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NANOTECHNOLOGY
AND
GLOBAL EQUALITY
DONALD MACLURCAN

NANOTECHNOLOGY
AND
GLOBAL EQUALITY

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“Anyone who believes exponential growth can go on forever in a finite world is either a madman or an economist.”

—Kenneth Boulding
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My deepest thanks go to Associate Professor James Goodman for venturing with me into the unknown and guiding me so wisely. To Associate Professor Mike Ford, and Professor Michael Cortie, thank you for your confidence in sponsoring me as a researcher from outside the sciences and for the valuable direction, insights and opportunities you provided. To my colleagues from the Institute for Nanoscale Technology: Dr Carl Masens, Dr Benjamin Soule de Bas, Dr Burak Cankurtaran and Dr Dakrong Pisuwan, thank you for welcoming me to your ranks, and to my office-companion and mentor Dr David Xu, my heartfelt appreciation. To the staff from the Faculty of Arts and Social Sciences at the University of Technology, Sydney, particularly Associate Professor Paul Ashton, Carolyn Carter and Juleigh Slater, thank you for your guidance and administrative assistance. Special thanks to Dr Patrick Tooth for your assistance with Endnote™ and Dr Leigh Wood for your help with NVivo. To all the interviewees from Thailand and Australia and Emeritus Professor Tony Moon and Dr Patarapong Intarakumnerd for assisting in the facilitation of this research, thank you for making my ‘field’ experience so valuable. Thanks to Drs Noela Invernizzi and Guilermo Foladori for adding immense depth to my inquiries and special thanks to Dr Sue-Anne Wallace, Dr Natalia Radywyl, Joe Fitzgerald and Kate and James Maclurcan for copyediting, proofreading and advising on matters of structure for various parts of my work. To the Bracken, Coote, Kremer, Inana, Logan, Norton-Knight, and Zehtner families, thank you for caring for me so warmly on my many ‘last’ writing retreats. To my family and friends, particularly Andrew McMillan, Lauren Simpson, Geoff Moore, Wafa Chafic, Suyin Hor, Tori Saint, Mickey Martin, Anna Louis, Jess and Jon Watkins and Jake and Fiona Logos who long endured my struggles with this work, thank you for your ongoing care and concern. Finally, to my partner, Julie Dardel, thank you for your assistance, patience and ever-loving support.
This book’s journey began with an upturned brochure in a park. I found it walking home one afternoon, spread open to a page about courses at the University of Technology, Sydney on nanotechnology — an area ‘set to revolutionise industrial processes’. Whilst the brochure’s content made for an interesting read, I was far from a scientist and, once binned, I didn’t give it another thought… until two weeks later. I was having a conversation with a staff member at that same university, when the word ‘nanotechnology’ popped into my head. I casually asked this person if they knew anything about the subject. “No, but I think there are people on level 16 doing that stuff”, came the reply. Sure enough, I easily found the newly formed ‘Institute for Nanoscale Technology’ and, upon entering, was greeted by the Associate Director, Mike Ford. I deferentially explained that my background was not in science and that I was merely looking for more information, given my surprise at finding a brochure about the Institute in a park ten kilometres away. I had been in the room less than five minutes when Dr Ford proposed that, given the Institute was looking to ‘branch out’, I undertake research looking at nanotechnology’s social implications. I sat stunned. Mike and I had never met, I had little idea what ‘research’ entailed and I still did not have a clue as to what nanotechnology was, let alone the nature of its social implications! Revisiting the basic research proposal I submitted a week later still brings me a laugh, but the novelty of having an ‘outsider’ in a scientific institute must have blinded everyone to my lack of research experience because three months later I sat down in an office vacated by a visiting professor and started to think about nanotechnology.

At this time, I had been working with The Fred Hollows Foundation, a non-governmental organization whose work in reducing avoidable blindness in the global South had pioneered new technologies and approaches to capacity building. I thus leapt forward with my research, having decided to explore nanotechnology’s potential implications for the South and global inequality.
Through this journey I have been able to look in a broad, exploratory manner, at a largely uncharted area that remains surprisingly understudied. Given my research began nine years ago, much of the work in this book is best viewed as a snapshot from and reflection upon an early period of nanotechnology’s development — although, arguably, the relevance of many of the insights remain.

