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1903.

The Minutes of the last Meeting were then read and confirmed.

The following paper was then read by the Author :—

ON THE UNSEEN LIFE OF OUR WORLD AND OF LIVING GROWTH. By Professor LIONEL S. BEALE, F.R.C.P., F.R.S., Government Medical Referee for England, Vice-President of the Victoria Institute.

IN the paper I am about to read, I shall venture to draw attention to some broad general questions of interest, which have an important bearing on recent doctrines lately very popular, in relation to our modern science, philosophy and religion, but considered and discussed from a scientific and rational point of view only.

There is in my judgment evidence of an absolute difference between *living matter and living growth*, and every kind of *matter that is not in the living state*, including the enormously preponderating amount of matter of our world, in very different states, and of diverse composition and the matter of the universe, that cannot under any conceivable circumstances, *live*. The distinction of all life, from all non-life, rests upon facts of ordinary general observation, as well as on minute investigation with the highest magnifying powers yet made.

I shall maintain, that there is no reliable evidence of any gradual transition from any condition of non-life, to any condition of life whatever—that all matter that *lives*, has unquestionably proceeded *from matter that lived before it*, and that to this truth, there has probably been no exception, since the time of the creation.

The facts and arguments which so far have been advanced, against religious truth, and belief in God and Infinite Power, in living nature, are in my opinion unreliable, even if considered from the side of science only. Man is man from the earliest period of his existence as a structureless germ; and there is no proof or evidence, that man has descended from, or is or was, in any way specially related to, any other organism in living nature, through evolution or any other process, and that in support of all such conjectures concerning man's origin, there is not at this time a shadow of scientific evidence.

For little more than fifty years, has it been possible for man to study the minute structure of living organisms, or to investigate the wonderful phenomena of life and growth and *vital move-*

ment, universal in living nature, and characteristic of all the living matter known in this world; but not of any other kind, state or condition of matter yet discovered, or to be made by any process known to science. For this short time only, have we possessed the required instruments, and other means of studying the great problems of life and living growth, such as very high magnifying powers with excellent definition, and more successful methods of minute research, than were at the command of our predecessors of the early part of the nineteenth century. Recently many new and important facts have been ascertained, and we have been able even to realize to some extent the changes which probably occur during living growth, and those which result in the formation of tissue-structure, by particles of living matter in man, animals and plants, and in some living organisms of extreme minuteness, all of which have been formed from and by living matter only.

I have already had the privilege of bringing before the members of the Victoria Institute several points of interest bearing on the general question of the nature of the unseen life, and when, and precisely where, lifeless matter becomes living, and have endeavoured to ascertain exactly what happens, when, from living matter, structures and substances are evolved, having wonderful properties and arranged in a manner not to be imitated, or produced artificially, or by means other than by life. *Transactions of the Victoria Institute*, vols. xxix; xxxi, p. 218; xxxii, p. 337; xxxiii, p. 52; and xxxiv, p. 216.

Last year I ventured to draw attention to a broad fact of general application to the whole life-world, to which I do not think there is one single exception—the fact of the presence of a large proportion of water in all classes of living organisms and at every period of life. This fact in my opinion is established not only in regard of everything and every particle that is actually alive, but is also true of everything that lived in the past, or that will live in future time, as long as life shall exist on this earth. The idea of life, in my mind, is invariably associated with water; water as it seems to me being the first necessity; life could not have existed before water. To consider therefore what sort of life may exist in the stars and suns and other infinitely distant heavenly bodies, and in cosmic vapour is surely needless. *Cadit questio.*

Multitudes of the most minute and wonderful of living things in living nature, the Protozoa, consist almost wholly of water. They increase and multiply at a great rate, and some will live even in distilled water, and when the water evaporates scarcely

a trace of solid matter remains. The germs of many of these living particles are so light that they are suspended in the air, and wafted long distances by the slightest current. Many such "low" forms of life, are however of complex structure, and their movements suggest a very elaborate arrangement of motor organs acting as perfectly as, and more quickly than, those of the higher animals which possess a complex nervous system, not a few of the movements of Protozoa being evidently under the control of the will. These minute organisms possess the power of choosing the direction in which they will travel, and have also the power of suddenly stopping at any moment. The air and the water seem to provide all that is required for their existence, growth, and increase in number. It seems not improbable that the living matter of these delicate organisms acts directly on their contractile tissues, as nerves act on the muscles of the higher animals, and that by this direct vital action their movements are effected.

The proportion of water in all rapidly growing living particles, and also in tissues and organisms generally, during early growth, is so large that it is difficult to believe that the water itself is only of mechanical service in development and formation, and not actually living. Water and air seem to be the only necessary constituents of some of the lowest organisms and living particles, and I think we may regard them as being universally present in everything that lives not excepting the Bacteria. Death occurs in every particle of living matter, if the proportion of water be reduced below a certain point, but long before the matter can be said to be *dry*. My belief is that in all living nature there is not one instance of perfectly dry matter of any kind being alive, and that water is universally present in every part of our life world.

Is it not probable that many of the lowest organisms in the beginning were created in water, perhaps from water and air which was dissolved in the water, that their successors were developed, grew, and multiplied in water, and without doubt lived and died in water? As to the *origin* of life, looking from the science side, nothing is at present really known. But can we ever forget what we learned in childhood that "the Spirit of God moved upon the face of the waters," or the command, "Let the waters bring forth abundantly the moving creature that hath life"; and is it not remarkable that the close relation between water and life, should have been affirmed ages before science or scientific research could have been thought of—"Water of Life"—"Living Water"?

Whenever and wherever the temperature is uniformly much below the freezing point of water, or much above its boiling point, it is certain that there can be no human life, or life of the higher warm-blooded animals; and, say, one or two hundred degrees below or above the points indicated, that there could certainly be no life of any kind whatever. The idea therefore that any kind or form of living thing, or living matter of which we have any knowledge or experience, could have found its way on a fragment detached from some remote member of the cosmos, which after having been whirled millions of millions of miles through space, at a velocity which would have destroyed life of any kind, and at last deposited here as the first living organism or particle—must I fear be regarded as a conjecture inadmissible under the conditions which probably ruled at the remote period of time suggested. This being so, is it unreasonable to ask whether it would not be wiser for us to postpone the further consideration of the nature and origin of species, and perhaps some other supposed evolutionary processes, and all discussion thereon, until we shall be able to claim a little more definite knowledge than we have, on the nature of the life and growth of some of the simplest living things around us, and perhaps also something more definite concerning the nature and origin of our own powers—vital, intellectual, moral and religious? And may we not hope that, as believers in science and truth, we may be permitted by physical authority to retain provisionally our belief in the creation of all life by the living God, and refrain from immediately accepting as true, purely physical doctrines of life, as well as the dictum that “the living and non-living are one,” which cannot in any sense be true?

