looking at it from a broad point of view as to what is best for the human race. If anything is to be done it ought to be done so as to steadily improve the condition of the human race. We know what the indulgence in intemperance, and other appetites, will foster and bring about. This is why this subject should be studied from a broad point of view, and there, no doubt, our excellent lecturer has shown his wisdom. When we come to look at these diagrams we see the work he has done, microscopical and otherwise, but this is a point that really ought to extend from the broadest possible basis.

I apologise for making these remarks, but I feel strongly on the subject. (Applause.)

THE PRESIDENT.—If any other members of the Institute wish to speak I hope they will rise and do so.

PROFESSOR ORCHARD.—I am sure we all feel indebted to Prof. Lionel Beale for this important contribution to the discussion of a subject of which I myself had no knowledge whatever.

We all, I think, agree with him that he has proved that vitality is something *sui genesis* associated with matter, but not in any way material.

I must dissent from the expression used by Dr. Shettle as to the material basis of life. It does not strike me as a very happy expression. Life is not built up of matter. There is no doubt of the material use of life. Life does make use of matter. That is very different to the notion that it is in any way the product of matter. Truly there are many contentions which seem to show that life is altogether different from anything else. One is surely this, as pointed out by Prof. Lionel Beale—that you cannot transmute physical force into life, nor transmute life into physical force.

As to the arrangement of the blood corpuscles, when an animal dies, that is surely explicable in some other manner. We must be careful, I think, not to confound accompaniment with cause, nor mistake conditions for effects. Transmutability is a characteristic of vitality. It is *sui genesis*. Another characteristic is, surely,

directive government, as one may call it. Vitality co-ordinates in a way that mere force never does. Force is not governing or directive. Another condition is what I think I may call the unique property of vitalism. That was alluded to the other day by Professor Japp in his address before the British Association in speaking of bodies known as Enanatiomorphs. He shows that vitalism nearly always produces or selects one kind of these Enanatiomorphs without the other kind, and that no other force or power in nature can do this. There is, therefore, in vitalism an uniformity—a directive government—and there is intransmutability to anything else. The suggestion, I believe, was let fall before the Victoria Institute some time ago by our honoured President that life was the result of the action of spirit. We know that matter cannot produce force any more than it can produce life. It is spirit from which force proceeds—it is spirit from which life proceeds. This is in harmony with the declaration in the Word of God where the spirit and life are associated together in such expressions as “the spirit giveth life.”

Mr. TUCKWELL.—I am afraid that I have nothing of importance to contribute to the discussion, but I should much like that we should have a little more of it. One would like if possible to have some light on such a question as this—What is the relation between individual bioplasm and living organisms? A question of profound difficulty and, I am quite sure, one of very great importance indeed. The gentleman who first spoke seemed—I do not know whether I misunderstood him—to suggest that life, *i.e.*, I presume, bioplasm has originated in material substances aided by motion, or something of that kind.

Dr. SHETTLE.—Pardon me for interrupting you—but my remark was that bioplasm was a created thing—created, I should say, by the spirit and power of God, and in no other way, and is maintained by His power now, just as much in the vegetable as in the animal.

Mr. TUCKWELL.—I am glad to have any misapprehension removed. I rather understood Dr. Shettle to refer to motion as having something to do with it, or being a manifest cause of the production of bioplasm. There must be a degree of heat that is destructive to bioplasm.

Professor LIONEL BEALE.—Oh, yes; certainly—a very mild degree.

Mr. TUCKWELL.—Then in that case it would be impossible in the

ordinary physical course of things that bioplasm could have originated from the material substances of which this world is composed, seeing, if you go back a certain number of millions of years you find that everything was in an incandescent condition. The subject is one of great importance from various points of view, and in regard to health, taking the condition into which human beings are apt to drop by unguarded and immoral conduct.

The degeneration of life, or the bios, is another of those points which I should like to have discussed. I do not know that Dr. Beale in his books has shown us that bioplasm is capable of rising in the scale of being. I have not read all his works. I remember how he shows that much disease arises from the degeneration of bioplasm. If that could be avoided it would show a great advance in medical science, and would be helpful to us as moral and religious teachers who have to mingle with people who are thoughtless and careless of their own and their children's habits, and it would be helpful to us in the exposition of the Scriptures. (Applause.)

A MEMBER.—Might I ask the President a question on a subject which I think is interesting?

I remember years ago, when the telephone was introduced, that a number of persons stood holding one another's hands, and a current of electricity was passed through them from one telephone to another. It was alleged that the sound had been changed into electricity, and that it changed back again into sound. What happened on its passing through the human bodies? Did it change into a form of fluidity, or did it remain electricity?

The PRESIDENT.—I have not much hesitation in answering that it simply passed through the bodies as an electric current.

The MEMBER.—Could that inquiry be pressed a step further? Of what nature is nerve force, that electricity so acts upon it as to cause, for instance, a rabbit's nose to move after the rabbit is dead? How are we to distinguish true nerve force and the electric current that produces this?

The PRESIDENT.—I may say that I do not profess to know anything about the vital action, or the action of electricity on animals; but in the particular case of the telephone and producing a shock by means of passing a current through the body, I do not think there is anything to indicate that that had anything to do with vitality at all. The body acts as a wet sponge would to convey the current.

The action of electricity on the nerves is a different thing altogether. I must leave that to physiologists.

A VISITOR.—May I be permitted, as a visitor, to make a remark? I think we are getting rather off the track of the discussion.

