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1903.

ORDINARY GENERAL MEETING.*

REV. G. F. WHIDBORNE, M.A., F.G.S., IN THE CHAIR.

The Minutes of the last Meeting were read and confirmed and the following election took place :—

ASSOCIATE :—William Warry, Esq., M.A. (Oxon.).

The following paper was then read :—

*THE LIVING GOD OF LIVING NATURE FROM THE
SCIENCE SIDE.* By Professor LIONEL S. BEALE,
F.R.C.P., F.R.S.

BEFORE reading the paper I should like to make an observation particularly with regard to the point that of all the broad questions left for us to consider, and I trust to determine, bearing upon the most important principles open to human knowledge and investigation, is the one which I venture to lay before you of the relation between living and lifeless matter. The difference between the extreme opinions with regard to the relation of life to matter is now most extraordinary. Many observers and thinkers insist that living things and lifeless things all belong to one category, while others believe that the distinction between life and non-life is simply absolute: that there is no relation at all between matter that is alive and matter that is not alive; that they are quite distinct, and that life depends, as far as it has yet been reached, not upon any

* Tuesday, June 2nd, 1903.

forces of non-living nature, but upon the Almighty ; that there is not a particle of living matter of any kind which can be explained, except on the view that it depends upon God.

The matter of the body of everything that lives in this world consists in part only of matter which is actually alive ; the greater part being composed of matter which *has been* alive, but which as structure has ceased to live—matter which in fact has been formed *from* and *by* matter which at the time was alive ; this being the only way in which structure and formed matters belonging to a living organism and endowed with characteristic properties or structure, can be produced.

The *living matter* consists of innumerable minute particles, Bioplasts, to be seen in the tissues and organs of man and the higher animals, varying in size and proximity to one another in different species, but present in all. At an early period of development, in all classes and kinds of complex organisms, the embryo consists almost entirely of particles of living matter, indistinguishable from each other, each of which, as development proceeds, may form on its surface a thin layer of delicate tissue, and this may increase *layer within layer*, until each particle appears separated from its neighbours by a considerable thickness of tissue which, as it has been *formed*, has ceased to live. As age advances, the proportion of this last increases, and the living particle within diminishes in size. In old age the living particles in the tissues become very small.

Allow me to say that these observations depend entirely upon what one is able to make out by using the microscope. Nothing that I have just referred to can be seen without comparatively high powers of the microscope.

All the matter that is alive, and at every period of its existence, contains a large proportion of water—water being absolutely necessary to every kind of living matter or bioplasm, that lives in this world as long as its life shall last. And there is no doubt that water was present in every particle of matter that lived in past time, even from the creation of life, when “the spirit of God moved upon the face of the waters.” The nature of life power is unknown, but there is no property of matter, no force, no factor, with which it is comparable. Distinct from all physical agencies, *vital motion* is not in the slightest degree affected by gravitation.

The division and sub-division of many particles of living matter, all through living nature, into very minute, separate, and growing living particles, is a fact of the highest importance as regards the question of the nature of life. Seen in the micro-

scope as innumerable separate particles easily destroyed, and varying in size from extreme minuteness, to particles generally measuring not more than the one two-thousandth of an inch in diameter. These living bioplasts, besides being very numerous in all growing tissues and organs, are present in very large numbers in many of the fluids of the body, especially in the blood, lymph and chyle, and in milk, at an early stage of its formation. In the *interstitial fluid* which slowly circulates in all the minute interstices of the tissues, distributing nutrient matter in solution, and receiving also in solution substances resulting from the action and death of living matter, minute particles of living matter also exist. All through the living world, every living particle has been derived from a living particle which lived before it, and each one may give rise to numerous living particles which may succeed.

No one can tell from any given particle of living matter what will be the structure, or what the properties or composition of the tissues and substances to be formed by it; not even the chemical composition of the lifeless compounds which result from the death of any particular bioplast can be ascertained. Such is the origin, and the earliest stage of all living matter at this time and I think I may say, has been so generation after generation from the very beginning.

Every living particle in nature as long as it lives contains water, which, if much reduced in quantity, would cause the death of the living matter; and death would occur long before a living particle became nearly dry. Some living particles and many *Protozoa* consist almost entirely of water. This moist Bioplasm or living matter possesses in its substance the power of *movement within itself, and in every direction*—movements, vital, inscrutable, inimitable, but to be seen and studied in many instances as long as the right proportion of water is present.

No living particle of matter can be chemically analysed: for any attempt to do so would cause its death, and then we should be dealing, not with the living matter itself, but only with various kinds of lifeless matter—chemical substances formed at and after its death. Form, colour, composition do not help us in any way to explain or account for the nature of living matter. Indeed they are, as I have remarked, but results of its death. Their character, properties and composition depend upon the vital changes effected by the life power while the matter lived.

In the tissues and organs of fully formed living animals and

plants, the minute particles of living matter alternate with non-living matter or tissue, which has been formed from and by the living matter, but which in the state of tissue or structure of any kind does not *live*.

This distinction between the living and non-living matter of everything in nature, is absolute; and when we say an organism has ceased to live, or is dead, to be accurate—we should rather say, *the once living matter is dead*. The tissue or structure died when it was formed, and was as dead while it remained in the living body, as it would have been if the whole organism had ceased to live.

Such structures in fully formed organisms, as hair, feathers, horn, nail, much of the tooth structure, the greater part of the ivory of the adult elephant's tusk, for instance, are lifeless, though they may have been firmly fixed to the living body for years, and, indirectly, may be of great importance to life. All these dry and lifeless structures were moist when formed by the moist living bioplasm or living matter.

A sharp line of distinction must therefore in all cases be drawn between the living and non-living parts of every living organism in nature. But it must be borne in mind that all the tissues, and all the non-living formed matter of every organism, was first in the state of living matter.

Of the precise nature of the life-power of living matter, little has yet been ascertained. The power, it must be admitted, belongs to life itself, and originated in previous living matter. I think we must place life-power, if not among spiritual powers, at least consider it as being nearly allied to the spiritual order, and absolutely apart from all physical *properties, forces, energies, or factors* of matter.

The living particles themselves and their action during life, can I think only be reasonably accounted for by attributing them to vital power, created, sustained, and regulated from the beginning, by the living God.