The remark that during the past century the tendency of scientific thought has been towards a purely physical explanation of all life and vital action, is no exaggeration. Thought, and the action of the human mind have been included in the physical category, and have been held to be *mechanical* in their nature. Such conclusions are, however, contrary to the obvious distinction that exists between matter which is alive and matter which does not live—a distinction admitted by most people who think, and in some instances to be demonstrated by microscopical observation. A few modern teachers of physical science suggest that life has arisen in non-living matter in obedience to unchanging resistless physical laws; and that life, like energy, material forces and properties, is in the domain of Physics, although no one has been able to point out a single particular in which any physical or chemical action resembles

the changes which occur in every vital act and in vital growth. Others prefer to consider the infinite power of life as immanent in all matter whether living or non-living. In the second century of the Christian Era, was it not argued that "either Providence or Atoms rule the Universe," but may we not now feel sure that atoms never did rule, and never will rule, anything in this world, and that ruling power in living nature has ever belonged, and will continue to belong, to Providence alone?

The wonderful advance in every department of natural knowledge and the unceasing improvements in the methods of investigation, including the preparation of all kinds of specimens for examination with high magnifying powers, during the Victorian age, have been unprecedented; and our new knowledge of the nature, genesis, movements, composition and physical state, not only of the matter of our world, but of the distant stellar systems, suns and their satellites, and the far off nebulae, visible and invisible—has reached far beyond anything discovered in all previous time. The more exact knowledge of the operation of the unchangeable physical laws, by which the lifeless parts of the eternal universe have been, and must continue to be governed, are but a few of the great and remarkable additions to the knowledge of scientific men now living. No wonder then, that these, and the results of other very recent investigations in several departments of Physics, should have led many thoughtful persons to conclude that *all nature, living and non-living, belongs to one physical category, and that all worlds and all things in, or of them, are ruled by Physical law!* But the doctrine that all nature living and non-living belonged to one and the same physical category—that associated with the material Atom from the beginning, were promises and potencies of life—and that the *power* some of us called *life*, was evidence of the universal operation of unchanging physical law, and therefore subordinate to eternal matter and its forces and properties cannot be true. The enthusiasm of arbitrary law loving physicists has led them to see everywhere in nature the effects of universal energy only, and nothing indicative of vital power either in their own consciousness, or in the creation and maintenance of the life of the world. Geological research has however happily rescued us from the impending doom suggested by these supposed new physical revelations and such assurances as this:—Man is but a mechanism made and controlled, like the machines of which man is the maker, by physical law; and will and thought, and intellectual action, are but kinds or forms

or modes of matter and motion, "*sui generis* or *variously modified*"!

But does not the geological record prove that through infinite past time—farther, much farther back, than the imagination or reason, at this time with the aid of all human knowledge, can penetrate, countless living things grew and multiplied in air and water, and lived and died according to the general principles which prevail in the existing life-world of to-day, in which man occupies the highest position, and is and has been, playing the most conspicuous part, though but during a comparatively short period of the incalculable time that has elapsed since the beginning of life?

Is it not of surpassing interest to reflect that all this very ancient unseen life-power, the effects and mode of operation of which, have only so very recently been revealed to us, by the wonders of the structural results of vital growth, do not essentially differ even in minute particulars, from the effects of the life-power and the living growth of existing living forms, and that there is no evidence to lead us to suppose that the principles by which our whole living world is now governed, have not been in operation from the very beginning?

Although ancient life-forms have been supplanted by many generations of new organisms and new types, living and growing under very different external conditions, their derivation from, and origin in, structureless living matter, the development and formation of their tissues and organs, the general arrangement and action of their nerves and nerve-centres, the contraction of their muscles, the circulation of their blood and other fluids, and even the development, nutrition and action of their sense organs, were conducted in those early days according to the vital principles governing things now living. Indeed, vital action generally, seems to have been designed, created and carried out in primeval times and to have been governed and sustained by life power, like that which is in operation in the living organisms of to-day. In short, vital action characteristic of all life, simple and complex, past and present, seems to have continued without interruption or change in principle, from the very beginning, up to the present hour. Will any one from the science side, venture to suggest a limit to or change in, the design and power of Providence?

Facts of observation distinctly prove that life is, and has ever been, absolutely different and separate from all forces and properties of ordinary matter, and that the realm of life has ever been absolutely distinct from the realm of matter. Who shall

say that a time will come when death shall be universal, and that all life shall cease?

The idea of any relation having been established between non-living and living, by gradational advance from lifeless matter to the lowest forms of life, and so, onwards to the higher and more complex, is scarcely more than a vague surmise, and not the slightest evidence in its favour is supplied by the facts of any section of living nature, of which anything is known.

The life of the very lowest organisms that exist, or that have ever existed, is just as wonderful, and in all respects just as inexplicable by fact and reason, from a physical stand-point, as are life, mind, and soul of man himself; and it is as impossible now, as it would have been in ancient time, to account for vital actions of the lowest simplest organisms in living nature, although our present knowledge is by comparison infinitely great.

The lowest living particles *now* in existence cannot be regarded as in any sense higher or more advanced than the lowest simplest life of remote past ages, nor was the lowest simplest primeval life in any sense or degree nearer to the inorganic; and we can give no better account, say, of the vibration of the most ancient cilium of the lowest primeval protozoon, than of one of a mollusc of to-day, or of a cilium that belongs to a single living particle detached from the mucous membrane of the air passages of man.

Physical authorities do not appear to have considered what particular matter in various parts of a living organism, is the exact seat of those unseen vital actions characteristic of all that lives, or the real nature of the matter to which only the term *living* can be correctly applied; for, by far the greater part of any living plant or animal, *is not alive*, perhaps ceased to live months or years ago. The bulk of the bark and nearly all the wood of a living tree, for example, is as dead while the tree is growing, as it will be when the tree has been cut down. No living organism is alive in every part; and of many living forms, by far the greater part of each one has long ceased to live. Living matter, and matter that has ceased to live, indeed exist in every organ and tissue of man and animals at every period of life.

The tissue already formed does not *grow*, cannot *increase of itself*, like living matter, nor does tissue form new tissue; neither is tissue nourished, though permeated by constant slowly moving streams of fluid, circulating in its interstices, which fluid contributes to its preservation in the normal state, and prevents

any degenerative changes. It is only the particles of *living matter* connected with tissue, and which were concerned in its formation, that cause the *interstitial circulation* referred to. In bone fluid flows towards, and from, the living matter in the lacuna, in those minute intercommunicating tubules, known as the "canaliculi," and in some other hard tissues the interchange of fluid is provided for in a very similar manner. But many tissues of man, animals and plants are, as already remarked, as dead and lifeless while still forming a part of the living body, as if they had been completely separated from it some time before.

