

**THE LIVING SUBSTANCE; AS
SUCH: AND AS ORGANISM;
SUPPLEMENT TO JOURNAL OF
MORPHOLOGY, VOL. XII, NO. 2**

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The Living Substance; As Such: And as Organism; Supplement to Journal of Morphology, Vol. XII, No. 2 by Gwendolen Foulke Andrews

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GWENDOLEN FOULKE ANDREWS

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LIVING SUBSTANCE

AS SUCH: AND AS ORGANISM

BY
GWENDOLEN FOULKE ANDREWS
(MRS. STAN ALLEN ANDREWS)

Supplement to JOURNAL OF MORPHOLOGY, Vol. XII, No. 2

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TO

MY MOTHER,

WITHOUT WHOSE EXAMPLE OF PATIENT PERCEPTION
THESE RESEARCHES COULD NEVER HAVE BEEN MADE;—

AND

TO

MY HUSBAND,

WITHOUT WHOSE UNSELFISH ENCOURAGEMENT
THEY WOULD NEVER HAVE BEEN OFFERED TO THE WORLD;—

THIS RECORD IS DEDICATED.

"That which is is far off and exceeding deep:
who can find it out?"

"Because however much a man labour to seek
it out, yet shall he not find it; yea, moreover,
though a wise man seek to know it, yet shall
he not be able."

Ecclesiastes.

THE LIVING SUBSTANCE:

AS SUCH: AND AS ORGANISM.

GWENDOLEN FOULKE ANDREWS.

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PREFACE.

THE editing of certain studies in protoplasmic phenomena having been set aside again and again by circumstances, I am impelled to publish a somewhat condensed account of the more important facts which bear on problems of the day.

To do this is to do less justice to the work than one could wish, seeing that the larger truths presented were built up as mosaics by mere accretion of individual facts; a method forbidden by the scope of a summary when the number of facts is legion.

Yet it is possible to give a bird's-eye view of the ground covered, and, perhaps, to justify those broader statements,

which, however they may read, here and there, under such constraint as hypothesis and argument, are but summarized facts.

The work, at time of its doing, embodied an appeal to the normal, living substance, as against "preserved" and tortured states, in which the prevailing standpoint delighted, and from which even workers of physiological bias had not freed themselves.

As pioneer work it then ran sufficiently counter to prevailing enthusiasms to be in danger of harsh dealing; to-day it may hope for some scattered sympathy. A direct, independent appeal to protoplasm, *per se*, which I have been led to call in terms of my results, the living substance, as such; it was unhampered by theory or predilection, except what may be described as a belief in life-genii more complex and more potent than even surface tension and osmosis.

The work was carried on partly at the Marine Laboratory at Wood's Holl, partly at the University of Pennsylvania, and finished in the spring of 1894. It was assisted by constant study, during the preceding ten years, of many of the forms then used for specialized research. The very full memoranda made always at the moment have since been confirmed by frequent and iterated observations on the same, or closely allied, material. A few new facts gained in the course of these are omitted here, since they are in the nature of confirmation purely, and the mass of facts was already too great to be used *in toto*.

All controversial references, except a few to Bütschli's epoch-making work on protoplasm, to which I owe much, and which gave the point of departure for these researches, have been omitted, both because the work, save for this, was wholly independent, and because such reference would have increased the paper to a size unsuitable even for book form.¹

And a controversial tone is wholly unnecessary, since the facts harmonize rather than clash with all other well-authenticated facts known to me.

¹ As an understanding of Bütschli's views is advisable for perfect comprehension of this paper, it is recommended to those who have not opportunity to read his whole work, to read a review of it by Dr. E. A. Andrews which appeared in *Science*, N.S., vol. II, Dec. 27, 1895. In Bütschli's magnificent work the existing theories are reviewed.

The new facts are not thought to *explain* the phenomena, but only to *unify* them, so that the future master who shall find for us an explanation may have a less incoherent mass of contradictory evidences to deal with.

Though it is felt that acknowledgment to those who have from time to time befriended the work by giving opportunities to the worker, were better left for a later and more complete presentment, which should more fully justify their faith and requite their kindness; it is impossible to omit here recognition of help without which the work might never have been done.

To Dr. Edmund B. Wilson, who in 1888 admitted me as a hearer to his class at Bryn Mawr College, I owe such technical training as I possess; and also then, and later at Wood's Holl, stimulus and inspiration to research work, such as springs naturally from contact with so gifted and catholic a mind, and such as grows under an unflagging interest and practical help given all who show interest in their work.

Through the kindness of Dr. C. O. Whitman, I occupied for three summers a room in the Investigator's Department of the Marine Biological Laboratory at Wood's Holl, Mass., and received much encouragement and stimulus, both from him personally and from the environment his scientific achievements and genial influence create,—a circle of disinterested workers who gather about him there, making an atmosphere electric with enthusiasm, and holding neither method nor result a secret from one another.¹

Finally, the liberal practical aid of Dr. Horace Jayne, Dean of the University of Pennsylvania, providing a private laboratory in the Biological Department, greatly furthered the work and enabled me to bring it, so far as it goes, to a satisfactory conclusion during the winter of 1894. The perfect optical conditions enjoyed there, the open north light and freedom from vibrations, gained me some valuable points; and

¹ I desire distinctly to free from all responsibility for my choice of a subject, or its treatment, the above savants. The privileges and help acknowledged here were given to aid research on the embryology of rotifers, the results from which, because incomplete, are still unpublished. The present work was carried on at the same time and was known to myself only, being then but fragmentary results.