With regard to *living matter, living growth, and the formation of tissue*:—In every department of living nature, at all times, and in all ages, in all developmental processes, a great fact for consideration is the universal presence of a large proportion of water, and the faster the growth proceeds whether in health or disease the greater will be the percentage of water. Some vegetable, as well as animal tissues during the very important and earliest stages of development, may contain for a time more than eighty or ninety per cent. of water, and I think it will be found that all living tissues and organs, and abnormal

growths during the periods of rapid increase, contain nearly as much. I wonder that thoughtful persons have not been impressed with this broad and probably universal fact, especially as Mr. Darwin's evolution hypothesis suggests that all living organisms probably sprang from one or a very few simple life forms, each of course containing much water. If his followers had admitted that, from the beginning to the end of life, the changes in the germ during its development, and every succeeding living particle till its death, were governed by some direct superintending and sustaining life power, the view would I think have been near the truth.

By the study and contemplation of the changes occurring in life and living growth, we may perchance approach nearer to a true conception of the nature of the vital changes governed by infinite Almighty Power, than by directing attention to the overwhelming lifeless cosmic matter and the extreme cold and heat of the Cosmos, infinitely far away from any particle of matter that can possibly live, or move and grow.

In my last paper to the Institute, I alluded to the elaborate structure of the valves of diatoms, as positive evidence of the direct influence of constructive power and agency, which can only be attributed to the infinite living power of Providence, and I feel confident that anyone who will attentively examine a few slides of these beautiful objects in the microscope, will agree with me.

Again, by patiently watching the highly complex movements of the legs of the tiniest insect, or spider, on a summer's day, the thoughtful mind will be convinced by what is observed, of the action of a very elaborate and highly complex nervous system, the general arrangement of which will be as clear to the understanding, as if every part had been microscopically dissected out, and prepared in the most perfect manner for demonstration.

The observer who from long and careful microscopical investigation is aware of the general structure and arrangement of the thin layer of the active grey matter near the surface of the convolutions of the human brain, and has thought over the great number and distribution of the vessels taking part in its blood supply, and who is able to compare this with the corresponding arrangements in other parts of the human body, will mark the provision for the free supply of a large proportion of arterial blood, and will feel satisfied with the evidence afforded of purpose and design. He would infer wonderful activity and very high office of the extensive and elaborate structure, and

the large proportion of very moist living matter which is well known to exist in this part of the brain. This is by far the most important and wonderful part of the human organism. And if he had the knowledge which patient microscopical enquiry into the minute structure of this part of the brain alone can give, and had frequently contemplated his own thinking power and noted the wonderful precision of some of the most delicate and complex of man's voluntary movements (say for example, in drawing, and in playing musical instruments), seated probably in several parts of the cerebral cortex, particularly if he was in good health, and especially after rest, when his mind was clear and active, would I think believe, on this ground alone, in the infinite power of the living God of living nature, unless he had determined under all circumstances, to refuse to admit the existence of what he had seen with his own eyes and was evident to his understanding, and to neglect the inferences which necessarily follow the careful consideration of well demonstrated facts.

Thus at the outset of our enquiry, it appears that the consideration of a few broad general facts connected with many different organisms at various ages, and belonging to different departments of living nature, regarded from the science side only, compel the reason to infer, that all growth and the process of the formation of tissue, like life itself, must be due to powers which are of the living world only, and that all the chemical and physical changes occurring in living nature are brought about and regulated by *vital action—vitality* itself, a power which has not been isolated or made evident by scientific investigation. It seems to me therefore that this power in living matter only, must be admitted to be a special endowment—a power created by God, supported and sustained by Him only.

The life of a part and of the whole of a living body, really depends upon the millions of millions of minute particles of living matter or Bioplasts, in all parts of the moist tissues and organs, these minute particles being generally separated from one another by intervening tissue which has been formed by vital changes occurring on the outer part of the living matter of the bioplast. Thus each bioplast or particle of living matter, becomes separated from its neighbours by tissue of gradually increasing thickness which is permeable to fluid. The living matter of each bioplast by the tendency of its parts to move away from other parts, or *from* a centre, causes fluid to move slowly in the opposite direction, *towards* the living matter. In

this way, each minute bioplast receives its nutrient matter in solution, and any products of action and disintegration of the bioplasm would be dissolved and slowly removed, and at the same time, by the constant movement of fluid in the interstices, the tissue by this slow but steady movement of fluid would be preserved, and its healthy condition ensured. This circulation of fluid, I have spoken of as the "interstitial circulation" because the fluid is constantly moving in the interstices of the tissue. It is a most important system, and indeed exists in organisms not provided with proper organs of circulation, as well as those possessing a special circulating fluid—the blood—which is driven through the vessels by a special pulsating heart or propelling organ.

Let me now ask your attention to an argument of a different kind, which seems to me equally conclusive against placing physical and vital phenomena in the same category—the maintenance of the uniform internal temperature of the body of man and the higher animals, notwithstanding the constant changes in the outside temperature. Many intelligent persons are not aware of this remarkable fact, and of its very great importance to the well-being of the organism, and the serious consequences which may result, if the internal temperature rise only a few degrees above the normal—a change which is not unfrequently followed by serious disease, and in too many instances leads to an early death. By this fact alone the reason of thoughtful persons ought to be convinced, that the physical and chemical changes in man and the higher animals, cannot in any way be compared with those in the physical and chemical laboratory. Only think of the structures concerned, and especially of the arrangement and actions of the nerve and vascular systems engaged in the restoration of the body to its normal condition, after it has been subjected for a few weeks to an internal temperature of but three or four degrees above the normal. Think also of the wonderful heat-regulating powers of the wren, which maintains its normal temperature, probably several degrees above 100, during the coldest weather. Consider its small size, and think also of the physiology of the common little bat of our climate, and study the finest nerve fibres distributed to its vessels, just beneath the epithelial layer of the membranous part of its wing, one of the most wonderful and beautiful examples of the finest nerve distribution in nature (see *Bioplasm, an Introduction to the Study of Physiology and Medicine*. J. and A. Churchill, pp. 280 to 336, Plates XV to XX).