By this unceasing interstitial circulation alone, is the health and activity of the living particles in all the tissues and organs of the body ensured. In man and the higher animals, it is quite as important as in the lower forms of life, which are not provided with self-acting circulating organs, by which the nutritive fluid is propelled into the immediate vicinity of the living particles, and then caused to flow towards them by the *vital action of each living particle*. By any change in this natural vital process, either in excess or deficiency, or in departure from the normal composition of the fluid, as occurs in many derangements of the blood as in fevers and inflammations, or by the introduction of poisons into the circulating fluid, the health of the part of the body may be deranged by the establishment of local or general diseases of various kinds, and perhaps the inception and growth of tubercle or cancer or some other abnormal vital phenomena may be thus accounted for. Only by taking daily a fair quantity of water can this important interstitial circulation be provided for, and the health of the tissues and living matter of the body insured.

By the "death" of the whole or a part of the body, is really meant the death of these innumerable particles of living matter or bioplasm, which in fact constitute the only part of tissue, organ, or "living body" that is really alive, and the only living matter which during life, lives or dies. Through these living particles of the body only, can it be said that we live and move and have our being. Vital power alone accounts for *growth*, between which process, and the lifeless aggregation as of particles of sand, or other non-living matter, there is no analogy. Deposition of matter layer after layer is *not growth*. The formation of crystals and their increase, is *not* an example of *growth*.

Between living growth—and the physical aggregation and deposition of lifeless particles of matter layer upon layer or the

gradual increase of a crystal by matter being deposited on its outer surface from its solution, there is no analogy. In *growth*, the matter which is to contribute to any increase must be dissolved, and the solution must pass into the very substance of the matter that lives, where only can life-power be imparted to the new matter, and certain of its constituent substances be caused to live. To this mode of the production of living matter in all living nature, there does not appear to be an exception. The necessity of absolute contact between living and non-living, seems to be essential for the communication of life to matter, and thus only, does life of any kind become temporarily immanent in matter. I regret to say that by some eminent teachers having great authority, children and students have been taught that living growth is comparable with the addition of non-living particles layer after layer to non-living matter. Crystals *grow*, says Herbert Spencer, but neither crystals nor any things that do not live, *grow*.

Increase, and *growth* are two very different processes, and the physical aggregation and deposition of non-living matter adduced as examples of *growth*, have nothing in common with that wonderful process, which occurs in the living world only. See Herbert Spencer, "The Principles of Biology." Revised and enlarged edition, vol. i, page 135, "*Growth*." But neither the author nor one of his followers, nor any fellow of the Royal Society seems inclined to consider with me, this important matter. This question of the nature of growth being closely related to that of the nature of life, involves the consideration of the great principles by which all life is distinguished from all non-life. Growth as already stated, occurs in the living matter only.

The action of all our sense organs and of the motor phenomena of all organisms from the very lowest simplest living forms, up to man himself—Touch, taste, smell, sight, hearing and the action of other wonderful sense-organs in nature, as well as all active movements in a living body, depend upon the health and growth of its living matter. These and many other questions of the kind, were beyond the means of investigation of the wisest and most thoughtful of the men of past time, and have not yet been adequately explained by contemporary science.

During the last century, very ancient doctrines of life were revived and advocated with more zeal than discretion. Not long since, we were again assured that modern scientific investigation had confirmed the doctrines of Epicurus and

Lucretius, that we and all living things were but matter, "variously modified," by physical action "*sui generis*," and that all living things were machines, working for a limited time, and like the machinery made by man, doomed from the first to deteriorate and wear out, and at last to be cast away.

Though the structure of tissues and organs may appear complete, and on examination after death, nothing more than the *tissue* can be discovered by dissection and ordinary investigation, it must be borne in mind that no eye could see, or ear hear, no tongue could feel or taste, no structure in the brain could take part in thinking, understanding and speaking, unless the minute living particles of Bioplasm or living matter connected with the several tissues, were intact, alive and active—living particles, in the absence of which, no tissues could have been formed or could act, or be preserved in a healthy state.

Not one of the highly skilled confident advocates of physical doctrines of life, has yet succeeded in explaining according to Physics or Chemistry, the difference between one particle of matter which is alive, and the very same matter when life has ceased, nor has any chemist or physicist been able to tell us why a living particle once dead, has never been resuscitated or caused to live again by any physical or chemical treatment, or its life been restored from the "universal energy."

More than fifty years have passed, since, by repeated observations of the living matter of plants and animals, and the careful study with very high magnifying powers of the movements of the living matter of the *Amœba*, and especially that of very young *Amœbæ*, colourless blood corpuscles or leucocytes, living mucus and pus corpuscles of man, and some animals, and many other living growing particles in health and disease, was rendered certain that *vital movements* of living matter, were in their nature distinct from all movements of non-living matter. As already explained, the formation of all tissue-structures and organs in living nature, also depends on such particles of living matter or Bioplasm. The life-power being in its nature distinct from all material properties, forces or molecular phenomena, are inexplicable by any physical laws, or material properties yet discovered. In "*Life Theories and Religious Thought*," and many other works and memoirs published between 1860–80, I gave reasons for my belief in *Vital Power* in all living matter of our life world, from the lowest simplest living particle in nature, to that which is concerned in reasoning and in other mental processes by which

man is distinguished from all other living creatures. These and other observations connected with life and vital action were not in accord with the physical doctrines of life, then and indeed now very popular; but, as about the middle of the last century many scientific problems of profound importance were being settled by acclamation and the opinions of some who knew little of the facts, and could not discuss a purely scientific question such as the nature of life, from what they had seen, I could only publish my views, describe and illustrate by drawings what I had seen and shown to others, and give my reasons for entirely dissenting from the popular doctrines of contemporary evolutionists, monists, Rationalists, and Agnostics, here and abroad. Thousands of intelligent people have been persuaded to give up every religious idea, and to accept a number of vague general propositions, which are absolutely opposed to belief in Infinite Power, and living nature as being entirely and wholly due to the creative and sustaining power of the Almighty.

But is it not time that thoughtful and intelligent persons of all denominations and classes, had the general scientific facts of life and growth brought under their notice, so that they might judge whether these were really opposed to religious belief, as many have been led to suppose? My own conviction has long been that the more minutely living nature is studied, the more strongly will the reason be convinced of the evidence afforded by science alone, of the Infinite Power, Wisdom and Goodness of God.

