Randy Wayne
Self-Evaluation 2019

1. What are the central themes and priorities in your research, and what are you most pleased with?

As a researcher, I try to ask and answer the most fundamental scientific questions related to how plants transform light energy into food, how plants sense and respond to the physical environment, and how plants respond and develop in time. Specifically I work on the following fundamental scientific questions: what is light, what is gravity, and what is time? I do this by critically analyzing the foundations of relativity and quantum mechanics that have given us the scientific description of light, gravity, and time that is accepted by the consensus. My unique and original work is based on a deep understanding of the history and philosophy of science, a deep need to resolve inconsistencies between standard theories that have been swept under the rug, and on my computational and experimental skills.

Stanislaw Ulam said, "*Ask not what physics can do for biology, ask what biology can do for physics."* Biophysics is currently populated by people who have moved from physics into biology. However, historically, biologists and physicians, including Thomas Young, Hermann von Helmholtz, Robert Brown, Robert Meyer, and Adolf Fick have had a profound influence on physics and there is still room for a biophysical cell biologist to make an impact. This is because cells live in the world of neglected dimensions between the world of macroscopic physics and the world of microscopic physics. Studying physico-chemical processes in such a world has its advantages and its disadvantages. One disadvantage of working in this world of neglected dimensions is that it is not easy to assume that a given subset of physical laws can be neglected in order to model biological processes and solve the equations easily. On the other hand, one advantage of working in the world of neglected dimensions is that I have the opportunity to look for fundamental laws that are applicable to microscopic systems as well as macroscopic systems and thus help to unify macrophysics and microphysics. Such laws provide a parsimonious toolbox for modeling and solving a wide range of physico-chemico-biological problems. Recently, I have been asked to review a paper in a mainline physics journal that relates to matter-antimatter symmetry, and Govindjee, who is well known for his work in photosynthesis, has written to me to tell me that he is fascinated by my work.

As a result of my unusual background in biophysical plant cell biology, which instructs me that (1) friction is inevitable at any temperature above absolute zero and (2) anything material must be larger than a mathematical point, I have developed alternative interpretations for the fundamental observations that suggest that time is relative, reversible, and an illusion, and that objects are not there until they are observed. My inferences are founded on the principle of causality, the principles of mechanics, electricity, and magnetism, and the laws of thermodynamics. This contrasts with mainstream science, which is founded on the theories of special and general relativity and the uncertainty principle of quantum mechanics, and rejects the fundamental principle of causality. Based on causality, mechanics, electrodynamics, and thermodynamics, I have reinterpreted the oldest and the newest observations on why the speed of particles cannot exceed the speed of light, the relativity of simultaneity, the optics of moving bodies, the deflection of

starlight, the gravitational redshift, the precession of the perihelion of mercury, stimulated emission, the global positioning system (GPS), and the observations of gravitational waves, in terms of absolute time.

I have also developed a model of the photon that is consistent with all the seemingly contradictory observations that led to the wave-particle duality. I consider the photon not to be an elementary particle of zero dimension but a composite particle with extension. I call this composite particle the binary photon. The binary photon is composed of matter and antimatter with conjugate properties of mass, charge, and sense of rotation. Giving the binary photon mechanical and electrodynamic properties consistent with classical physics, nullifies the need for relative spacetime. My model is consistent with Schrödinger's equation for a boson and shows how wave function solutions to the Schrödinger equation can be interpreted as paths of particles in absolute space and time. My model is also consistent with Kirchhoff's diffraction equation, the fundamental equation of image formation, that scientists, including Hans Bethe, were unable to make consistent with the standard electromagnetic theory of light. My model gives a mathematically and physically rigorous theory of image formation. My model also allows the law of refraction to be consistent with the conservation of linear momentum.

