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Practice and performance as research in the arts

Suzanne Little

Over the last couple of decades a new trend has emerged in research in the performing, creative and fine arts, one that includes practice and performance as representations of and vehicles for research. This is a highly significant and often controversial extension to the conceptualisation of academic research. As a new form of investigation, it has come under intense scrutiny in academia, where issues of validity, rigour, originality and claims to knowledge are key to the acknowledgement of work as research and to the subsequent accrual of government and public sector funding. As Shannon Rose Riley and Lynette Hunter note:

While performance practices have always contributed to knowledge, the idea that performance can be more than creative production, that it can constitute intellectual inquiry and contribute new understanding and insight is a concept that challenges many institutional structures and calls into question what gets valued as knowledge. Perhaps the most singular contribution of the developing areas of practice as research (PaR) and performance as research (PAr) is the claim that creative production can constitute intellectual inquiry.1

As an emerging area, performance-based research is still in a state of flux, growth and acceptance; it has yet to secure a universally agreed language, assessment system or consistent criteria for its nomination as research. This is changing, however, and much has already been done on a country-by-country basis. For example, government bodies and academic/practitioners in the UK and Australia have generated guidelines for what constitutes this type of research and how it may be assessed and ranked. This process is also occurring in numerous other countries, including New Zealand, where performance-based postgraduate degrees are becoming more common. New Zealand’s proximity to Australia means that a climate of exchange is emerging and hastening the acceptance of this new form of research. Reciprocal arrangements are being made between institutions in the two countries to cover key practices such as assessment.

To understand the major contribution that this emerging form of research is making to the arts, it is necessary to outline briefly the many different forms that
it can take, the impetus for its development, and its claims to knowledge. In doing so, it is important to acknowledge key debates, such as whether creative work can or should embody a form of knowledge. Should the research focus on the practice or the final artwork, and is it possible to fulfil the research criteria of 'originality' in this mode of investigation? Such issues are too complex to be conclusively resolved here. However, they will be touched upon in order to give an overview of the rapidly shifting and evolving field of performance and practice as research in the arts.

Some terms and definitions
A definitive list of the terminology and the various forms of research employed in this developing field does not yet exist. Similarly, while the same term may be used in different countries, it may involve different practices and foci. Thus, definitions in the field tend to be somewhat blurred and often contested. This is symptomatic of the emergent state of these practices and approaches; it is also due to the complexity and diversity of the object of investigation - artistic practice and product - and to the fact that, in this type of research, the object of study is also the means of investigation. Hence, it would seem reasonable that different terms have arisen in different places to service diverse projects occurring across dance, music, theatre, design, visual arts, film and contemporary performance.

Broadly speaking, Australia and Britain use the terms 'Practice as Research' (PaR) and 'Practice as Research in Performance' (PARIP), often to distinguish between research projects that may be solely centred on creative process (PaR) versus research involving a significant performance element (PARIP). In the United States, the term 'Performance as Research' (PAR) is commonly used. Other terms include 'Practice-integrated Research', 'Creative Practice as Research', 'Creative Arts Research', 'Research through Practice', 'Practice-based Research' (PBR) and 'Practice-led Research' (PLR). The last two terms, PBR and PLR, are used in the sciences also. Some of these definitions and terms overlap, and a number are used interchangeably. This may suggest a lack of rigour; however, it can be argued that it is due to the relative newness of the field and, as Maggi Phillips, Cheryl Stock and Kim Vines suggest, that 'methodological indeterminacy is also a consequence of creative practice's intrinsic emergent nature'.

The chapters in this book represent a wide range of practice and performance as research projects undertaken in music. In this chapter, a number of the above terms will be used interchangeably to respect the original terminological choices of the theorists and practitioners being quoted. Where possible, the terms 'performance as research' and 'practice as research' will be used to differentiate between performance- and practice-oriented research work. Carole Gray's 1996 definition of practice-led research is often cited in discussions outlining the major principles and strategies involved in this type of research.

Firstly, research which is initiated in practice, where questions, problems, challenges are identified and formed by the needs of practice and practitioners; secondly, that the research strategy is carried out through practice, using predominantly methodologies and specific methods familiar to us as practitioners.

Gray's statement does not accommodate the breadth of strategies, methods and questions being generated and used in the field currently, nor the use of critical theory and conceptual frameworks that often frame and inform this research work. But as a statement first articulated in the late twentieth century, it provides a useful starting point for examining the origins of this new form of research and its place within the wider research realm.