Of real privilege has been the chance to ride at ‘the boundaries’, engaging with the very different approaches of a sociologist and a physicist who oversaw my research. Working across faculties, whilst exploring the interdisciplinary field of nanotechnology, has only added to my interest.

As my understanding and critique of development has deepened, it has become clearer to me that nanotechnology is, at its sociological best, a medium to assess the processes and possible trajectories accompanying technological futures. In an unjust world, where struggles to avoid the co-option and mainstreaming of ideals are ever-present, there would seem to be value in bold creativity, grounded in existing wisdom.

As this book goes to print, I realise that its writing has helped uncover in me a passion for exploring alternatives to the ‘growth’ paradigm and a particular interest in collaborative junctures between feminist, indigenous, peasant, Marxist and ecological thought. I now see ‘the boundaries’ as exciting spaces for new reflexivity, and finally recognise that the greatest resilience to avoiding co-option lies, as it always has, at the periphery.

Donnie Maclurcan
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Commonly Used Acronyms

AFM: atomic force microscope
AMO: atomically modified organism
APEC: Asia Pacific Economic Co-operation
BIOTEC: National Centre for Genetic Engineering and Biotechnology (Thailand)
DNA: deoxyribonucleic acid
ELSI: ethical, legal and social implications
EPO: European Patent Office
ETC Group: Action Group on Erosion, Technology and Concentration
EPO: European Patent Office
E.U.: European Union
FDA: Food and Drug Administration
GDP: gross domestic product
GM: genetically modified
GMO: genetically modified organism
IP: intellectual property
IPRs: intellectual property rights
JPO: Japanese Patent Office
LDC: least developed country
MDG: millennium development goal
MM: molecular manufacturing
MTEC: National Metal and Materials Technology Centre (Thailand)
NANOTEC: National Nanotechnology Centre (Thailand)
NECTEC: National Electronics and Computer Technology Centre (Thailand)
NGO: non-governmental organisation
NNI: National Nanotechnology Initiative (United States of America)
NSF: National Science Foundation (United States of America)
NSTDA: National Science and Technology Development Agency (Thailand)
OECD: Organisation for Economic Cooperation and Development
OTOP: One Tambon One Product
RS&RAE: Royal Society and Royal Academy of Engineering
R&D: research and development
STM: scanning tunnelling microscope
TRIPs: Agreement on Trade Related Aspects of Intellectual Property Rights
U.K.: United Kingdom
U.N.: United Nations
UNCTAD: United Nations Conference on Trade and Development
UNDP: United Nations Development Program
UNESCO: United Nations Educational, Scientific and Cultural Organization
U.S.: United States of America
USPTO: United States Patent and Trademark Office
UTJCB: University of Toronto Joint Centre for Bioethics
WHO: World Health Organisation
WTO: World Trade Organisation
**Molecular Manufacturing:** An anticipated technology based on Richard Feynman's vision of factories using nanoscale machines to build complex products, including additional nanoscale machines.

**Nanometre:** One billionth of a metre or $10^{-9}$ metres.

**Nanoparticle:** A particle having one or more dimensions of the order of 100 nanometres or less.

**Nanoscale:** A length scale between 1–100 nanometres and the level of most atoms and some molecules.

**Nanotechnology:** The understanding and control of matter at dimensions between 1 and 100 nanometres, where unique phenomena enable novel applications.

**Nanotube:** A structure comprising atoms that form a hollow, nanoscale cylinder.

**Quantum Dot:** Semiconducting nanocrystals that differ in their ability to absorb and emit energy, based on the size of the crystal.

**Quantum Mechanics:** A set of scientific principles describing the known behavior of energy and matter that predominate at the atomic and subatomic scales.

**Quantum Physics:** The branch of physics which studies matter and energy at the level of atoms and other elementary particles, and substitutes probabilistic mechanisms for classical Newtonian ones.

**Self-assembly:** A method by which atoms or molecules arrange themselves into ordered nanoscale structures by physical or chemical interactions between the units.
Parts of this book have originally appeared in the following publications:


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