In the last number but one of the *Journal of the Royal Microscopical Society*, October 1902, page 529, the reader will find an excellent photograph by Mr. F. E. Ives of the central part of one of the valves of *Pleurosigma Angulatum*, magnified upwards of two thousand diameters. This successful representation of the very minute and elaborate microscopic structure deserves very careful study, for it illustrates by its striking details a very remarkable arrangement, the mode of formation of which it is not at present possible to determine. Everyone familiar with the general microscopical characters of the large class of organisms to which the *Pleurosigma* belongs, will at least agree that the beautiful markings, which characterize the different species, cannot possibly be explained or reasonably accounted for by physical or chemical processes of any kind. The more carefully the well known organisms are examined and thought over, the more wonderful will the structure appear, and the more difficult to explain. If the student, skilful with

pen or pencil, and very patient, will accurately copy a small piece of such a specimen, I think he will be convinced that the orderly deposition of the siliceous matter can only be regarded as resulting from the influence of that invisible undemonstrable factor to which I have adverted under the name of "vitality." I claim this structure as one of many minute structures, the formation of which has never been explained, and must I think in reason be referred to the influence of life-power.

Among insects there is a beautiful little moth, *Botys hyalinalis*, which can be made to deposit its eggs on the thin glass slides used for microscopic investigation. The small eggs are somewhat flattened, and the thin membranous "shell" of very delicate structure, is as clear as the finest glass, and through which the changes of the germ can be well studied under a magnifying power of three hundred diameters, and watched from day to day, from hour to hour, without moving the slide, and at the ordinary temperature of the air, during the last week of July and the beginning of August. When, about three hundred hours shall have passed since the eggs were laid, the fully formed caterpillar may be seen to eat his way through the delicate shell, and immediately begin to search for food.

For the pleasure afforded me by this interesting investigation, I am indebted to Mr. Jeffry of Ashford, who, several years ago, kindly sent me many specimens of the ova deposited by the moth on thin glass slides. These could be kept under the microscope during the whole period of incubation, about three hundred hours, and examined without any cover glass or any special arrangement. It is curious that in two consecutive years, the moths began to lay on July 27th.

Mr. Jeffry published some notes of his observations in 1885 in the *Entomologists' Monthly Magazine*, vol. xxii, p. 126, and a more detailed account in vol. xxiii, p. 173. Dr. Osborne also published an article in *Science Gossip* in July 1885, but whether the phenomena of the development have been more recently fully worked out, as is probable, I am not aware.

In these ova, we can see with the help of the microscope, the changes which take place from day to day, and register them by photography.

To the thoughtful and attentive observer of living nature nothing can appeal more strongly, or increase his longing to know and to understand the vital changes which occur in everything that lives. He can see the very spots where the developmental phenomena proceed without interruption, organs appearing, muscles growing, and at length contracting under his

eye, the alimentary canal forming, the air tubes or *tracheæ* developing in many parts of the body, and its various segments, the legs, eyes and mandibles, and other structures of the caterpillar.

But *how*, and exactly by what means, all these orderly and prearranged phenomena are caused and carried out, remains to science so far, an insoluble mystery of living nature. One sees the changes, and can as it were follow them, and they can be accurately represented in photographs and drawings; but however closely we study and think about all that we have seen, we cannot get much beyond the knowledge of the fact of their appearing and continuing, while the germ is seen to grow from day to day.

We know there are particles of living matter associated with every particle of tissue as it makes its appearance. The several structures *appear*, but they would not appear unless their appearance had been preceded by living matter. This is a fact—a truth throughout living nature, from the earliest moment of existence to death, in the case of every organ and tissue, and I think was as true at the time of the first creation of life, as it is to-day. Structureless living matter is the only seat of action of that factor “life” or “vitality,” between which and all energy, forces and physical agencies, the difference is *absolute*.

“Absolute” :—By this word used several times in this paper, is meant a distinction so wide that, as far as I can ascertain, there is no relation whatever between the changes which occur in living and non-living—that the state of the matter, its properties and energies while it is alive, cannot be compared with the state of the same matter, either before it began to live, or when it shall have ceased to live—that there is no analogy between the states of life and non-life—no gradation from one condition to the other, and that the coming of matter into life, is as sudden as its death. The cessation of life in any given particle of living matter however minute, whether derived from the lowest simplest particle in living nature or from man himself, is also sudden.

All the *laws of matter* are compensated or suspended as long as matter is alive, but come again into operation, the instant the living matter ceases to live. This distinction between life and non-life all through our world, is therefore correctly described as *absolute*.

For the excellent photographs I have the pleasure of showing you, of the eggs of *Botys hyalinialis* from the day on which they were laid to the day of emergence of the fully formed caterpillar,

I am indebted to a friend of Mr. Jeffry's, Mr. Hammond of Canterbury.

Will anyone venture to regard this living organism which we see actually forming, or its organs of complex structure appearing in regular order and performing their several functions, as a lifeless machine, or as having been formed and caused to act by physical and chemical agency alone?

In these beautiful little insect eggs, each with the food supply for its minute germ during the whole period of development, the evolution of a free and independent organism with eyes, locomotor organs, having the power of selecting, seizing, masticating, and digesting its proper food—with the sense of sight and other senses; and which ere long will undergo another change, and after a short time will reach a very different and higher stage of existence.

The structure and arrangement of the minute scales which protect the wings and body of the moth are also worthy of study, but the examination of one single scale is enough to convince anyone who reasons on what he sees, of design, prevision, infinite power wisdom and goodness, in this life world. Is it possible to conceive, that each minute structural character could be produced by means, other than by the fiat of Almighty Power?

Few among modern writers and thinkers on the philosophic and scientific aspects of living nature, appear to have formed a definite idea of what is to be discovered by studying the living growing matter of a developing organism at a very early period of its embryonic life. Their ideas of *evolution* for the most part have been founded upon the facts observed during the *later period of developmental progress*, when many tissues, even the bones are already distinct; many investigators apparently not being aware that the early changes in the evolutionary process, are of great interest and importance. It is then, when no structure has as yet appeared, that the particles of living matter or bioplasts, of which at this time the embryo consists, are arranging themselves and are preparing for the structure-formation, and the development of organs which is about to occur, and which had been designed and foreseen from the very first.