The rise of a third research paradigm?
Traditionally, research has been divided between two distinct paradigms falling under the headings of quantitative and qualitative. Quantitative research, the arguably better-known and longer established paradigm, is commonly associated with the sciences and operates on the principle of deductive reasoning. Proof of knowledge is normally presented in a numerical manner and the research adheres to a largely positivist philosophy. In other words, it works from a principle of proposing hypotheses or research questions and then testing them against empirical, measurable evidence. In doing this, scientific research usually conforms to a number of key principles. These include notions of objectivity, where 'ideally any two researchers who study the same behaviours, processes, or phenomena should arrive at identical findings' and replication and reliability, where '[r]esearch should be conducted in such a way that those who question its outcomes can repeat it and obtain the same results. A measurement instrument, such as a test of intelligence or personality, that yields the same results when repeated is said to have high reliability'. Additionally, quantitative research in the sciences is expected to demonstrate 'precision in measurement' and validity, referring to the exactitude of the fit between the concept that a researcher wants to examine and the evidence for that concept. In recent times, the principle of objectivity in research has become contested. Despite the researcher's best intentions, aspects such as funding, professional rivalries, gender bias and even the process of choosing a research topic reveal certain predispositions on the part of the researcher, which may in turn influence the work. Researchers working in the social sciences have thus tended to acknowledge that a degree of subjectivity is inevitable. Additionally, while it may be possible to control and replicate findings gathered in
a laboratory, social research and its settings are more difficult to recreate. Indeed, qualitative research gained legitimacy when it was perceived that another approach was needed to understand how we live in and make meaning of the world and that it should be an approach that takes into account the presence and role of the researcher in the research process.

Norman Denzin and Yvonna Lincoln contend that qualitative research is a field of inquiry that operates in 'a complex historical field that crosses seven historical moments'. For Denzin and Lincoln, North American qualitative research coincided with the traditional (1900–50), moving through the modernist age (1950–70), 'blurred genres (1970–86), the crisis of representation (1986–95), the postmodern – a period of experimental and new ethnographies (1990–95, post-experimental inquiry (1995–2000), and up to the present. They contend that the present (seventh) moment 'asks that the social sciences and the humanities become sites for critical conversations about democracy, race, gender, class, nation-states, globalization, freedom, and community.' As such, while quantitative research has done much to explain the biological natural world and herald advances in science, technology and medicine, qualitative research builds on this, helping us to make sense of the wider world and our relationship with it:

Qualitative research is a situated activity that locates the observer in the world. It consists of a set of interpretive, material practices that make the world visible. These practices transform the world. They turn the world into a series of representations, including field notes, interviews, conversations, photographs, recordings and maps to the self. At this level, qualitative research involves an interpretive, naturalistic approach to the world. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them.

This emphasis on interpretive practices, representation and the human meaning-making process has made qualitative research a preferred approach in the arts and humanities. That said, the line between quantitative and qualitative research is becoming increasingly blurred with the rise of positivism and the adoption of qualitative strategies in the sciences and vice versa. Mixed-method approaches are becoming popular in a world where interdisciplinary research is seen as a way forward for innovation and new understandings.

It is perhaps not surprising that research in the arts is also changing in response to what Brad Haeman refers to as an 'impasse' by some researchers with the restrictive nature of existing paradigms. In Haeman's view, neither the qualitative nor quantitative paradigm appears entirely relevant or appropriate for a form of research that is conducted through, and embedded in, arts practice and works:

Central to the argument for an alternative methodology for the Creative Arts is an insistence by practice-led researchers that research outputs and claims to knowledge be reported through symbolic language and forms specific to their practice. Such a move challenges traditional ways of representing research findings. Practice-led researchers believe it is folly to seek to only 'translate' the findings and understandings of practice into the numbers (quantitative) and words (qualitative) modes preferred by traditional research paradigms. They argue that a continued insistence that practice-led research be reported primarily in the traditional forms of research (words or numbers) can only result in the diffusion and ultimate the impoverishment of the epistemological content embedded and embodied in practice. Thus the researcher-composer asserts the primacy of the music, for the poet it is the sonnet, for the choreographer it is the dance, for the designer it is the material forms and for the 3-D interaction designer it is the computer code and the experience of playing the game that stands as the research outcome.