The physical oneness of the Universe.—The enthusiastic advocates of the adequacy of "Universal Physical Law" to cause and sustain all vital phenomena, do not admit that, during the life of any living growing organism or organ, or of a growing living particle of any structure-forming matter in the life-world, the power at work is distinct and marked off from all matter that is not alive, or that the state of life is absolutely distinct from the state of death, and that of non-life. I hope that ere long some of my contemporaries will consider and discuss this important question.

Will any one of the advocates of the doctrine of the "Physical Oneness of the Universe" maintain that there is no absolute distinction between living and non-living? Can any satisfactory evidence be appealed to in support of the supposed existence of a living organism or a living particle of any kind at this time, in any other world than this? Can the advocates of such purely conjectural ideas support the contention of the existence of any kind of living *being*, of a sidereal nature in any part of the Cosmos? Is it not certain that up to this time, the only living beings of which man has, or can have cognizance and knowledge, are those organisms which like man himself, have been created in, and inhabit this world? Could any ordinary living thing known to us, retain its life for a moment under the conditions now known to exist in any nebula, star, sun, or other celestial body yet discovered? And yet it is not surprising that the wonderfully successful exploration of an immense part of the infinite Cosmos in recent times, should have strongly appealed to the imagination of well informed persons; or, that the contemporaneous revelations of the minute structure and growth of the tissues, and the formation and action of our own organs, and the particles of living matter by which they were formed, should have been little noticed. Infinitesimal details of structure, unseen changes during development and growth, wonderful as these are, cannot as yet compete with the vast and overwhelming grandeur of the material eternal Universe. Astronomy and physical investigation generally, have advanced during the past century in greater degree than other departments of natural knowledge. The same remark applies to all departments of physics and chemistry—and no wonder people have been led to expect that some great physical generalization concerning all matter—living and not living—was about to enlighten the world, and the discovery of some universal physical law, equally applicable to living and non-living, lead to the revelation of the real *cause*

of all nature, at last to be understood by mankind—making it clear how the living comes from the non-living—both being directed, governed, and sustained, by the same universal physical laws. Unfortunately, however, the idea of “The Physical Oneness of the Universe,” can only apply to the *infinite non-living part thereof*. So far from the operation of physical law having been proved in anything that lives, the doctrine, as I have shown, is not supported by any one fact characteristic of *life*. No thinker who has studied the facts of life and growth in any one living thing, or the process of tissue formation, as it may be investigated in the animal or vegetable world, will admit that the dogma of the “Physical Oneness of the Universe,” is applicable to *any kind or state of life*. He who holds this dogma to be true, must have concentrated his thoughts on that vast part of the Universe, *which is and must ever be absolutely devoid of all life*.

The Telescope, designed and constructed in the early days of modern scientific discovery and progress, improved and still improving, has gradually brought nearer and nearer to the comprehension of man, some of the inexhaustible wonders of the lifeless celestial orbs, and the results of the operation of the universal law, by which their never-ceasing movements are governed. There is no evidence that these vast aggregates of lifeless material atoms, have ever been for a moment through the ages, the seat of one spark of life, or of the movements of one single living particle. Can we suppose that any living thing known to us here, could approach within thousands of miles of the nearest of them? Has not the successful investigation of the external part of many, proved the presence of some of the most refractory substances known, being in a state of vapour at a temperature, which we of this world are unable to realize? Must not many, if not all, of these colossal collections of inorganic matter be destitute of water, in which case nothing which can in any way compare with one single form of life known to us, could possibly exist in those remote regions so far removed from any means we possess of their minute investigation?

The more minutely and successfully physical investigation can be carried out, the more widely will physical phenomena be shown to be separated from every vital change or action. Physical and vital changes are, and must ever be, as the poles asunder. Between the movements of living matter, and those of lifeless matter of any kind, there is no analogy.

For little more than fifty years has the study of the minute

changes in living matter been rendered possible by great improvements in our means of investigation, by which results of great interest to all intelligent persons, have been obtained, and broad general scientific principles of importance with reference to vital action all through living nature, established, the application of which to our life world is not yet realized by the public.

To prove the exercise of Infinite Power as contrasted with the operation of physical law, or of physical and chemical properties of matter, one has but to examine under the microscope the living matter of the germ of a living organism, at an early period of its development—the very young leaves of a leaf bud or petals of a flower bud, or to study the germination of a common mustard or other seed in a thin layer of water, or the vital movements to be seen in a particle of the living matter of blood, mucus, or pus. All attempts to show that the wonderful vital movements of living matter can be included in the physical category, have failed, and must ever fail.

Modern forms of evolution, and evolution by law, as advocated by some, seem to be a progressive experimental process, perhaps never to be completed—inasmuch as some of the evolved soon die, while others having been created “more fit,” are supposed to have survived in the so-called struggle for life, and the progeny of the latter, it is concluded, would continue to improve and advance, generation after generation, without ceasing.

By some, living nature would seem to be looked upon as a vast well-found laboratory, or as an elaborate machine in which experimental creation was always proceeding of its own accord, without any power corresponding to human intelligence, direction, or power.

The great “laboratory of nature” is supposed to contain abundance of the ingredients entering into the composition of the bodies of the living things about to be formed, or the means of producing them spontaneously; there being in this great natural laboratory no professor or assistants, the substances necessary must have the power of taking up their proper positions, of arranging themselves, and of moving towards one another in the exact proportions; so that when the atoms come within the spheres of their mutual attraction, they may combine to form the required chemical compounds. The physical forces, or the forces denominated *vital*, then manifest themselves, and the living properties of the new atomic aggregations develop.

The Professor of Physics of Tufts College, Massachusetts, does not hesitate to suggest that when “chemists shall be able to

form the substance 'Protoplasm,' it will possess all the properties it is now known to have, including *what is called its life, and one ought not to be surprised at its announcement any day.*" (*Matter, Ether and Motion*. Society for Promoting Christian Knowledge, 1899, p. 283.) This book, it is announced is "intended for ordinary readers," on the ground that "it brings all natural phenomena under a few clear principles." The chapter on "Physical Life" in Professor Dolbear's book, seems to me quite inconsistent with belief in any form of living power, above or beyond the properties of lifeless matter, and to be opposed to the idea of the need of the living God in the creation or government of the living world.