I understood Dr. Beale to say that all visible bodies we see are really forms of matter. Bioplasm is shut up in a particular cell, and we do not see bioplasm. The question that has arisen this evening has been chiefly on the action of formed matter. I suppose, with Professor Beale, we shall never find out exactly what bioplasm is; but there is one point that I should like to have his experience on, viz. whether, in his microscopic investigations there is any possibility of differentiating the different sorts of bioplasm, and what are the different forms that bioplasm takes to itself when forming cartilage and gristle. It seems there must be in bioplasm certain differentiating points which seem to me to be almost beyond the possibility of our investigation, unless Dr. Beale can tell us that he has been able to differentiate, either by action or investigation, the position in which different bioplasms stand.

Professor LIONEL BEALE.—All the different forms of bioplasm in the body which form the different organs and tissues come from a single embryonic one capable of increase of size, and with infinite power of division. The bioplasm of each organism has individual characteristics as regards power of forming, although no physical, material or chemical properties can be shown to account for it. The "differentiating" depends, I believe, on *Vital Power*, and not on material properties, but I object to learned words like "differentiation," in which the simple statement of a fact is made to masquerade as something to account for it—as an explanation. No one has defined exactly what he means by the verb to "differentiate," or whether we ought to look for a "differentiator."

The VISITOR.—It is a wonderful thing that the goose, the sheep, and the hare all feed on grass, and one produces hair, another wool, and another feathers.

Dr. SHETTLÉ.—And there is also a directive influence of the germ in each creature, and that germ exists as an entity.

Professor LIONEL BEALE, in reply, said—My position is a more humble, but a much more decided one, than is generally supposed. I only aim at discussing the subject by degrees, beginning from the so-called simplest lowest forms of life. For instance, I have said nothing about the amœba. The living matter of a young

amœba is perfectly clear, transparent and structureless, and it possesses powers of movement not yet explained, perhaps inexplicable, but possessed by all *living matter*. I should like to discuss with my friends the movements of bioplasm or living matter, which movements are natural in every kind of living matter, and not in any kind of non-living matter. I would venture to speak of them as *vital movements*. The movement is totally different from any other kind of movement known.

We find that from the very beginning of the developmental process—say in the chick, particles of clear, colourless, structureless stuff, call it what you will, which divide and sub-divide, producing innumerable particles, and before long indications of vessels containing blood and a *pulsating organ* driving the blood through the vessels—and remember, the red corpuscles which give to the blood its colour—every one comes from pre-existing particles of Bioplasm. The *red corpuscles* of blood have no vital power of their own at all, for those of many animals readily crystallize—for instance, the red blood corpuscles of guinea pig's blood crystallize on a glass slide a few moments after it has been taken from the vessels of the animal, and I have seen a single blood corpuscle form sometimes one, sometimes *many tetrahedral crystals*—and very beautiful they are.

I cannot go into the great question of the origin of life, nor do I care to do so until we hear of some hypothesis more in accordance with reason, than anyone of those advanced during the past two thousand years. We now know of the colourless stuff out of which everything that lives or that has lived, has come, and I venture to say, every living organism that is about to come will have similar origin. Let us restrict ourselves, for a time, to the consideration of the actual matter in which all living here undoubtedly begins.

One gentleman referred to Professor Japp, whose observations are extremely interesting, and I am sure will lead to very important further observations. Three years ago a very distinguished chemist said he wanted a little more vitality. I quite agree with him. We not only want a little more, but very much more vitality than has been allowed by what is called the tendency of scientific thought; and I for one mean to demand it, and on purely scientific grounds, and in accordance with reason.

I was going to say something about the heart and its action; but I have already trespassed upon your time and thought, and must postpone what I would say to another opportunity. I think we ought to restrain ourselves for a time to a very restricted

portion of the infinite, and stick to the question of *the living matter* universal in all living, from the first moment of life to death. This clear and structureless matter having much water—from which all future structure is derived, and all structure “evolved” by “evolutional power,” if you please.

I believe that every word that I am speaking depends on changes in the Bioplasm of certain of my brain “cells” and the bioplasts concerned in vocalisation. All the wonderful changes determining the phenomena begin in, and must start from, the minute particles of living matter, which are in all the tissues, parts, and organs concerned, and I hope these bioplasts will be for a short time longer in a healthy state, and retain yet a little of their necessarily waning activity.

Two or three gentlemen alluded to the medical or medico-hygienic part of the question, and if I may be allowed to say a few more words, I should like to remark briefly on the universal presence of an enormous proportion of water in all Bioplasm or living matter. The relation between the quantity of food taken and the quantity of water required to dissolve its products seems to be seldom adequately considered. Many of us take far too little water, and many a poor child suffers torture in hot weather from being allowed too little. We have lately become more and more prejudiced against water. There are so many of those dreaded bacterial creatures found in it, that people have been led to associate horrors with these, and though the majority are harmless, many persons seem to think that bacteria of some kind are the usual and most potent cause of disease and death. For myself I have no objection even to filtered Thames water, and am not much afraid of its bacterial millions. A distinguished chemist once remarked that although they had been hunting for typhoid germs in the Thames for years, perhaps not a dozen had ever been found.

With regard to healthy human Bioplasm there is a great deal more to be considered of the greatest importance with reference to keeping alive the millions and millions of Bioplasts in our bodies, not only for a time, in health, but in a continuing healthy state, so that we may not only be healthy and vigorous in youth, but be able to look forward to a healthy old age. To live long in health is a great pleasure, and according to the experience of many, quite as great as in boyhood. I can easily imagine it to be a greater pleasure than many a small boy actually enjoyed, especially in his early boyhood, who meets with compensation

by being healthier and far happier as he gets older, and may even look forward to the enjoyment of some years of mental and bodily health in old age.

The PRESIDENT having conveyed the thanks of the meeting to Professor Lionel Beale, the proceedings terminated.