The unseen vital changes which precede all structure-formation in living nature are the phenomena from the knowledge of which alone can we hope to be able to gain a correct idea of the wonderful vital processes which result in the construction of tissues and organs, of which there is not a

vestige in the early period of embryonic life. At this earliest period, all is structureless, and of the substances resulting from the death of the living matter, water constitutes the largest proportion. It is at this time that the most important *vital* changes are in operation, the vital powers determining which, have been inherited from organisms preceding, and are transmissible to the germs of those which are about to follow.

In development generally, and in each individual organism, progressing phenomena are recognized from the earliest period of the life of the germ, to the mature state of the living organism. In man, from early life, progressive vital action in the organism generally—is associated with *advance in mental power*, but which continues and increases, as youth leads on to adult life and maturity, and in some instances even in old age.

The living matter of the embryo of man at an early period of development could not be identified or distinguished from that of animals, although the unseen changes and preparation for the formation of man's organs so different in structure and power, proceed from the first according to a definite but different plan. During these early, and all important developmental changes, the living particles by which the several different tissues and organs are formed, are *without structure*, their chief constituent being water.

It is not in form, composition, material properties, colour or appearance, that the several embryos of the different classes and species of organisms in nature differ from one another, but in *vital power* which is undemonstrable—power which operates unseen and in darkness by which all growth and structure formation in the life world have been determined from the first beginning of life, up to the present time.

Can anyone doubt that this wonderful life-power has been handed down from living particle to non-living particle, or that the capacity of forming structure has uninterruptedly proceeded through the ages without a break, modified in some cases by the influence of external conditions, and as I venture to think also in obedience to the original capacity of the vital power, and to change in potency after a certain time, with which the primordial living matter was endowed at the time of its creation. But from the early period of development of the germ, man is man—animal animal—and plant plant; each kind possessing its own characteristic life-power, inherited from its predecessors.

I am sorry to differ very decidedly from the great majority

of my scientific contemporaries in this matter, and cannot help remarking, that about the middle of the last century there seems to have been a determination on the part of many authorities to do their utmost to raise *animal* and to degrade *man*. Was not man called a machine, and was it not said, that all his actions were mechanical? The learned philosophers of that day did not insult the ape by calling *it* a machine, but only their contemporary equal, *man*. There is not one part, or particle of anything living that in reason can be considered to be a *machine*. Every living particle *grows*. But what machine—what mechanism is there which has *not* been *designed*, and *its several parts* constructed, by man?

Think of the preparations required for the construction of any machine—the forming and fitting together of its several parts; and then think of the soft structureless living matter, and of the unseen preparatory stages, through which every living organism and all structures in living nature, must pass through, during their period of development and growth, as they gradually advance towards the short evanescent stage of completeness and maturity, which must be followed by death—most remarkable in insect life; where in fact we meet with three distinct phases of being, abruptly marked off from each other, but in each of which, special developmental changes, including the formation of complex tissues and organs, characterize grub or larva, chrysalis, and the complete, often winged, imago. Were it not for correct observation, the organism representing each of the three phases of existence, would have been regarded as a distinct creature, the latest phase, marking the highest and most advanced developmental form, as shown by its elaborate, and perfectly acting, tissues and organs, all foreseen from the first, although to this last stage, the nearest to perfection, death will soon succeed, and in some instances, even in a few hours.

In the vertebrata, long preliminary periods of unseen changes pass, before there is a vestige of structure-formation, during which the minute bioplasts are growing and grouping themselves according to the size and character of the structure designed, and as if it had been foreseen from the earliest moment of the life of the germ, or before that.

Living nature, it might be said, *everywhere* affords evidence of preparation for a *future*—promise of a living nature which is to be. And may not death itself be looked upon as a natural and necessary preparation for new life which is about to succeed? Just as in autumn and winter, do we not see

preparation and promise, in anticipation of the spring and summer that are to follow ?

Few recognize the fact, that new living particles, sometimes with new powers, arise in the very substance of the living matter. These appear as very minute particles which gradually grow—and somehow acquire new powers which never come from the outside but always spring up *from within*. Growth never depends upon the apposition, aggregation, or collection of separate minute particles, being deposited on the *outer* surfaces of living matter. This vital movement *from within* occurs generally in the early developmental period of living matter. It also occurs all through life, and particularly in the living matter of the so-called “cells” in the cortex of the cerebral convolutions of man and animals, or on the brain surface, and in other nerve centres, from *within* living matter which already exists. This is all important; and, does it not suggest to the mind highly interesting possibilities, as to the precise seat of origination of new vital capacity, and of new and advancing mental power? Nor must we in this connexion forget the often sudden occurrence of new ideas, which seem to arise spontaneously in the mind, and even the “voice within” ?

Every one who has carefully considered what he has observed of the living matter of a vertebrate embryo during the early period of its development, and has tried to reason concerning the facts of observation, will I think feel compelled by the evidence, to acknowledge the unceasing operation of Infinite Power, throughout the whole life world—no other inference appearing reasonable to the mind of an observer, who has seen and made himself acquainted with the facts. The countless numbers of separate particles of living matter or Bioplasm of which every embryo at this early period entirely consists, the arrangement of these particles in many groups, and the composition of the substances which result from their death, the large proportion of water associated with them while living and growing, being also noted as well as the *absence of all structure* at this early period—will I think satisfy the observer that the influence of life-power must be admitted, and the arrangements caused by life, recognized as the direct work of the God of Life—no other explanation having presented itself as possible, to the mind that reasons on the subject at this time.

I have myself had an opportunity of studying the living particles of the human embryo at early periods of its development. A few of the minute bioplasts from the collections in

different parts of the body representing the organs about to be formed, could not have been distinguished from one another, or from those of embryos of the lower animals; although the results of their development differ so widely.

Think of the remarkable differences of structure and action which would exist in a few short weeks, and the new powers of the bioplasts, as series succeeded series, and the yet more wonderful potencies of structure-formation to be manifested at the appointed time—surely evidence of the unseen designing and sustaining power of Omnipotence—the only reasonable explanation that can be offered by the student of these wonderful vital phenomena up to this time (1903). The living particles not only possess the power within themselves of giving origin to new living particles—these growing and in turn producing others—the vital powers of each series being different from, and in nature higher and more advanced, than those of their predecessors.

Shall we not place all these vital phenomena in a class by themselves absolutely distinct and separate from those of non-living matter, and the non-living Cosmos? Development, growth, and the formation of structure, cannot in fact be mechanical molecular or physical, but *must* be regarded as having been directly determined, foreseen and ordained by Infinite Power.