Here, is one of the most recent of astronomical discoveries, as recorded by a very confident reviewer and I conclude supporter, of universal physical doctrines, in the last number but one of the *Edinburgh Review* (Jan. 1903, p. 140). I wonder what his scientific countrymen will think of it:—"We may rest assured that our intuitions of truth and beauty far from being peculiar to humanity are shared perhaps in a transcendent degree, by *sidereal beings who know as we know if more surely and clearly, and worship what we worship*, though we may hope with a fuller apprehension of the Eternal Majesty"! (Italics mine.)

It is to be hoped that the Edinburgh reviewer will inform us of the nearest sidereal body which he considers to be the abode of the knowing, thinking sidereal beings he postulates, and tell us whether he inclines to the view, that like us they live, or if they have lived, and died in past time, and what idea he has been able to form of their probable composition, dimensions and weight, the mode and period of their construction, and ultimate destiny.

The Microscope is an instrument of a more humble character, and of capacity far inferior to that of the telescope, being necessarily limited to the investigation of objects of extreme minuteness, and of close proximity to us. It is of more recent invention than the telescope, and is capable of great further improvement. New and better methods of the microscopical investigation of minute details of structure than any we now possess, will probably soon be discovered. We may therefore expect to learn much more than is at present known concerning the wonderful phenomena of life and living growth, in living organisms of all kinds. By the use of the microscope, however, we are now in many instances, able to see into the very substance of living matter, and to study some transparent structures during their formation. In this respect we have an

advantage over the astronomer, who at present is unable to penetrate very far into the substance of any of the immense objects he brings under observation, situated at enormous and unknown distances from his eye.

Many facts of living nature which can only be ascertained by the aid of the microscope, are far more worthy of attention and of very careful study than is generally supposed, on account of their bearing on broad questions connected with all life, including that of man. The results of minute investigation with this instrument have not yet been adequately recognised by science, philosophy or religion, although many profound truths of living nature, have already been elucidated by its aid, which could not possibly have been otherwise made known to us.

The new knowledge connected with cerebral structure and general nerve action, is sufficient to encourage us to pursue enquiry further, and to seek for more exact and definite information. Microscopical research steadily pursued, will enable the observer to distinguish the special work effected by vital power, from all results of physical and chemical change. Thus the separation of the kingdom of life from the non-living cosmos, will become more evident to the mind, and the realm of non-living matter will be distinguished from that of life; and I think, if we use our reason aright, the direct works of God—from any results of force or energy, and the operation of “Universal Physical Law.” Is not the microscope to the world of life, of which we ourselves constitute a very important part, what the telescope is to the non-living universe—the life that is infinitely near us—to non-living matter infinitely distant, and ever unapproachable by us? Are mind and thought, intellect and reasoning, less worthy of contemplation, than lifeless heat and cold, and blind inanimate physical force, by which life may be destroyed at any moment but can never be restored?

Some philosophers seem to have considered that there was a hard and fast line of separation between animals and vegetables, while not a few have been inclined to degrade the latter, and consider them to be near to matter that does not live. But by microscopic investigation, we learn that the lowest living microscopic fungus is as much a member of the life-world as man himself. Everything—every particle that *lives*—is absolutely separate and distinct from every particle of non-living matter. Everywhere in the life-world, the *Vital Factor* which I have defended for half a century, reigns supreme. Living growth, formation and action, entirely and absolutely depend

upon life-power which at present undemonstratable, was derived from already existing life-power.

What happens to, or becomes of the life, when a living particle dies, has never been ascertained. No law explains it. Life comes from life, and it cannot be included among any forces or properties of matter. At death, life leaves matter without passing on to any other matter, or assuming any other form whatever. Life never arises anew. The same matter lives and dies, but the products resulting from its death, cannot be caused to live again, unless they are dissolved, and then taken up by living matter which imparts to them life-power. Life after life, series after series, of organisms have been as it were using and animating the same matter. As age has followed age, millions of different forms of life have animated atoms which die and may be animated over and over again by other living particles. The life, not the matter, is therefore the individual *living* creature or particle, for many of the same atoms may have helped to form the temporary abode of unnumbered individuals, differing widely from one another in nature and power.

I have shown many friends a fortunate preparation of very delicate peripheral nerve-fibres which could be traced without interruption over a considerable area of very thin tissue (young frog's bladder, Mylo-hyoid muscle of green tree frog). My friend sees and traces network after network without a break, and sees the bioplasts connected with the fibres. He admits the continuity of many of the finest fibres with dark bordered nerve fibres. We quite agree as to the facts demonstrated in the specimen. But to get my friend to think of what such a specimen proves, and the mode of its formation, the growth, structure and action of this very small part of the nervous system which he sees, and to get him to consider how nerve-action is performed in the living animal, or say, over the whole surface of the bladder, or of a muscle, seems most difficult. No doubt in thinking over what he has seen, the hard black representations illustrating nerve-distribution in text books on minute anatomy have strongly impressed him, and as well as the hard wire-like pictures of the soft delicate nerves of nature, have rendered it difficult for him to form an idea of the actual nature and importance of the soft moist transparent nerve-tissues and the countless bioplasts he sees. The specimens referred to have been preserved without change since the preparation was first spread out flat in preservative fluid, and ultimately in strong glycerine or syrup, and the excessively thin cover-glass applied, forty or fifty years ago.

Viewed as an isolated preparation its interest can hardly be appreciated, or its meaning clearly understood.

Many of the most important conclusions arrived at by me, on the structure, growth and action of the tissues of man and animals were published in the Transactions of the Royal, and of the Royal Microscopical Society, in my Croonian lecture to the Royal Society, and Lumleian and other lectures at the Royal College of Physicians between 1855-75. A brief account of the principal observations, illustrated with many drawings on wood by myself, will be found in *Bioplasm, an Introduction to Physiology and Medicine*, pp. 345 *et seq.* (J. and A. Churchill, Great Marlborough Street), and in the later editions of *How to work with the Microscope* (Harrison and Sons, Pall Mall).

