Foreword

The following chapters underline the fact that citizen science is now a significant international phenomenon. No longer simply a broad concept, but instead firmly taking shape in a range of specific actions, citizen science has emerged on a scale that few could have anticipated. As the contributors to this book discuss, professional and practitioner organizations have sprung up across the globe, tens – even hundreds - of thousands of participants are engaging in citizen science world-wide, and thousands of citizen science projects have been developed. And, just in case there should still be any doubt about the emergence of citizen science, even the Oxford English Dictionary has found it a place.

However, and taking again an important lesson from this book, it seems impossible to contemplate the dramatic growth of citizen science over the last decade in particular without asking a number of questions. Is this solely a matter of data gathering or are citizen science projects raising larger issues with regard to science? What could be the function and contribution of citizen science within moves towards global sustainability? Should this really be seen as a new movement or is it simply a new way of describing what practical enthusiasts having been doing for a very long time? And, as an important focus for many of the contributors, what is the role of *information and communication technologies* (ICTs) in all this? One also becomes curious about the citizen scientists themselves. What motivates them? Does the experience of citizen science have some kind of transformative effect upon them? What barriers do they face?

Now that citizen science has become a recognized scientific and social activity, it is essential that we take the time to analyze, explore, document and, very importantly, learn from accumulated experience. One significant implication of the following chapters is that the challenge is no longer simply to advocate citizen science but instead to consider what it has actually become – and to reflect seriously upon where it might go from here. This is especially important when several commentators point to the diversity in meaning (or, put less politely, the differences and even contradictions) within citizen science.

In discussing the dramatic rise of citizen science, we should be alert to the negative as well as positive future possibilities. Of course, one's only response to citizen science's emergence and growth should not be to look for problems. Nevertheless, it is undeniable that the rapid expansion of citizen science raises questions about its further development. Could one imagine a situation where differences in the definition and practice of citizen science undermine the current sense of shared experience? Equally, we cannot ignore the question of how to network, build and even institutionalize citizen science without losing its contextualized and citizen-generated appeal. Sometimes, what thrives on the margins can struggle once it becomes 'mainstream'.

Considering the chapters that follow, and with special regard for this book's overall focus on 'analyzing the role of citizen science in modern research', three closely-linked questions come to mind – although

I am sure there are also many others. The first addresses the relationship between what we can call *the 'democratic' and the 'data-gathering'* aspects of citizen science. Often, these are presented as fundamentally different activities or even as alternatives. On the one side, we have the idea of citizen science as a matter of 'remote sensing' or 'crowdsourcing' (in the broadest sense of that term). This suggests that citizen science is basically concerned with providing support for mainstream science in a large-scale and 'participatory' fashion: with 'participation' here being defined in strictly non-political terms. On the other side, we have the notion that citizen science should be seen as a matter of 'opening up' science, asking questions about the form and direction of contemporary research, and giving citizens a voice within scientific institutions. This suggests a form of 'participation' with directly political consequences: how can 'scientific citizenship' be defined, developed and implemented?

My first question then is whether we should continue to think of these as two separate paths within citizen science. Is there really a distinction between democracy and data-gathering - or should we not see the two as closely inter-connected? If we think for example of local engagement with issues of sustainability, it seems to me that seeking further knowledge of one's environment can also be understood as a practical expression of citizenship. Certainly, the distinction between the tracking of neighbourhood pollution by citizen scientists and drawing political attention to local environmental problems can at times be so slender as to be almost non-existent. One can make a good case that the different meanings of citizen science should not be kept apart – especially when the boundaries between 'science' and 'society' become ever more fluid in contemporary society. Another way of putting this is to ask whether citizen science is also an emergent expression of citizenship in a world where traditional forms of politics are under widespread challenge (for further discussion of this, see Irwin, 2015; Irwin & Horst, 2016).

That takes me very nicely to my second question. This one concerns the relationship between *citizen science and larger changes in science itself*. Sometimes, we talk as if 'science' is a fixed, heavily-guarded and unchanging institution which occasionally opens its doors to 'citizens' - only to politely dismiss them after accepting their kind gifts and compliments. But what if we also look at contemporary science in more fluid and open terms, and consider it as a field of changing and diverse practice – from nuclear physics to classroom biology, from corporate R&D laboratories to government environment inspectors? Citizen science seems then much less like an outlier and much more as (to steal a phrase from one of the following chapters) an 'advanced learning environment'. Rather than citizen science needing to evolve in order to fit with the requirements of science, it could just be that science (or at least some parts of it) is also shifting in the direction of more flexible and dynamic relations with larger society – as increasingly-used expressions such as 'open science' (or indeed 'open innovation') suggest. This might mean that citizen science will in future be seen as an important and integral aspect of science (like big data or interdisciplinarity) rather than as an unusual activity or 'add-on'.

The third question flows directly from one strong theme of this book and was already hinted at above. What is the relationship between *changing ways of networking and sharing knowledge – notably in the area of information and communication technologies – and the nature of citizen science*? Are digital platforms, mobile devices and Geographical Information Systems best seen as enablers of citizen science or do they change the relationship between citizens and science in a more fundamental way?

When I was first writing about citizen science over twenty years ago, I had no real understanding or imagination of the changes ahead. Back in the 1990s, how did one even find out about the existence of related projects, especially beyond one's own region? Data collection was a much slower business and it was simply impossible to think of citizen science projects communicating simultaneously with thousands of participants across the globe. Of course, and as again several of the following chapters

discuss, this raises important questions concerning the motivation for citizens to get involved in ICT-based citizen science. Equally, one wonders about what is lost as well as gained in this situation – or is that simply the misplaced nostalgia of someone who grew up in a pre-digital era? More specifically, does ICT-based citizen science allow the same opportunities for mutual learning and engagement as 'traditional' (i.e. face-to-face) interaction? Do we inevitably lose the depth of citizen participation as connectivity increases? I do not know the answer to that, but I am very glad to see such issues being raised and opened up to larger reflection.

One can say then that citizen science has come of age. With this increased maturity and new standing, come further questions, fresh possibilities and, inevitably, challenges. I am very glad that international colleagues are taking up these issues enthusiastically and boldly. I very much hope this book will provide just the foundation we need for the next level of dialogue, research, learning and practical action.

Alan Irwin
Copenhagen Business School, Denmark

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