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A table of contents for *Journal of the Transactions of the Victoria Institute* can be found here:

[https://biblicalstudies.org.uk/articles\\_jtvi-01.php](https://biblicalstudies.org.uk/articles_jtvi-01.php)

JOURNAL OF  
THE TRANSACTIONS  
OF  
The Victoria Institute,  
OR  
Philosophical Society of Great Britain.

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EDITED BY THE HONORARY SECRETARY,  
CAPT. FRANCIS W. H. PETRIE, F.R.S.L., &c.

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VOL. XX.



LONDON:

(Published by the Institute)

INDIA: W. THACKER & Co. UNITED STATES: G. PUTNAM'S SONS, N.Y.

AUSTRALIA AND NEW ZEALAND: G. ROBERTSON & Co. LIM.

CANADA: WILLARD Co., LIM., *Toronto*.

S. AFRICA: JUTA & Co. *Cape Town*.

PARIS: GALIGNANI.

1887.

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## NOTE ON STRUCTURE AND STRUCTURELESS.

BY LIONEL S. BEALE, M.B., F.R.S.

ALTHOUGH jelly, as, for example, the jelly-like matter of which many of the *Acalephæ* are composed, or the so-called vitreous humour of the eye, appears perfectly transparent when examined by the unaided eye,—as transparent as glass,—both these tissues have a distinct *structure*, which may be revealed by microscopical examination, especially if the delicate tissue be tinted with certain colouring matters. But there is another kind of matter said to be “jelly-like,” which is found throughout the living world, in which no structure whatever can be discerned, though it be submitted to examination by the very highest magnifying powers. And in many cases where, in relation with this matter, fibres or fibre-like structures, or granules, or globules have been discovered, these are in contact with, and in most cases formed from, the transparent and really structureless substance. And where, as in many instances, these bodies exhibit movements, the latter are communicated from the semi-fluid structureless material. In fact, it is this which moves and causes the movement in the fibres or granules. Now, it has been somewhat positively laid down that *structure* will ere long be discovered in this truly structureless living matter. “By higher magnifying powers than any we possess or can have any idea of, *structure* will be revealed.” Those who agree in this contention, and they are many, do not attempt to show how the “structure” of their imagination will help them to explain the facts of life. They seem to be very certain that the mysterious phenomena of life are to be somehow explained by *structure*, although we have been for years discovering structure after structure, and we are just as far from anything like a reasonable explanation of life as ever—nay, we are farther than we were some years ago, because views have been forced upon us of late which are not supported by facts. We are told we *must* accept these views because the facts which are to prove them will certainly be discovered at some future time, and we are in the meanwhile to believe in the prophetic demonstrations vouchsafed to us by scientific prophets.

But, if we allow ourselves to be guided by actual facts and

observations, and discard all prophetic assurances, we shall come to a very different conclusion. Look where we will in the living world among organisms, high and low, complex and simple, at the earliest period of existence, in the adult and in old age, in forms and types of such antiquity that, could we carry ourselves back for tens of thousands of years, we should find examples of the very same forms growing and multiplying as are now with us, and in creatures which have perhaps only exhibited their present characteristics during recent times. We come face to face with perfectly clear, transparent, colourless, semi-fluid or diffuent matter, so utterly devoid of any character to which the term "structure" can with fairness be applied that every part moves freely, not only from one place to another, or vibrates backwards and forwards, but every part seems to move into and out of every other part. If "structure" can be applied to this matter, the term may be applied to clear mucilage, or to syrup, or to water in the liquid state. We must then carefully distinguish the "structure" we mean when we apply the word to mobile liquids from that we indicate when we speak of the "structure" of a tissue, of a cell, or to the "structure" of a crystal, of a rock, &c. By "*structureless*" I mean not only that no threads, or fibres, or lines, or dots, or parts, or particles can be discerned by the use of the highest powers of the microscope, but that every part of the matter termed "*structureless*" is mobile, and can freely pass amongst other portions, and concerning which *structure* of every kind must be considered absent if the question be regarded from a purely theoretical standpoint only.

No tissue can be formed, no structure can be evolved, no secretion produced, no beat of heart or movement of respiration, no contraction of muscle, no emanation or flow of nerve-current, not even the lashing of a cilium, or the taking up of a particle of food, can be effected without changes in the *absolutely structureless*. How any one in these days, with the facts before him, can be searching for structure which shall enable him to account for actions and functions peculiar to living things is most extraordinary. All that lives, and all that has lived, has begun not in structure, but in the structureless; and whenever in a living thing structure is found there some time before would have been discovered *structureless living matter* only.

While no one can be found who will maintain that all function and peculiarity of arrangement, and of chemical composition, of variety of organisation and type in the living world, is due to original structure certainly existing, though not discovered, at the earliest period of existence of the

minute germ, almost every one who writes or speaks on the subject seems to believe that "structure" is the undiscovered secret. On the other hand, to my mind the evidence we already possess is conclusive that all structure is a consequence, and not a cause, of prior changes in the structureless, and that universally in the living world "structure" is preceded by absolute structurelessness.

The source of all function as well as structure and character of all forms and types, is the structureless. It is to the operation of some force, power, or property temporarily (that is, while the matter in question is alive) in or upon the material particles of this matter, that structure is due. "Life" is associated with the structureless only, and is altogether independent, not only of structural peculiarities, but of internal chemical composition. Matter exhibiting structure never possesses the vital property of producing its like, and structural characters and chemical properties can be demonstrated only in the case of matter which has ceased to live,—not in the structureless substance which is actually alive,—that is during the time when it manifests all its wonderful powers of movement, formation, and transmission of power like its own to the non-living. Life must be sought for not in the structure, but in the structureless. It is here only we can study its working. In structure, and action, and function we see the results, the consequences of the working of life-power, but the life-power itself has fled ere structure can be discerned, or the presence of a definite chemical compound proved.

We *know* that the material substance of the structureless is alone under the dominion of life-power, and that the matter of all structure, like the rest of the lifeless matter of the universe, is under the sway of ordinary physical law. I do not see how we can proceed one step in the study of the truly vital until the absolute structurelessness of living matter, and the temporary domination of the physical and chemical by the vital, be admitted; and I venture to maintain that, if we had allowed our judgment to be guided by facts of observation and experiment only, we should long ago have accepted these propositions as established, necessary, and incontrovertible truths.