This does not mean that all artistic practice conforms to, or is representative of, a dedicated academic research enquiry. Research of this kind involves a specific intentionality and the adoption of certain practices and aims. As Anna Pakes explains, the key difference between a practitioner-researcher and an 'ordinary' artist is

[the extent of her awareness of, and explicit reflection on, her art as an appropriate creative response to the initial questions. Or, it may be the intention to approach art making as research-based rather than 'purely' artistic endeavour. But in either case, a premium is placed on the intentional agency of the creator ...]

Additionally, research of this nature is generally intended to add to a shared knowledge, not just that of the individual artist. This is an important point of difference and why it is often demanded that a written document accompany the creative process or artwork in this type of research, a point that will be returned to later. But for Haeman, concerned with the history and development of this new form of enquiry, the key issue is the identification of a rupture in qualitative research enquiry (previously the primary province of arts research) and the emergence of what he refers to as a third research paradigm, that of 'Performance Research'.

Acknowledging Denzin and Lincoln's identification of a 'performance turn' in qualitative enquiry, Haeman takes this a step further, claiming that new practice-led research strategies and practices have 'over-stretched' the limits of 'qualitative research' and a new third methodological category is emerging, namely 'Performance Research'. He draws on J. L. Austin's notion of performativity, where the act of saying or naming something constitutes an enacting transformation. The most commonly used example of Austin's concept is that of the binding and enacting power of the words 'I do' uttered at a wedding ceremony. Haeman uses Austin's
The notion of performativity to explain the active and generative nature of the process and artwork in this new form of research.

When research findings are presented as utterances, they too perform an action and are most appropriately named Performatively Research. It is not qualitative research: it is itself .....

... The 'practice' in practice-led research is primary — it is not an optional extra, or the necessary pre-condition of engagement in performative research.

Whether these new research practices in the arts comprise a third research paradigm or are a radical extension of qualitative research is up for debate. What is certain is that it requires a new conceptualisation of the idea of research and a re-thinking of the place of artistic practice in the research realm. Paul Carter examines the emergence of creative or practice-based research from a different perspective. He looks to Jeremy Bentham’s phrase ‘invention lottery’ as a starting point for gathering together the various arts modes and understanding the nature of this new form of research.

The condition of invention — the state of being that allows a state of becoming to emerge — is a perception, or recognition, of the ambiguity of appearances. Invention begins when what signifies exceeds its signification — when what means one thing, or conventionally functions in one role, discloses other possibilities .... The poet explores the ambiguous realm between language and music; the dancer between music and the materiality of noise. In general, a double movement occurs. of decontextualisation in which the found elements are rendered strange, and of recontextualisation, in which new families of association and structures of meaning are established.

For Carter, this double movement is characteristic of a conceptual advance similar to the Socratic method in philosophy: 'The distinction of practice-based research is to mediate this process materially, allowing the unpredictable and differential situation to influence what is found. These transformative qualities differentiate practice-led research from other forms. The apparent lack of fixity and closure in what he describes can arouse suspicion as to the validity and worth of the research. Carter maintains, however, that what is seen as a lack or deficit is a positive attribute: 'It is a powerful, because complex and multi-sensorial, method of real-world analysis, and its aleatory, constitutionally open, anything-goes character, which is said to weaken its claim to rigour, is in reality, a sign of its sophistication.' Carter's claims focus on the process or practice of invention in creative research, revealing a complex series of interactions and transformations that are also constitutive of the final artwork. Arts research of this sort may elucidate the practice portion of arts production or the artwork itself.

Conversely, Stephen Scrivener, writing from the visual arts perspective, strongly believes that the role of visual arts research is only to produce art: 'An alternative position is that the art-making process yields knowledge that is independent of the actual art objects produced. However, this relegates the art object to that of a by-product of the knowledge acquisition process, and ... places visual art making in the service of some other discipline.' He argues that while it may produce 'valuable knowledge', this approach should not rise to dominance in arts research. Scrivener traces the evolution of this new form of arts research and its challenge to the role of art back to changes in the UK education system. Scrivener explains that in the UK in 1992, polytechnics moved from the realm of vocational training bodies into the research world of universities and with this came the acknowledgement of the art world as an 'equal player' in academia.