When I consider the general facts of life, whether from the point of view of the minute structure, composition and properties, of the tissues as formed in the various classes of organisms, from the lowly Protozoa up to man himself, or the early changes occurring during the development, particularly of man and the higher animals, from the collections of innumerable minute moist colourless structureless moving particles of living matter, each less than the one two-thousandth of an inch in diameter, I cannot but wonder at the general resemblance and simplicity of the appearance and constitution of the living matter, which when dead and subjected to chemical analysis, is found to consist of but very few elements, all through living nature. The evidence that neither the *living growth*, nor the characteristic tissue-forming capacity, is to be accounted for by the chemical composition of the dead matter, *but by life power only*, is conclusive.

From living matter alone can living matter of any kind be derived, and there is every reason to believe this has been so from the original creation of life; for it cannot be shown that life has been inherent in any atom or particle of non-living

matter yet discovered. There is no reliable evidence that one single particle of living matter has ever been produced or made from matter that was not alive, and that did not itself proceed from matter that already lived; and, as all individual life has certainly ceased in death, leaving the matter and its material properties behind, *must* it not follow that life as we know it in this world, can never be proved to be due to physical changes, or to any inherent properties or qualities of matter or of its elements, which do not live, or to the operation of any physical laws, conditions, or circumstances, yet discovered by man?

Let us ask whether there is any law or property in nature, which indicates any necessary connexion between life, and any definite elements of matter found in this world—in which world alone, as far as we can learn, there are constantly countless living particles and living organisms, growing, multiplying and dying, and being replaced by their successors—the very same atoms of matter, thus living and dying over and over again—the *matter* with its forces and properties persistent and unchanged, *remaining*—the *life* which for a time controls and rearranges material atoms, according to the wonderful life-power with which each kind of life has been endowed, existing for its allotted time only and then ceasing for ever—*Matter*, its physical forces and the laws by which it is governed apart from life—*Life*, a power *per se*, the *effects* of the operation of which man sees, and to some extent may understand, but which must in a short time cease in every individual living particle, and *without undergoing conversion into any kind of energy*. Life therefore *must* be a *power*, distinct from all material properties forces and agencies.

Can we then with our general knowledge of living nature, and of the intimate changes in life and growth, as revealed by minute research, give up our belief in God, simply because we have been assured by some recent scientific authorities, that we are but matter, and that we are animals; or believe that we are machines, formed by, and acting on the same mechanical principles, as those machines which man himself designs, and makes, repairs and improves? From all such doctrines, if guided by reason and facts of science and observation, we shall dissent, at least until the advocates of physical life bring forward stronger reasons for the acceptance of their conjectures, than they have yet been able to adduce. During the last century, physical doctrines of life were, in my opinion unreasonably and unjustly pressed upon the public for acceptance.

When the discreditable opposition to religious thought by which the nineteenth century was distinguished from all previous centuries, shall have subsided, and the occasional undeserved personal attacks on some science-teachers belonging to educational institutions which like King's College, London, had been founded and conducted upon religious principles, shall have finally ceased, as before long they will cease, the soundness of our principles will be generally admitted, and the long hoped for reunion of religion and science will become, at least in England, an established fact. There will then be some prospect of educational peace being restored, and the unceasing progress of science-knowledge and learning resumed, and steadily develop among all classes without further interruption, and the unmerited condemnation of those who perceive in matter that lives, something, not in any way connected with any kind of non-living matter, force, material properties, or blind, passive, irresistible physical laws, will be forgotten.

Anyone who has seen and studied small particles of living matter growing dividing and subdividing in the fluid in which it lives, will certainly reject physical doctrines of life. No one can say how minute the smallest particle may be, that can divide and subdivide, *inherit* and *transmit* its special life-power. Many living particles that can be studied, being less than the $\frac{1}{100000}$ th of an inch in diameter.

Fifty years seems a reasonable time for a student and teacher of more than one department of living nature, to have waited for the criticism of intelligent contemporary critics, of inferences he has been compelled to draw in the course of minute research conducted in one of the most important departments of science and human knowledge, having direct bearing on our views of living nature, philosophy, and religion; and therefore of the greatest interest to every person of intelligence.

The fact of being one of a rapidly diminishing number, I regret to say, of the Senior Fellows of the Royal College of Physicians and of the Royal Society, as well as of those of my own college which was the scene of my being taught, and of my teaching others. in minute Anatomy and Physiology, Pathology and the Principles and Practice of Medicine, from 1837, almost up to the present time—will I trust be received as an adequate apology for again craving the attention of the members of the Victoria Institute, to yet another dissertation on the difficult problem, in regard of which there are irreconcilable differences of opinion; and with their permission, of appealing to the

thoughtful, and especially to the scientific members of my profession, who are necessarily much interested in this all-important question of the nature of life. May I hope that some of the general conclusions I have advanced, may at last meet with the free criticism of those who have studied the question, and may have drawn inferences different from my own?

The reunion of religion with that department of science which is of the highest importance to the health and well-being of mankind, in every part of this world, has been firmly established in our own time. I mean, the reunion of the science and practice of medicine and surgery, with religion, which has for many years been growing in strength as well as in the number of its advocates and supporters. May this reunion soon include all who recognize true science, and the importance of some knowledge of life and living nature! By further scientific investigation, it is certain that new truths will be discovered, which will probably show that advance in scientific knowledge is intimately connected with, if not inseparable from, the progress and spread of religious thought.

I look forward with confidence to the union of scientific and religious views of living nature, and hope for the support of the thoughtful of different religious opinions, and that many will join in acknowledging the evidence we now have of the infinite sustaining, as well as of the creating, power of the God of life, the living God of the kingdom of life; and of the absolute separation of all life from all non-life in creation, from the very beginning, of which beginning, nothing more has yet been revealed to us by modern research than we are taught in the first five words of the Bible.

The life power of which probably most thoughtful students of science are conscious, can only belong to human life. It is this alone by which man is enabled to investigate the phenomena of life and vital action of all kinds of living organisms and to appreciate the mighty differences by which man's life power, has ever been distinguished from that of the rest of living organisms.

By the "living particle" so often spoken of, especially those particles belonging to man, I mean particles of soft structureless matter already described, and consisting principally of water, which are destroyed by the slightest touch, and by being removed from their natural position, and also by being placed in water or exposed to the air for a very short time. Such are the living particles present in all our tissues and organs as long as we live, in truth by the agency of which alone we live and move and

think. In many organs these living particles act together in groups of many thousands, each individual particle being generally less than the $\frac{1}{20000}$ th of an inch in diameter, and there is no reason to suppose that ancestral life particles differed in character, or principles of vital action, from those of to-day.