Unfortunately the results of my work were strongly opposed to the doctrines of life and living growth, generally taught in the schools, and pressed upon the notice of the public, during the time of Darwin, Huxley, and Tyndall, when no one who had been led from his observations to form conclusions different from those advanced by them, could get a patient hearing. And so things have gone on to this time, and Universal Physical Law, the lifeless physics of the entire universe, living as well as non-living, prevail. But physics cannot explain ordinary facts of living nature. Creation by and the dependence of the whole world of life upon God may be denied and ridiculed; but, as is well known, no one has explained from the physical or chemical side, one single case of life or living growth. To get over the difficulty, some authorities, and especially Herbert Spencer, insist, that physical deposition, aggregation, crystallization, and the mere accumulation of solid particles are examples of *growth*, thereby sanctioning the idea of a Godless living world.

By the telescope man has been able to see the wonderful works of God that do *not* live, but were created and completed (?) æons ago, by His Infinite Power, and now, and for ever, will be governed, by His eternal unchanging universal law.

By the microscope, man is enabled to see and form some idea of the design, construction and gradual formation of the wonderful living, ever-changing, growing and multiplying living organisms, which constitute living nature as we know it at this time, and which living nature receives unceasing support, and, as many think, is under the direct supervision of Almighty power which shall never cease. Does not careful minute investigation in all departments of living nature, convince man of God's living presence in every part of the life

world; and is it not certain that further minute investigation and discussion on life, development and growth, will gradually bring the living human intellect nearer to Him?

General conclusions concerning the life of our world.—Evidence which I regard as conclusive, has compelled me to teach during the last half century certain definite principles as regards the nature of life and growth, and of all things living, and things that have lived in time past.

The conclusions referred to are as follows:—

(1) That, the distinction of every kind of life and growth, and the formation of tissue, in all things living—from every kind of non-life—is absolute.

(2) That, there is no evidence in support of the view that any kind of life has proceeded, or has in any way been obtained, from non-life.

(3) That, while it is certain our world must have been formed ages before the appearance of one living particle, there is no evidence justifying the idea of the gradual production of a living organism, from any matter, or combinations of non-living substances.

(4) In several papers published in our Transactions during the past twenty years, and in other works, I have traced the formation of the wonderful structures characteristic of widely different living organisms, from structureless colourless living matter containing invariably a large proportion of water; and have shown that the facts demonstrated lead up to certain general conclusions of great interest to all who desire to understand the nature and progress of developmental phenomena, and the mode of growth of living things in general, as well as of man. The nature of those differences by which the state of life is marked off from every kind of lifeless condition—from inorganic matter—and from the state of death, which occurs only in matter that has lived, has been referred to.

(5) Many arguments have been advanced in support of my contention of the influence of *Vitality*, Vital power, throughout the whole of the life-world known to us, the only life-world of the existence of which we have proof, and, as far as has been proved to exist at this time, the only life-world in the infinite universe, the only life-world yet shown to have been created, governed and sustained by the Almighty. The infinite designing, directing, sustaining power of the eternal living God, as it seems to me, looking from the science side only, must be acknowledged in every kind of living matter and at every period of life.

(6) Can there be any reasonable doubt that life, vital power, vitality, stands alone, a power *per se*, not related to any of the forces, potencies, or properties of any ordinary lifeless matter, and as far as existing evidence justifies us in concluding, in the universe? Whence originally came vital power in living nature, and what becomes of it when it ceases at death, is at this time unknown to science.

(7) But, so far, there is no indication of life ever having been brought within the domain of physical law. Rather does life seem to be a power which I venture to think, will ere long be regarded as allied to, if not to be actually included in, the spiritual order of things.

While it must be fully conceded that the most profound and *almost* universally applicable generalization which ever originated in a human mind was founded upon the fact familiar to everyone, the fall of an apple in autumn, and though it is not surprising that the universal law then discovered, has been supposed to govern all matter in all states and places in every part of the universe, was it likely that the contention that matter in one particular state, living for a short time only in this comparatively infinitesimal portion of the universe of material infinity, should for a moment not only cease to obey, or act contrary to the universally received universal law, but behave as if there was no such law at all? Philosophy and reason alike have at times refused to listen to this fact—that there is one state, in which matter resists and absolutely overcomes the influence of gravitation. That matter in this one state only, might and does move in every conceivable direction, and by virtue of its own inherent power and notwithstanding the ordinary tendency of every *lifeless material particle* to be drawn towards, or to be pulled by the weight of lifeless particles towards the earth, was not conceivable at that time; the power of self-movement being known only in matter that lives, evidently inherited from the living matter from which it came, and this from preceding living matter.

Contemplating broadly the only *living* nature of which we have knowledge and experience, can we for one moment agree that life and all living things obey this great “universal” law of gravitation? Do not countless members of the vegetable kingdom by growing away from the earth as long as they live, act contrary to that “universal law”? In this growth are not atoms and particles of matter moved, and somehow piled up one above the other, against their natural tendency to be moved

towards the ground? And are not living organisms out of number able to overcome this law in flight, and by the ordinary movements of their limbs in raising parts or the whole of their bodies, from the ground by the action of their *soft moist nerves and muscles, and the power* of the bioplasm of these tissues? Indeed is it not a fact that *all* living organisms overcome gravitation? And in short, is there a living particle in our life-world which *in all its parts obeys this law*? Are we not therefore compelled to recognize in these facts the influence of a power distinct from all the forces, properties and qualities of every kind of matter that does not live—a power which characterizes only matter which is alive, but which ceases when life ceases? *Vital* and *physical* are opposed. If physical actions and physical laws and properties were not overcome by *Life-power, Vitality*, there would be no life.

RELIGIO VITÆ, RELIGIO SCIENTIÆ, RELIGIO MEDICI.
REGNUM VITÆ, REGNUM DEI.

DISCUSSION.

The CHAIRMAN.—Ladies and gentlemen, I am sure we must be deeply grateful to the Professor for giving us such, if I may use the word, an eloquent paper in every sense of the word, eloquent not only in the words in which it is expressed, but the depths of thought and the forcible truths that it enunciates.

Before going any further the Secretary will read some communications which have been received. Perhaps I might first put a formal vote of thanks.

[Put and carried unanimously.]