In 1996, the UK's institutional RAE (Research Assessment Exercise) officially recognised practical work as an assessable form of publication, due in part to the lobbying of the Standing Conference of University Drama Departments (SCUDD). The UK Arts and Humanities Research Board funded the five-year PARIP (Practice as Research in Performance) project that ended formally in 2005. PARIP worked to investigate issues raised by this new form of research in performance media. As such, it made a major contribution to shaping the field, helping to illuminate and validate its practices and offering ways in which it may be assessed. Much of the information and guidelines generated by PARIP are still available online and there are also numerous conferences, working groups and texts that continue to refine and report on developments in the field. The result is that while there is still some resistance, practice and performance and its link between the art world and research is firmly enshrined in a large number of universities and institutions. Similar processes have occurred in other countries, including Australia (where it has been recognised for nearly two decades), Finland, South Africa and Canada, and it is also gaining recognition in other countries, including New Zealand. Practice and performance as research projects are now deemed valid research outputs for academic/practitioners and acceptable pathways for achieving honours and postgraduate degrees in a wide range of institutions. Despite this, there continues to be a great deal of debate from artist-academics about the role of the work of art in research and the necessity, or not, for written documents and other documentation to accompany the creative work or process.

Nancy de Freitas and Stephen Scrivener argue variously that an artwork cannot be relied upon to communicate knowledge or the rationale for its significance. Scrivener also makes the claim that the artwork cannot, in an academic sense, contribute to new knowledge nor is it the business of art to do such:

If an individual cannot read an artwork then there is unlikely to be consistency of
interpretation between individuals. Since this is a proposed prerequisite of shared knowledge, it is unlikely that artworks function as a means of sharing knowledge. I have argued that a feature of a ‘body of shared knowledge’ is that it is organised such that an item of knowledge can be authenticated by recouping its justification, i.e., the ‘body of knowledge’ comprises both knowledge and justification. I have argued that, at least for the great mass of artworks, such justification doesn’t exist. Finally, I have argued that claims to new knowledge require both the knowledge claimed and its justification to be communicated. Again, this does not appear to be a general characteristic of artworks.27

While these claims represent a significant point of view, there are a number of strategies and approaches that are put in place to reveal and record knowledge or insights born from such research. Often the focus is placed on the practice or process of making creative work and the experiential knowledge that can occur in this laboratory-like environment. The interest and valuing of experiential knowledge is part of the rationale for another common model, the written exegesis, which works to facilitate through reflection and to record insights and findings in a form that is publishable. An accompanying exegesis is usually a requirement in academic performance and practice as research submissions. The exegesis details and extrapolates on the research process, explaining methodological and conceptual frameworks, detailing the work and findings in a reflective and critical manner. For Barbara Bolt, it is an indispensable text:

In the exegesis, the nature and authority of the knowledge claims that flow from practice-led research are able to be sustained beyond the particularity of a practice to contribute to the broader knowledge economy. Rather than just operating as an explanation or contextualisation of the practice, the exegesis plays a critical and complementary role in the work of art.28

The exegesis should not be considered a ‘translation’ of the artwork or practice but a document that is read in conjunction with the work, the one informing and explicating the other and vice versa. Disputes may arise where the exegesis is seen to take primacy over the practice and/or performance work. However, even within this there are different permutations. The need for – and the potential role of – the exegesis may be judged on the projected relationship between the practice and the ‘findings’ of the research:

The crucial issue is the extent to which the research is distinct from, or distinguishable from, artistic practice. Where research outcomes are considered indistinguishable from dance practice, practice itself forms a primary site of, and method for, investigation. In this instance, any other articulation of findings, such as within a written text or ‘exegesis’, may be useful, even necessary, but will always be to some extent derivative of the dance practice.

Alternatively, if dance practice is viewed as simply one component within a larger research design, then research ‘findings’ will exist, and be able to be articulated, to some extent outside the mode of practice. Thus it is possible to formulate a continuum of approaches between these two extremes – the consolidation of outcomes and practice on the one hand and the separation of outcomes on the other.29

The types of differentiation outlined above are usually reflected in the term used to describe the project (i.e. practice as research in performance or PARIP) where there is a consolidation of outcomes and practice, and practice-led research, where there may be a separation between the two.