I have tried my utmost over and over again, to consider living nature from the point of view of modern Agnostics, Monists, Free-thinkers, and according to the doctrines of some who belong to parties and subdivisions, sections and subsections, old and new, high and low, broad and narrow; but I have failed. I have never been able to get the simple question of life and death, or the action of any one particle of living matter adequately discussed, though it is familiar to every Biologist; because discussion on the fundamental questions bearing on the nature of life and the living world, has long been opposed.

How then is it possible for me not to believe in *Life Power* as distinguished from the properties of matter—life power which ceases, or which may increase and multiply, and by which new matter may be animated or caused to live—and matter left after the death of that which was alive?—Life Power, and lifeless Matter.

If this be true, must we not admit two very distinct states of matter, *living* and *non-living*—two states of nature—*living* and *non-living*—two realms, or kingdoms—one living, of *Power*,—the other not living, of *Matter*—one *temporary*, always changing—the other permanent and indestructible—one *governed by the living God*, the other *by non-living law*? *Life power* infinite, active, living and dying—*Matter* passive, blind, powerless—governed by eternal unchanging law?

In this paper I have endeavoured to make clear what I believe to be the truth as regards the absolute distinction between all living and non-living; and have tried to prove the distinction of all life from non-life.

As regards man, I could but express my very strong conviction that man is absolutely separate from all the lower animals; but believe me, there are very strong facts and arguments against the doctrines now generally entertained, concerning man's nature and origin, and his relation to the Infinite. I hope therefore we may have opportunity of discussing at greater length the important question of Design, human and divine, and man's true position in living nature, from the science side, based on facts and observations ascertained in the course of studying the structure growth and action of the living matter of his body, and the structure, mode of formation, and action of the highest

and most remarkable of his tissues, and particularly of the arrangement and action of those bioplasts and tissues belonging to man's nervous system, not to be compared with anything else in nature, from which perhaps we may be able to deduce what is man's true place, and his relation to his Creator.

I regret to say that some intelligent writers of our Press, the most free and in some matters, the most reliable in the world, seem but too anxious not to offend their readers who may differ in opinions according to the parties, denominations, sections, divisions, or sub-divisions, to which they belong; and generally, in their occasional criticisms of scientific questions there are indications of a desire, not to express opinions that would be likely to offend their readers' views; and so to study the tendency of the thought of the day, on questions of religion and science, as to avoid the discussion or criticism of serious questions bearing on the nature of life, and the relation of living nature generally, to Infinite Power Wisdom and Goodness. The general Press seems to take what it calls the secular view; as if even the simple question of life and death of man could be secularly treated, without reference to its religious side, and to the question of the creating and sustaining power of the living God; and as if a sharp distinction could be made between the supposed *secular* and *religious aspects* of Life power.

For nearly a century very arbitrary assertions by high authorities of their time, erroneously supposed to be based upon new discoveries, have been thoughtlessly forced into popularity, and have so modified and weakened the foundations of religious belief, as to have led many intelligent persons who could not investigate and judge for themselves, to accept and spread doctrines, incompatible with belief in God and the spiritual world,—doctrines which have tended to shake or destroy religious feeling in England—all this too, without serious discussion and proper deliberation, on the part of those who were well acquainted with the scientific facts.

The life-power, mind, and intellect of man, have been placed in one and the same category with the life power and instincts of the lowest animals, although it is certain that man is a being apart, and absolutely distinct from all other organisms in living nature.

Of those who agree with the so-called Freethinkers, Agnostics, Secularists, or Monists, and of those scientific men who support the views advocated by that eminently representative but disquieting author of "The Riddle of the Universe," I beg to enquire:—what results of investigation, general or microscopical,

physical or chemical, and what known facts, or scientific opinions, arguments or reasons based on research, in any department of living nature or of physical science, can be advanced, which would justify an unprejudiced student of Physiology or Biology in defending the contention, that man cannot in reason, from a scientific point of view, be in any sense regarded as "the child of God," or as "an inheritor of the kingdom of heaven"; for is not man the only living being who *knowing* God, can pray and worship?

DISCUSSION.

The CHAIRMAN.—I am sure we have all listened with the deepest interest to this Paper (hear, hear), and we shall read it with the greatest interest when printed.

It is most important that we should bear in mind this one fundamental point which underlies this valuable paper—that life springs from the living and not from the non-living. It is true that there is a great deal of loose talking about it. So with growth, we may speak of the growth of a crystal, and no great harm is done if we recollect that we are using the word in an inaccurate sense;* and so, in many cases, we get into a way of using words figuratively, and then supposing we have proved a thing; and I believe figures of speech, by way of illustration, to have been amongst some of the most fatal sources of error in scientific study. We use the word "life" in an inaccurate sense, but we must come back to those points which Professor Beale (and perhaps he is better qualified to speak than any man in England on these physiological questions) forces on our attention, that the living, though even a minute fraction, perhaps, of what we call living, contains in that minute fraction the secret not only of life itself, but all individual life. The charm of studying organisms led many to suppose, when I was a student, that in organization is the secret of life, whereas in life is the secret of organization. (Hear, hear.)

* As Dr. Beale has himself explained, the growth of a living object is from within; the "growth" of a crystal is by accretion from without.—ED.

Now, the important proof in our investigations, to my mind, lies in the absolute certainty, as I hope it does to yours, that there is something that we do not know. It is important, then, to come to that knowledge if it will save us from infinite mistakes. Our late distinguished President always impressed me, when speaking on a scientific subject, by the absolute humility with which he said he did not know, and, therefore, it seems that until we are willing to confess our ignorance of what life is, from a scientific point of view, we shall know nothing of it.

I most earnestly commend this paper to your careful attention. The conclusions that are drawn in it by the author are so entirely—perhaps I should not say what I agree with, for I am incapable of following all those masterly arguments—but I have felt, following them at a distance, that they show clearly there is nothing that can conceivably explain the mystery of life without the Living One outside. How can I express it? The Living One Who is not the living thing, but the *source* of the living thing. We come back to the words of Holy Scripture, where God is spoken of as Him in whom “we live and move and have our being.”

Let us hope that in the confession of our ignorance we may rise to higher truth—that we may rise from not knowing the difference between the dead and living, or the physical and spiritual, to the higher and deeper knowledge of the spiritual.

Rev. F. A. WALKER, D.D.—If I might select one or two points out of the admirable and learned essay we have just listened to, I should be very glad to put to the author this question: What is the lowest degree of cold that he thinks living organisms can exist in, and the highest degree of heat?*

Dr. WOOD-SMYTH.—This is the first time I have had the privilege of attending at the Victoria Institute, and it has been a great delight to me to hear Professor Beale on this subject, because the most exhaustive researches I ever made in my life were made years ago on the lines of his work.