The CHAIRMAN.—There are one or two questions I should like to ask the Professor, but I should like first to express my own personal gratitude for many thoughts which it seems to me are hardly to be taken in all at once, but to be well thought over and to form the ground of suggestion of further thoughts. As one reads the paper through, every now and then in what appeared to be a casual sentence, there seemed to be wrapped up a most striking root thought, which I am sure we shall be very wise if we try to

cultivate for ourselves. One thing on the first page struck me as being remarkable, where the Professor points out the multiplicity of living particles that go to form, if I understand aright, one life—that one life is composed of a multitude of little lives. I cannot help thinking that there is a great deal of truth in that thought.

Professor BEALE.—They all come from one original one.

The CHAIRMAN.—Then with regard to the passage where the Professor points out that water is essential to life I would ask a question, which I know how he will answer of course, is there a living particle in a dry seed, a seed that appears to be dry? I think perhaps he might tell us something very interesting about that. What seems to come out rather strikingly when we read that “the tissue or structure died when it was formed” in the new body, and yet went on I suppose to be carried on in that new body, is the old *Mors janua vite* view of forces. I was also struck with the thought that vitality has both living products and dead products. If I understand aright the living particles produce on the one side dead bodies and on the other side new living particles. Might it be that the form of life which we think of as spiritual or the resurrection life may be that in which the products will all be living, and that that may explain many of those points with regard to the scriptural idea of the resurrection life where there is an ascendancy over the laws of matter?

Professor BEALE.—If I may reply to the last question first, it seems to me when any actual living particle dies it is impossible to suggest what becomes of the life that is gone. Where it has gone it is impossible to say. It ceases; it does not become converted into force as has been said. There has been a remark about “Agnostic.” “Agnostic” is used in two very different senses—as if one knew not at all, and also as if one was not certain. The Agnostic has said distinctly and many times that man is a machine and all his actions are mechanical. Now that seems to me not an Agnostic observation, it is a very positive affirmation that man is a machine. The answer to that is that man is not a machine, and not one of his actions is mechanical. There are no mechanics at all in living things. That is the point. But it is said your brain and muscles move—they live. That is true, but the part of matter that forms a great part of the brain is not living matter at all. It cannot reproduce itself, whereas all living matter can. Many would say that the bark of the living

tree belongs to the living tree and therefore it is living. It is nothing of the sort. The bark is dead while the tree is alive, like our nails and the horns of animals, and so on, and the same with our hair. It is ridiculous to say that the hair is alive as long as it is connected with the head, or else the use of a pair of scissors makes the difference between life and death. No one has defined the difference between life and death; that has to be done. What I hope is that we may have discussions about this. It is impossible to get on without discussion. Many of us, I am quite sure, are quite ready to answer any question that may be proposed as well as we can, and then those present will be able to judge for themselves whether our answer is sufficient or not. We shall not get much further with this, although there has been a wonderful advance during the last month, since May 2nd, when Lord Kelvin's paper was read, and now on June 2nd we get very satisfactory information that an advance has been made.

The SECRETARY.—Yes, I think there has been a movement in the direction of belief in an almighty governing and guiding Power.

Professor BEALE.—Very strongly, and all I regret is that the proprietors and editor of *The Times* were not present just to hear what we had to say.

Mr. MARTIN ROUSE.—I should like to ask Professor Beale whether he has observed that the living particles in a particular portion of an animal increase in number and size as the animal continues to grow?

Professor BEALE.—Yes, during the early period of life. The fact is life goes on and out in the lower animals much more than in the higher.

Mr. ROUSE.—May I take it when you say that living matter is not under the influence of gravitation you mean the life particles are not, because the animal taken as a whole of course is, but the living particles resist gravitation?

Professor BEALE.—Yes, but the animal's structure is dead.

Mr. ROUSE.—Might the permanent structure then cease to live?

Professor BEALE.—Yes; it is not only the external parts of our body, such as the outer layers of the cuticle, the hair and the greater part of the teeth, that are dead, but the fibrous tissue is

dead. For instance, the tendons are dead. The point is this, that if you take the growing part of the skin, even of an old man, if you cut off the outer dry part and come to the lower part, take a very thin layer and transfer it to the surface of another individual which has been properly prepared to receive it, it grows. Therefore it seems to me, the test as to life or not is, if matter is living it will grow. Non-living matter will certainly not grow, and the word growth comprehends wonderful changes. Nothing can be used for growth—for increase in living things unless it is dissolved. All the matter, all the atoms must be dissolved in water somehow before they can be appropriated and grow.

Mr. ROUSE.—When you speak of the matter being absolutely dead you mean it has no living particles within it ?

Professor BEALE.—No living power.

Mr. ROUSE.—The cell walls of it are dead ?

Professor BEALE.—The cell walls are dead.

Mr. ROUSE.—But the cell substance then is alive ?

Professor BEALE.—Yes.

The SECRETARY.—There is one point on this, and the previous discussion which has occurred to my mind as a mistaken idea about life which I wish to just state with due deference. Professor Beale has said that when life departs from a body no one knows what becomes of it—you cannot tell what becomes of it—it ceases—as if life was an entity. An entity, if it left the body, we might know something about what becomes of it—it might enter into another combination. But as life is only a condition of existence, it is not an entity and you cannot speak of it as going elsewhere, or disappearing, or entering into any new combination. As the Professor has clearly pointed out, life must come from life, but it means, I apprehend, that one living body has the power of communicating that condition of existence which we call life, but not, as it were, importing into the other body some definite object or entity. I was reading in a weekly paper a recent article on this very subject, and the writer seemed to deal with the question of life as if it was an entity. I said to myself, This seems to me to be an entirely erroneous view ; it is not an entity ; it is not a substance so to speak ; it is a condition. Now I do not know what force that would have with my friend, the Chairman, when he speaks of the question of the resurrection. I have not thought that question out,

but possibly it might have some bearing upon it. The resurrection of the body, or of the spiritual body, would seem to be under that view, not the passage of the life, but the power of the dying and saved individual to transfer into the spiritual body that life which he himself possesses. The whole subject is one, if very vague and indefinite, yet worthy of consideration, and I will just throw out that postulate to Professor Beale.

Professor BEALE.—I should like very much if Professor Hull would join some of us in trying to get some of these matters discussed from the scientific side. I should venture to suggest that life is a power belonging to the order spiritual, and therefore I should not speak of it as a condition.