A final traditional research requisite that raises a significant issue in performance and practice as research projects is that of originality. Along with the requirements for the contribution and effective transmission of new knowledge, the other major necessity for a work to be considered research is its originality. Similar to the arguments concerning whether knowledge can be embedded in, accessed or read in artworks is the idea that the work may not be intellectually clear enough for its original contribution to be ascertained. This also speaks to the notion that the practitioner/researcher may be required to co-opt their practice and artwork to fulfill cognitive ends at the expense of artistic development. While there is an argument to be made that as a research project it must fulfill these ends, it should theoretically be possible to find a balance between the two. In effect, this can work both ways. It may not be necessary to demonstrate originality in the artwork if it is demonstrable in the cognitive content of the project and this may still be a contribution to knowledge of the art form. Pakes uses the example of a choreographer tackling an issue through dance performance:

... the framework against which the object's originality is judged seems broader, since it also incorporates the other criteria of representation or discussion; the dance work's manifestation of the content is compared with the way, say, philosophers discuss the issue in order to see what is different or interesting about the way dance handles these ideas.30

It is easy to imagine the same type of scenario being taken up in a music, theatre or visual arts practice-as-research project. Similarly, practice or performance as research may be used to introduce cultural knowledges and methodologies into artistic praxis (where practice intersects with theory), in order to create new, ethically sensitive ways of working.

Dunedin is a particularly fertile ground for practice and performance as research due to the strong concentration of practitioner academics in a small geographic space and the city's status as a firmly established and highly innovative arts space and incubator. The breadth and potential of the emerging forms of research outlined
above has yet to be widely accepted and understood. The ability to ‘access’ processes of invention and creativity and use symbolic forms as a means to new knowledge and understanding is undoubtedly a powerful step forward in research terms. While there are still issues deserving of attention, including the role of art in academia and a possible bias towards cognitive research outcomes, projects in this field promise to extend our investigative horizons. Performance and practice as research offer the means and space for developing existing and new art forms and a place for a new interdisciplinary research nexus to be formed and refined.

The creative artist as research practitioner

John Drummond

The American dancer Isadora Duncan was greatly taken with the famous playwright George Bernard Shaw. At a dinner conversation she was bold enough to proposition him and suggest that they should have a child together. ‘Just think,’ she said, ‘With your brains and my body, what a wonderful child it would be!’ Shaw looked at her. ‘Ah, yes,’ he said. ‘But what if the child were to have my body and your brains?’

The story, which is probably apocryphal, rests on the assumption that beauty and brains are somehow separated – that people are either beautiful or brainy, and of course we preserve such facile distinctions in our everyday popular culture. Beautiful blondes are ditzy, while nerds are physically unappealing – except, of course, to other nerds. But lurking behind that distinction lies another, also perpetuated in popular culture, which is that scientists (except for the mad ones) are people who coldly and logically apply their immense intellects in a systematic way to the solving of complex problems, whereas creating beauty is a kind of casual activity driven by inspiration and genius, practised by people who are rather peculiar. Hollywood biopics sustain this view inexorably – witness the appalling versions of Mozart presented in the movies Amadeus and I, Giovanni.

One might think that those images would be avoided in the lofty halls of the academy, or that in universities we would have moved beyond such popular myths. Well, one would be wrong. In my capacity as Blair Professor in the Department of Music at the University of Otago, I was called to a university committee meeting recently to address the work of one of the creative artists on our Music Department staff. One of the members of the committee, a respectable scientist, peered at me over his specs. ‘I see he has made a CD’, he said, in the kind of voice I’m sure he usually reserves for first-year students who make a mess of their experiments. ‘But what does he actually do?’ was the plaintive question. ‘Where’s the research?’

Where indeed? And where could I begin to explain? Should I start by pointing out that his children, who learned piano from my wife, had to practise every day if they wanted to master the discipline of music-making? Should I quote Thomas Edison’s line about creative activity being ten per cent inspiration and ninety per cent perspiration? Should I go on to explain that making a professional music CD requires musical skills of a high order, as well as production skills, hours of work
Suzanne Little

Suzanne Little is a lecturer in theatre studies and the coordinator of the interdisciplinary performing arts studies programme at the University of Otago. She completed her PhD on framing theory for theatre at the Queensland University of Technology and has additional qualifications in visual arts and film. Suzanne has also published on reflective learning and the representation of trauma in political dance and documentary theatre.

