Afterword

We live in a time of unprecedented activity in the science and technology of light, so much so that the nomination "Century of the Photon" is already heard.* Moreover, technological advances are increasingly focused on quantum physics, to the extent that quantum technology is being regarded as a new discipline. The quantized form of light, the photon, will of course have a prominent role in such developments. Photonics is at the core of recent technological advances in light, and much of it concerns topics that are truly dependent on the quantum-based fundamentals introduced in this book. Furthermore, specifically quantum forms of light are required for a myriad of optical interactions, most of which feature in extensive applications.

The photon is primarily a conveyer of energy. Just as sunlight provides the basis for life (with photosynthesis at the bottom of nearly every food chain)† and vision—both processes associated with photon absorption—so too do we find that many areas of photonic technology are also associated with energy and illumination, primarily in connection with solar energy harvesting[273,274] and solid-state lighting.[275] Of course, the link between photon energy and frequency also provides the basis for a rich diversity of spectroscopic and imaging applications, which in the photonic era have become increasingly pervasive across wide areas of quality control and analysis in the food, health, and safety sectors, as well as in medical and environmental diagnostics.

From another perspective the photon, when regarded as a conveyer of information, is a concept that, beyond simple causality, represents a powerful corollary of modern relativity and cosmology theory. Once again, we may observe how the familiar process of vision, by which we naturally gain most of our information about the outside world, is continually being expanded. Modern society is already heavily dependent on radio and microwave wavelengths for wifi and Bluetooth, now extending to autonomous vehicle sensors operating in the infrared. Moreover, the development of optical fiber coupling, enabling low-loss information processing and communication with single-photon detectors[56,224] (and the prospect of exploiting quantum attributes of light) opens up further channels for the photonic age.

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* It is fascinating to consider that for the photon—indeed, any particle traveling at the speed of light—relativity theory shows that time has no meaning.

† In this sense, given that almost all life on Earth, since its dawn countless millennia ago, has been sustained only by an endless flux of photons from our Sun, the term "Century of the Photon" might seem naively patronizing.

Yet the lowly photon at the heart of all these developments retains an element of mystery. The second page of the third edition of Rodney Loudon's classic book on quantum optics observed "it is no longer so straightforward to explain what is meant by a 'photon.'"[55] Far from becoming increasingly well understood, the photon appears harder to understand than ever, despite a simplicity that the original concept suggested. Much of the knowledge that has been described in this book would have been unrecognizable to the originators of photon science, some of it unfamiliar to optical scientists even one generation ago. With conservative extrapolation, it seems likely that other surprises may soon be within our grasp.

Photon

Pure energy am I, no other entity existing
Particulate of aspect, though of zero mass consisting.
Contemporaneous are my fields electric and magnetic,
Entwined and co-dependent undulations sympathetic.

I spin with restless energy, yet spend no time in turning,
Imparting it where I should land, selection rules discerning.
You measure me: I cease to be, I cannot live inactive:
I give my energy, my whole, no fractional subtractive.

With simultaneous start and end, in galaxies uncharted,
I vouch for conservation of life-energy imparted.
My destiny uncertain, from some origin once shining,
I travel with celerity defying and defining.

No birth or death for me, nor even tense discrimination,
My grammar elementary: participle conflation.
With start and end contiguous, though space no real constriction,
I find no time to read or rhyme – time is for me a fiction.

Let others count the years, time is inscrutably material:
I nothing know the nature of 'diurnal' or 'sidereal' –
Nor purpose: certainty renounced, unsure of where I'm bound,
Whilst distance is no object, there's no home I've ever found.

Call me entangled, virtual, real, snake-like or sheer ballistic;
Such adjectives serve only to confuse a life simplistic.
What care have I if written off as nothing but a phantom
Or conundrum! I shall ever be your quintessential quantum.

David L. Andrews (reproduced with permission)[276]

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David L. Andrews is a Professor at the University of East Anglia, UK, and leads research on fundamental molecular photonics, energy harvesting and transport, opto-mechanical forces, and quantum and nonlinear optics. He has over 350 research papers and 20 books to his name. The current focus of his research group involves the quantum aspects of optical transmission, optical vortices and chirality, frequency conversion, optical nanomanipulation and switching, optically nonlinear mechanisms in fluorescence, and energy-transfer processes. Andrews is a Fellow of SPIE, the Optical Society of America, the Royal Society of Chemistry, and the Institute of Physics. He is also a member of the Board of Directors of SPIE.

David S. Bradshaw is an honorary research associate at the University of East Anglia. He graduated twice from the same university, first receiving a Master's degree in chemical physics (which included a year at the University of Western Ontario, London, Canada) and then a Ph.D. in theoretical chemical physics. Overall, he has co-written 80 research papers, including book chapters, all based on molecular quantum electrodynamics. He has also created a website explaining the key physics in this theory. His long-running research interests include optical trapping, resonance energy transfer, optical binding, and nonlinear optics. Bradshaw is a Member of the Institute of Physics and the Royal Society of Chemistry.