Brigade Surgeon J. ROBINSON.—I would like to ask whether the “material eternal universe,” on p. 275, refers to a past eternity—that there is no creation at all of matter as matter; or whether the eternity here spoken of is a prospective one. In what sense is that eternity to be understood?

Professor BEALE.—Matter in different forms—the cosmos. It is lifeless, absolutely lifeless.

Mr. ROBINSON.—I meant to ask as to calling matter into existence?

Professor BEALE.—I do not say whether it can be changed.

Mr. ROBINSON.—I heard Mrs. Besant lecture at Reading, and on this question she at once, without hesitation, said it was a very stupid idea on my part to conceive that matter was not eternal. Matter, as matter, through its ultimate developments, might be the formation of a cosmos.

Professor BEALE.—May we not do all we can first to make out the nature of the things nearest to us, and then consider those far away afterwards?

Rev. J. TUCKWELL.—I think it is extremely difficult to express what we all feel on this exceedingly useful and suggestive paper. There are one or two points which I think may be wisely emphasised by us in our thinking over the matter. What struck me as being of very great value was what the Professor has called the necessity of supposing that in biological existence, behind and antecedent to it, there must be some designing, some intelligent, some vital force. Now I think if we take that thought and read Professor Beale's paper with it in our minds, it may be of very great service to us.

If I understand Professor Beale, he, as well as Lord Kelvin, suggests that we must suppose—we cannot do without the supposition—that there is a Creator, a designing, thinking mind, determining the action and the products of those different forms of bioplasm. It is the same in our own body. If I understand it, the bioplasm at the root of my nails has in it no different physical properties, so far as can be discovered, from the bioplasm at the root of my ear, both are enriched by the fluid which circulates and conveys nutriment all over my body, and yet in the one case the bioplasm is working night and day and producing matter of one kind, and in the other case it is producing matter of another kind. Surely there is an indication there, above and beyond all we know of physical nature, of a creating, directing force, determining what shall be the product of these different forms of bioplasmic life. I should like also to thank Professor Beale for the suggestion which he has emphasised this afternoon, that there is a great difference between all material forces and products, and the products of what is called by him vitality or vital powers; or to refer once more to Lord Kelvin's letter, Lord Kelvin disavows anything like a confusion between the form of a crystal and the growth of a plant or an animal. The formation of a crystal, he allows, may be described by the expression, "fortuitous concourse of atoms." Those atoms or molecules are drawn together, or precipitated together by the physical forces of nature, and you have the crystal which is piled up by particles *ab extra*; but in the case of a life you have an entirely different condition of things; an entirely different process of form. You have a bioplasm working from within and laying layer upon layer of dead matter inside the cell, and so what is described as dead matter within the cell is thrown out upon the dead matter that is outside, and continually increasing in quantity so that there is no growth without death. It occurred to me that Professor Beale's paper, and especially his reference to that subject, explains what has been felt by some to be a very difficult expression used by our Lord himself. Not very long since I heard an infidel challenge the statement which Christ made, "Except the corn of wheat fall into the ground and die, it abideth alone; but if it die, it bringeth forth much fruit." I think Professor Beale's paper, this afternoon, gives us an explanation of that extremely difficult passage. It shows us that the corn of wheat cannot grow without death. The gelatinous substance then

of the cell has to die in order that the material that builds up the new plant may be formed ; and that layer after layer of it may be formed, the process of death has to go on continually. I think if it were only for the light thrown upon that one passage, and the evidence that it is in strict accordance with what we know of scientific biology, Professor Beale's paper would have been valuable beyond expression.

Professor BEALE.—May I appeal to Professor Hull, and may I appeal to my colleagues on the Council to consider whether we must not have a little alteration in some of our arrangements, in order that we may have, now and then, one of these points thoroughly discussed. It seems to me to be quite within the purview of the Institute ?

The SECRETARY.—It is not the first time that you have brought this proposal before us, and I think we discussed it at one of the meetings of the Council, and I have thought over it myself. I would wish you, in the first place, to consider that the arrangements for the meetings and discussion of papers have been of long standing. They are the result not only of the arrangements made years ago by the members and associates and the Council of the Institute, but they have been, as it were, confirmed by subsequent use and experience. They are something like the rules which govern the meeting of Parliament, and it is very difficult to introduce additional meetings and discussions without possible disarrangement of the ordinary meetings and discussions, and also adding, perhaps, very largely to the labours of a very small staff, which I hope you will consider. I find, as a matter of fact, as your Secretary, that it takes me all the time that I can spare from other engagements to deal with what we are now doing ; and the Council, when they did me the honour of appointing me as Secretary, accepted my statement that I should give the time necessary to conduct the affairs of this Institute as Secretary, provided I was allowed the time for other numerous engagements and duties. You have no idea the amount of labour that getting these papers and discussions through the press involves. I have to read the MSS., correct them and send them through the press ; attend to their issue—first the proofs, then the revises, and then ultimately to get them all into the shape for the volume of Transactions. Possibly, if you thought it worth while to have a couple of meetings thrown in, which would not involve either

printing or reporting, there might be no difficulty, but I doubt much if they would be of much use.

The CHAIRMAN.—It is quite evident, ladies and gentlemen, this is an indication of a forward movement. It is equally evident that we are already allowing our Secretary to be overworked, so that we cannot move forward, and it is quite evident that we must aim at increasing our staff. It is equally evident that one way of doing that is for the members and associates to aim at increasing our numbers. It has long appeared to me that this Society is not nearly as fully representative in our members as it ought to be for the valuable work which it is doing, and for the prestige which it has. I believe that there are a large number of people who, with a very little inducement, could be found to join this Society, so I am going to make an impertinent remark which I only hope will produce living matter, *i.e.*, that you who are present should each of you try if you cannot find some friend, scientific or otherwise, forthwith to join the Institute, and thus you will try from this little cell to set forth a new line of vital action which shall bring out still more good from the most important work of the Victoria Institute.

The SECRETARY.—I have only to say that if every member and associate was as active in getting members and associates to join as our Chairman, we should probably double our numbers in the forthcoming year.

The CHAIRMAN.—Now, thanking the Professor for this interesting paper, we adjourn.