In my opinion, one only has to look at the laboriously built scaffolding of independent and contradictory hypotheses that provide the standard description of the world in terms of dark matter, dark energy, and cats that are dead and alive at the same time in order to realize that there is a need for a new fundamental theory of nature that describes in an intelligible way what we see in the living and nonliving world across multiple scales of space and time.

Admittedly, my research goals are no longer perceived to be aligned with the goals of CALS, which is evidenced by my salary and title. I was hired at a time when one was expected to be the best scientist one could be *even* if the field had no money. There was room for this kind of diversity and inclusion. Now one is expected to be more compliant and be the best scientist one can be *only* in the fields that provide the most money to the University. I am pleased that my approach has provided not only ways to visualize the interaction between light and matter in plants, but also possible remedies for the existing contradictions in the fundamental laws of nature.

2. What are your main contributions to teaching and what do you enjoy most and/or least?

In the past year I have published the second edition of *Plant Cell Biology: From Astronomy to Zoology* and the third edition of *Light and Video Microscopy*. The two books provide outreach to the world for the fundamental knowledge and unique, critical, and creative way of thinking I present to the students in the Plant Cell Biology and Light and Video Microscopy classes. In both cases I present essential knowledge based on first principles and emphasize how we know what we know.

Last spring, I taught *Light and Life* (PBIO 1130). By most accounts, whether theological or scientific, light is fundamental for the origin and continuation of life. The extraordinary relationship between "light and life" provides an important unifying framework to

understand life in terms of physics, chemistry and biology. I hope to turn my lectures into a popular book on *Light and Life*.

3. What are your contributions to undergraduate advising & training

As an advisor and the Agriculture & Life Sciences Advising Coordinator in Biology and Society, I make advising a priority and meet with students as soon as they ask for an appointment. I treat the students as if each and every one of them is a unique individual who has distinctive talents. I do not define them as either victims or privileged. I help them find meaningful, joyful, and thought-provoking classes that will help them to find, be, and become their best selves, develop their character, and be positioned to achieve their goals upon graduation, when they are at the top of their game, rather than after a gap year.

In terms of undergraduate research, two of my publications on experimental evidence in support of the binary photon that were submitted this year are the result of research done working one-on-one with Margaret Lovier and Michael Halberg, both of whom were undergraduates.

4. What are your contributions to graduate student/postdoc advising & training?

None.

5. Describe your local (Section, SIPS, CU), national and international collaborations.

At Cornell, I work with Mamta Srivastava (BTI) on the importance of the binary photon on understanding image formation in the confocal microscope, with Richard Furnas (Mathematics) and Michael Rutzke (Soil and Crop Sciences) on the magnetic properties of light, and with Karl Niklas (Plant Biology) on the polarity of cells. This past fall I worked with Peter Hepler (UMASS Amherst) and Larry Winship (Hampshire College) on imaging the movement of water into growing pollen tubes using fluorescence microscopy. It was an extraordinary experience working with two people who together have nearly a century of experience working at the bench.

6. How is your research funded and what support are/will you be seeking

I fund my research out of my own pocket. Proverbs 16:16 says *"How much better to get wisdom than gold, to get insight rather than silver!*" Unfortunately, I have had to make a choice between doing the unpopular research that I do and doing fundable research. Although I recognize the importance of bringing in grant money in running a university, and I respect and am thankful for those who do research that also brings money into the university, I believe that I have used wisdom in making my choice to do research that I believe provides insight into the fundamental nature of the world.

7. What outreach activities have you done and/or would you like to do?

None.

8. What changes & improvements would you like to see in the Section, SIPS and Cornell that would improve i) your ability to function and ii) the section/SIPS as a whole?

I would like to see better space for teaching laboratory classes.

9. Provide a complete CV: Publications

Books:

Wayne, R. 2019. Plant Cell Biology: From Astronomy to Zoology. Second Edition. Elsevier Academic Press, Amsterdam.

Wayne, R. 2019. Light and Video Microscopy. Third Edition. Elsevier Academic Press, Amsterdam.