I went over his experiments, one by one almost, and found them,

* As Dr. Beale does not appear to have given a direct answer I may suggest—between the temperature at which albumen coagulates (165° F.) and the zero of Fahr. for unprotected animals.—E. H.

as he represented them, perfectly true. There was one drawing in his book that I remember well was open to grave suspicion. He represented germinal matter, spinning a fibre of muscle, much as a spider does his thread. But in the course of my research I came upon this very object. If anything, it was more clearly marked than the one illustrated in Professor Beale's book. It is a most important discovery, and it is impossible for us to estimate its value. If you take the whole of Professor Huxley's discoveries together they will not equal that one discovery, and yet nothing is thought of it on account of the wrong-headed attitude which men of science entertain towards this great subject. Let me say that there is a change of opinion. Herbert Spencer, in the last edition of his *Biology*, gives up generally, the chemical theory of life, and says it is an enigma.

It may be slow, but the time will come when Professor Beale's views will be accepted. It has taken a whole century for hypnotism to be admitted, as it is to-day, to be a potent influence and power in mind. All this is very useful to be brought before the Institute, and I hope it will tend towards a victory for Truth and for the Bible.

The only explanation of life which we have is the one that is given to us in the Book of Genesis where it says, "And the Spirit of God moved upon the face of the waters." The Hebrew word there is a participle expressing continuity and intensity of vitalizing action.

REV. A. K. CHERRILL.—Professor Beale has given us so much, that I cannot help feeling inclined, like a certain well-known character in fiction, to send up my plate and ask for "more"!

There are two points on which I would like to ask him a question—first, as to the structureless matter of life of which he has spoken. Are we to understand that what he refers to is actually structureless, or that we are unable to discover the structure? In his description of the commencement of life he speaks of most elaborate structure, and it is difficult to see how this very elaborate structure can come out of no structure at all.

MR. MARTIN ROUSE.—I was going to ask Professor Beale to reassure us, or to reassert, in terms that escaped me, whether the growth of matter within a cell was all performed within the cell—whether the whole growth takes place within the cell?

Professor LIONEL BEALE.—Yes, from within outwards.

Mr. ROUSE.—Whereas in all lifeless matter, the deposits are from the outside ?

Then I would ask Professor Beale whether the chemical compounds of these bioplasts, that form man as well as other animals, are absolutely the same ?

Then I would say it is monstrous and absurd to speak of man as a machine, for the simple reason that a machine never grows, even regarding the cell itself as living matter, which we now know it is not, but even regarding a cell as living matter, it of course affords no analogy in the inorganic world.

Then I would say, on the theory of development and complete evolution, why should all insects have exactly three stages ? If this theory really had any true existence, one kind of insect would have two forms, another three, another four, and another five or six and so on, and they would be variously developed up to higher and higher perfection ; whereas there are innumerable thousands of species, each one of which has exactly three forms or stages. [Hear hear.]

Rev. JOHN TUCKWELL, M.R.A.S.—I should like to say how deeply indebted I feel to Professor Beale for that extremely thoughtful and splendid paper that he has given us this afternoon. No doubt in all our minds many questions have arisen, and I am sure there are many that cannot yet be answered. Professor Beale has told us how difficult many of those points are.

I was particularly glad that he called attention, however, to the commencement of life. Our globe is said to have been at one time a mass of molten matter, and it is always difficult to understand how, upon the materialistic ground, there can be any connection between the first germ of life and the moist ashes of a burned world. Professor Beale has, I think, rendered great service in calling attention to the extreme difficulty of accounting for the first germ of life on the theory of evolution.

Another point I am very thankful for his calling attention to, is what I may refer to as the higher development of the higher species. If, as we are told, every germ of life that propagates itself can only result from similar life of the same form, or class, then the difficulty is to understand how, by any process of evolution, the bioplasm of the plant can ultimately become animal bioplasm, or how

animal bioplasm can ultimately become human bioplasm. If there is a vital principle in every particle of bioplasm that determines its future character, how are we to reconcile that principle with the development of higher species from lower ?

Professor ORCHARD.—We have to thank Professor Lionel Beale for a very masterly and fascinating paper.

Before I make any observations on the subject of the paper, which at this late hour must be very few, I wish warmly to associate myself with the tribute of affection that has been paid to our late President.

He served his generation, by the will of God, and now the Christian philosopher has entered into that life which is above the brightness of the sun. While we sorrow over our own loss, we cannot but rejoice in his gain.

It struck me while listening to Professor Beale's paper, that its especial value consisted in its discriminating power. It discriminates between the assumptions and fallacies of evolution and the facts of science. It discriminates between regarding man as a machine, and the actual fact that he has a will and is a living growing creature. It discriminates, again, between growth and mere accretion. It is important that we should have these matters brought before us in contrast to mere speculative assertion.

That life is distinct from mere mechanical force is, I think, generally admitted. You cannot translate mechanical forces to life ; nor can you translate life into the equivalent of those forces.

Since Professor Japp gave his famous address, I think few if any (I do not know whether Professor Pearson still holds to his view) will dispute the tolerably strong evidence of those forces that life is an energy which testifies to a living God and His work.

I thank Professor Beale much for his valuable paper.

Professor LIONEL BEALE, in reply, said,—It would be difficult for me to enter into a consideration of the many interesting questions that have been asked, for it would occupy a great deal of time, but it suggested itself to my mind whether we could not, with the permission of the Council of the Victoria Institute, have a short conference in which one of those questions might be started amongst us ; when we should be able, probably, to unravel a great deal of difficulty and to come to some definite conclusion that might be of great use. Is it possible ?

The CHAIRMAN.—It requires careful consideration. If it were possible it would be most interesting.

Mr. MARTIN ROUSE.—Cannot that question be answered about chemical compositions ?

Professor BEALE.—The chemical composition of bioplasm cannot be determined, because in the attempt you kill it. When you try to find out what it is made of, the first thing you do is to destroy it. It is a certain product that results from death.

Mr. MARTIN ROUSE.—I have heard you say that before ; but I wondered whether the vital products of the dead matter that are introduced into the formation of man were the same as those that are introduced into the formation of animals ?

Professor BEALE.—Pretty nearly.

Mr. MARTIN ROUSE.—If you were to select 20, or 100, or 1,000 cells and test them chemically, in animals, would the result be the same ?

Professor BEALE.—Pretty nearly. It is the *living power* that is transmitted from one to the other, and so with regard to every word we speak. Probably thousands of "cells" are at work at the same time, and those cells come into existence certainly at the same time, and act harmoniously together although they are separate.

All these questions are very interesting, and I should be glad to have the opportunity of meeting our friends to discuss them *seriatim*.