Communication from Lord GRIMTHORPE, LL.D. :—

I did not receive Dr. Beale's interesting paper in time to write anything on it for the meeting on June 3rd. I had been thinking on the subject occasionally in consequence of the discussion started by Lord Kelvin, and continued until *The Times* found they had been too much occupied with politics and hundred year old news, and attempts to get relief from its encyclopædic speculation. Indeed I had, as you know from former papers of mine, asked the question, "How did the world evolve itself and all the beauty of nature, and how are all its laws maintained?" Dr. Beale's difficulty about such internal forces of vegetable matter had been in my mind aggravated

by the failure of any philosopher of genius enough to invent an accepted solution of the rising of sap in trees, was aggravated by the rejection of mere capillary attraction to account for it, as it was for a time thought to do. And there are the heavy heads of such things as sunflowers to increase the puzzle. Indeed, our oldest law called gravity has not got beyond the region of universal fact—a totally different thing from any prime cause of it. Weight seems so natural that we are apt to forget that Newton only proved it as a fact, and all subsequent experience has only confirmed it as an universal law. Few people reflect what would be the condition of a world, and still more, of a universe without it, in which nothing would stand firm without bonds of some kind. Or you may realize it by simply throwing a few corks on to a large basin full of water, out of contact with and not very near each other, which will soon settle for themselves to join each other and the basin. And now the general puzzle is perhaps increased by the gradual reduction and at last abolition of any solid atoms, which are dismissed for mere “emanations” of undemonstrable vibrating entities, as both electricity and light are at last pronounced to be. Even a watch main-spring only does its work by cohesion (which is only attraction completed) of its particles in the old popular sense of the banished atoms. All the chemical affinities too, are only attractions from no known or yet imagined prime cause, except the one called (in banished language) creation, and maintenance by an omnipotent and omnipresent force and will, which plainly foresaw what behaviour it would cause. The famous Tyndalic dogma of a promise and potency of life to dead matter is transparent nonsense, invented to conceal ignorance by fine words. All these forces are quite as inconceivable without a prime cause as the entity called life, which is only the power to attract and “assimilate” the air and water and other materials for repairing decay or destruction—or, the knowledge and power to lay eggs and all other seeds, which in their turn grow up to imitate their parents and begin the same course again *ad infinitum*. The head of the Birmingham University, Sir Oliver Lodge, quoted Aristotle’s knowledge of such things as a reason for sticking to Greek learning, which really told us nothing. And he did not answer any of the above questions, which must have been somewhere in the mind of such a contemptuous philosopher as he appeared in the aforesaid great diffusion of universal knowledge,

and you will see them approach faster as they get near. Meanwhile we go on blundering and trade-unionising against all practical knowledge of how to do or to improve anything that is wanted ; as if the only practical rule of life were to get the most pay for the least and worst work that can be sold for more than it cost the doer of it, and yet talking of "Labour" as the only potentate worth acknowledging. Had we not better begin again at the other end, as some prime Author and Maintainer of the universe did, who not only made His own laws but enforces them every minute ?

As I once wrote for you a paper on "Beauty of Nature*" with the same general object as the preceding one of Dr. Beale's, I invite your members to reflect what answer they or anybody can give to the question suggested just now by a short walk, in this suddenly fine afternoon, in the garden,—What made merely promiscuously planted oak trees look so beautiful ? Certainly not I, some thirty years ago, when I planted most of them at random ; and certainly not my gardener. But I and the persons with me all exclaimed at it, and then it came into my head to ask this question, for any of your members to answer.

And reverting to universal gravity, let me tell those who do not know, that Newton's friend Paley reminded the readers of his admirable book called *Natural Theology*, which is better reading than any scientific one that I know or ever knew, that he asked therein how gravity can be accounted for ; and that he anticipated the erroneous dictum of a well-known atheistic philosopher, that the law of gravity is only "the expression of a necessary law of space." It is nothing of the kind until he establishes the new theory that gravity is a mere emanation of straight lines of attraction in every direction.

Communication by Rev. J. RATE, M.A. :—

I am much interested in Professor Beale's paper, and am glad that it endorses Lord Kelvin's statement, viz. :—that "Modern Biologists are coming once more to a firm acceptance of something ; and that is—a Vital principle."

* *Trans. Vict. Inst.*, vol. xxi (1887-88).

But I see no reason why the same Almighty Power which is exerted in the creation and support of living matter should not be equally exerted in maintaining the laws which govern inanimate matter.

Newton in his immortal work, the *Principia*, closes it by an argument in which he treats of the attributes of God as manifested in the laws which govern the material world, concluding, "*Et hæc de Deo, de quo utique ex phænominis disserere, ad philosophiam materiam pertinet,*" and then he adds, "*hypotheses non fingo.*"

If I may be permitted, I will add a note on Causation which I published many years ago. "A fallacy arises, I think, from viewing the laws of Nature too exclusively of the material world. Looking on Nature, as it is, a great and connected whole, consisting of matter, force, organic life in the vegetable and animal world, sentient and psychical life in man and animals, and spiritual life in man—we find each lower law dominated in its turn by the law of the higher existence. Thus the laws of inanimate matter are dominated and interfered with by the laws of organic life in plants and animals; the laws of organic life are dominated by the laws of psychical life in animals and man; and in man the laws of psychical life which he derived from Adam are dominated, when he 'puts on the new man,' by the law of the 'Spirit of life,' which he derives from union to Christ. The first man Adam was made *εἰς ψυχὴν ζῶσαν*; the last Adam was made *εἰς πνεῦμα ζωοποιῶν* (1 Cor. xv, 45). Thus one law controls another; the higher controls the lower, interferes with its usual unimpeded operations and effect; but is no violation of it."

What first satisfied the mind of Socrates in inquiring into the nature of Causation, was the saying of Anaxagoras, *εως ἀρχῆ Νοῦς ἐστὶν ὁ διακοσμῶν τε καὶ πάντων αἴτιος*. "Having heard a certain person reading once in a book, as he said, by Anaxagoras, to the effect that it is a Mind which regulates, and is the Cause of all things, I was indeed delighted with such a theory of Causation; and it appeared to me in a manner to be quite just for Mind to be the Cause of everything; and I supposed, if such were the case, that the regulating Mind sets all things in order, and disposes them severally in such a mode as they may best abide in." (*Platonis Phædo*, Ch. xlvi.)