Articles:

Wayne, R. 2018. A description of the electromagnetic fields of a binary photon. African Review of Physics 13: 128-141. (Published 2019)

Wayne, R. 2019. Using the Schrödinger equation for a boson to relate the wave-like qualities and quantized particle-like quantities of the binary photon in Euclidean space and Newtonian time. African Review of Physics 14: 49-64.

Wayne, R. 2019. The Kirchhoff diffraction equation based on the binary photon. African Review of Physics 14: 30-48.

Wayne, R. 2019. ERRATA CORRIGENDUM: The Kirchhoff diffraction equation based on the binary photon. African Review of Physics 14: 0006.

Niklas, K. J., R. Wayne, M. Benítez, S. A. Newman. 2019. Polarity, planes of cell division, and the evolution of plant multicellularity. Protoplasma 256: 585–599.

Wayne, R. 2019. Why does light move? African Review of Physics (submitted)

Wayne, R. 2019. The binary photon: A heuristic proposal. African Review of Physics (submitted)

Lovier, M., M. Srivastava, and R. Wayne 2019. Rethinking the Nature of Light: The Binary Photon and the Point Spread Function. African Review of Physics (submitted)

Halberg, M., M. Rutzke, and R. Wayne 2019. The Intrinsic and Contingent Properties of the Binary Photon: The Equivalence of Color, Wavelength, and Frequency in Dielectric Media. African Review of Physics (submitted)

Faraday, C., R. Furnas, M. Rutzke, and R. Wayne 2019. The Action of a Magnetic Field on Light and Matter: Possible Direct Interaction between Magnetism and Light. African Review of Physics (submitted)

Wayne, R. 2020. Signs in the Heavens: The Impact of the War on the Acceptance of Einstein's Theory of Relativity. World War One Illustrated (In Press)

Commentaries:
Wayne, R. 2019. Putting the Measurable over the Meaningful. Letter to the Editor, Boston Globe Magazine, March 1, 2019.

Wayne, R. 2019. LETTER TO THE EDITOR: Re: 'College Shouldn't Be a Breeze.' Cornell Daily Sun. November 4, 2019.

Wayne, R. 2019. LETTER TO THE EDITOR: Re: 'Remember What It Means to Be a Student.' Cornell Daily Sun. November 12, 2019.

10. Provide www links:
Lab Website: http://labs.plantbio.cornell.edu/wayne/
Cornell Faculty Page: https://plantbio.cals.cornell.edu/people/randy-wayne/
Wikipedia Page: https://en.wikipedia.org/wiki/Randy_Wayne_(biologist)
ResearchGate: https://www.researchgate.net/profile/Randy_Wayne
Google Scholar:
https://scholar.google.com/scholar?hl=en&as_sdt=0%2C33&q=randy+wayne&btnG=

Conclusion

I will relate a story that Albert Frey-Wyssling, a plant cell biologist, told about Hermann Staudinger who proposed and developed the idea of macromolecules and polymers at a time when the gatekeepers of the day believed that macromolecules were artifacts. "*I remember Staudinger's lecture to the Zürich Chemical Society in 1925 on his high polymer thread molecules with a long series of Kekulé valence bonds. It was impossible to accommodate his view in the unit cell as established by X-ray analysis. All the great men present: the organic chemist, Karrer, the mineralogist, Niggli, the colloidal chemist, Wiegner, the physicist, Scherrer, and the X-ray crystallographer (subsequently cellulose chemist), Ott, tried in vain to convince Staudinger of the impossibility of his idea because it conflicted with exact scientific data. The stormy meeting ended with Staudinger shouting 'Hier stehe ich, ich kann nicht anders' [Here I stand, I cannot do otherwise] in defiance of his critics*." Staudinger held his ground and won the 1953 Nobel Prize in Chemistry. I too profess, "*Here I stand, I cannot do otherwise*."