Scott Muir

Scott manages Martin Phillipps, the Chills and Delgirl along with several other Dunedin bands. He founded Dunedinmusic.com. He is the student events and venue manager at the University of Otago, deputy chair of Independent Music NZ and deputy chair of the Dunedin Fringe Arts Trust. Scott also sits on the board of the Music Managers Forum (NZ) and plays a role in mentoring young musicians through guest lectures at the University of Otago, and by providing direct consultancy.

Anthony Ritchie

Anthony Ritchie studied composition at the University of Canterbury and the Ljazz Academy in Hungary. He moved to Dunedin in 1989 as Mozart Fellow in composition at the University of Otago, and was later composer in residence with the Dunedin Sinfonia, completing his Symphony No. 1 'Boam' in 2000, his Symphony No. 2 was premiered at the International Festival of Arts. In 2004, his opera The God Boy was critically acclaimed at the Otago Arts Festival. In the past five years he has had six CDs of his compositions released, including New Zealand Poets in Song and his latest, Octopus, featuring chamber works performed by members of the New Zealand Symphony Orchestra. He has composed over 150 compositions, and many have been performed overseas. He is now a senior lecturer in composition at the University of Otago.

Notes

Introduction / Dunedin sounds / Dan Bendrgen
3 In particular, see Ian Biddle and Vanessa Knights, eds., Music, National Identity and the Politics of Location: Between the Global and the Local (Aldershot: Ashgate, 2007).
5 Connell and Gibson, Soundtracks, 98.
6 Connell and Gibson, Soundtracks, 97.
7 Connell and Gibson, Soundtracks, 96.
9 Dix, Soundtrack Diaries, 235.
12 Matthew Bannister, Positively George Street: A Personal History of Soho's Feelings and the Dunedin Sound (Auckland: Reed, 1999), 27.
13 Bannister, Positively George Street, 36.
14 Bannister, Positively George Street, 38.
15 Bannister, Positively George Street, 40.
16 Bannister, Positively George Street, 65.

Chapter 1 / Practice and performance as research in the arts / Suzanne Little


4 Paul Gray et al., The Research Imagination: Introduction to Qualitative and Quantitative Methods (Cambridge: Cambridge University Press, 2007), 10–11.

5 Ibid., 11–12.

6 Ibid., 10.

7 Ibid., 11.


9 Ibid., 2–3.

10 Ibid., 3.


20 Ibid., 15–16.

21 Ibid., 16.

22 Ibid.


24 Ibid., 2.


28 Ibid., 10.


30 Maggi Phillips, Cheryl Stock and Kim Vincs, Dancing Between Diversity and Consistency: Refining Assessment in Postgraduate Degrees in Dance (Mt Lawley: West Australian Academy of Performing Arts at Edith Cowan University, 2009), 15.


34 Ibid., 6.

35 Chapter 2 / The creative artist as research practitioner / John Drummond


2 Roger Forman, Amadeus, screenplay by Peter Shaffer (1984); Carlos Suarz, I. Gionanni, screenplay by Carlos Suarz, Radoslav Ishild and Alessandro Valiani (2009).


4 See Wolff, 171 and 485.


7 In diminution, the note values of a theme are reduced; in augmentation, they are increased. In inversion, the intervals of the theme are inverted. In retrograde, the notes of the theme are presented in reverse order. In stretto, the entries in a fugal texture occur at a shorter distance than previously.

8 Sir Isaac Newton, Philosophiae Naturalis Principia Mathematica was published in 1687.


11 Wolff, 1–11.

12 Vorspiel refers to the Prelude, Introduction or Overture of the opera.

13 Charles Le Brun’s Mithode Pour Apprendre à Dessiner Les Passions was published posthumously in 1698.


16 Quoted in Stone and Kahle, 34.


18 Ibid., 26.

19 Quoted in Carol Oman, David Garrick (London: Hodder and Stoughton, 1958), 35.

20 Stone and Kahle, 30.

21 Quoted in Stone and Kahle, 518.


26 The Special Theory of Relativity, [which] essentially deals with the question of whether rest and motion are relative or absolute, and with the consequences of Einstein’s conjecture that they are relative’, http://www.allaboutscience.org/theory-of-relativity.htm, accessed 15 October 2011.

27 ‘My mouth fell open and my pulse began to race’. James D. Watson, The Double Helix, A Personal Account of the Discovery