Foreword to the Special Issue

This special issue "Recent Advances in Fatigue Modeling, Characterization, and Applications" is a celebration of Professor Neil M. James and of Professor David L. McDowell for their co-editorship of the International Journal of Fatigue from 2007 to 2020. During their 14 years editorship, the number of documents published in the journal increased from 231 in 2007 to 513 in 2020 and the journal impact factor increased from 1.60 in 2007 to 5.57 in 2020. Professor Guozheng Kang was also appointed as a co-editor in 2017.

The field of fatigue is wide in scope, involving many engineering disciplines and broad classes of materials. Under their co-editorship, the journal generalized its scope to include this wide range and now publishes numerous Special Issues on specific fatigue topics. The journal has become the most highly ranked fatigue journal in the World with a rigorous review process and fast publication times.

For the occasion of celebrating their contributions, a few of Professor Neil James and Professor David McDowell's colleagues or collaborators were asked to share thoughts, memories and anecdotes. Here are a few examples.

Professor Danie Hattingh - Nelson Mandela University, South Africa
My experience of Prof Neil James is that he consistently acted as an "agent for positive change" within his research discipline. Always ready with inspirational ideas or a sound strategic analysis with a strong focus on networking, recognising contribution and success by research partners. Prof James has developed a solid scientific and engineering understanding, backed by years of experience and always made tangible contributions, across all aspects of a research project. His dedication towards ensuring that maximum impact is derived for both academic and industrial partners was a trademark of his work. The impact of his dedication is evident through his involvement with publications, mentorship of young academics, student supervision and with the industrial take-up of the technologies developed as a result of research programs. The impact of his work around supporting internationalisation of the student experience is also evident in the co-authors involved with his publications. I have enormous respect for his ability to ensure mutual benefits for all, from his national and international partnership and collaboration efforts.

Professor Michael Vormwald – Technical University of Darmstadt, Germany
I have come to know Neil James as a good advisor and thank him for that. Technical advice - such as how to apply for measurement time at the synchrotron - was as welcome as human advice - such as how to order pink gin to be considered an insider by the pub landlord.

Professor David Taylor - Trinity College, Ireland
He provided leadership and guidance, making a real and lasting contribution to his university and his research field

Professor David Nowell - Imperial College, UK
I remember when Plymouth started doing a degree course on surf science. I teased Neil a bit about this and he put up a manful defence (modules on fluid dynamics, coastal ecology, fashion, marketing etc), but you could tell his heart wasn't in it. A couple of years later one of his daughter's studied on the course.
... or there was the time that he came to Oxford to do a PhD exam. I had booked him into college accommodation the night before, together with parking, but he completely failed to find his way into central Oxford. In the end I drove out to McDonalds myself and he then followed me in...

Professor Youshi Hong - Chinese Academy of Sciences, China
My good friend Professor Neil James is an intelligent and industrious scientist, and has devoted a great deal of his academic life to IJFatigue. During the excursion of second joint workshop between IJFatigue

and FFEMS in Malaga in 2013, I asked him: "how much time you spend on the journal?" He answered to me after thinking for a few seconds: "three hundred hours a year.

Professor Michael D. Sangid – Purdue University, USA
Throughout his career, David McDowell has made seminal contributions to developing computational mechanics toolsets to understand and predict fatigue behavior. His research has shaped the field and guided many researchers, including me, to pursue physics-based predictive models for fatigue. David is especially known for advancements in crystal plasticity and constitutive modeling that has examined the role of microplasticity near microstructure features in materials, which have beautifully combined detailed mechanics and materials science fields to address fatigue processes. He has brought new perspectives as co-editor of the International Journal of Fatigue, providing a focus on microstructure rationale to understand fatigue.

Professor Somnath Ghosh – Johns Hopkins University, USA
Professor David McDowell is a true visionary and a leader in the field of Mechanics of Materials. He has made tremendous advances in many areas, including nonlinear constitutive models, fracture mechanics, defect field mechanics, microstructure-sensitive computational approaches, high cycle fatigue of engineering alloys, atomistic simulations of dislocation nucleation, multiscale computational mechanics of materials, and systems-based computational materials design. His research has received a high level of recognition from his peers in the national and international mechanics community. He has been a role model to me throughout my career and I have looked up to his vision and impact with deep respect.

Professor Fionn Donne – Imperial College, UK
Dave has contributed enormously to the understanding of plasticity across the scales, but in addition to the science (particularly) and technology of fatigue. He pioneered the mechanics and statistical approaches to microstructure-sensitive fatigue. His contributions are recognised across the world, and he has inspired many (very much including me) with an amazing legacy. From my short sabbatical at Georgia Tech, to Dave's visit to Oxford, and at numerous meetings at international conferences, it was always guaranteed that he would engage with all with a genuine welcome, friendship, fun and of course, rigorous analysis.

Professor Richard W. Neu – Georgia Tech, USA
Dave is a wise mentor, an inspiring colleague, and friend. As an advisor, he has his student's best interests in mind. As a researcher, he has the remarkable ability to integrate deep, cross-disciplinary knowledge in a clear and logical way.

To celebrate the outstanding editorial work they did in the period 2007-2020, this Special Issue collects 18 papers submitted by a number of authors who had over the years the pleasure to collaborate in various forms with Professor Neil James and with Professor David McDowell. The large variety of fatigue & fracture-related aspects being covered in this Special Issue give a clear picture of the way International Journal of Fatigue has been shaped over the years by these two eminent colleagues.

Let us conclude, by saying on behalf of the fatigue and fracture international community… Neil and David, thank you so much for the excellent editorial work you did, much appreciated!

Ali Fatemi
Memphis, Tennessee
and
Luca Susmel
Sheffield, UK
January 2023

Professor M. Neil James

I became interested in the topic of crack closure and the emerging controversies over the conditions under which it might exist, and how it might influence fatigue crack growth rate while working as a postdoctoral researcher at the University of Cambridge with Professor John Knott, FRS as my supervisor. I had previously completed a PhD at Cambridge on the growth of small surface fatigue cracks with Gerry Smith as my supervisor. During this time, I had realised that, at least for some steels, crack closure could be shown to be the reason for the reduction in fatigue crack threshold values as crack size decreased. Improving understanding of the topic of fatigue crack closure and, in particular, plasticity-induced closure has remained one of my core research interests over the intervening 40 years.

However, the whole area of fatigue has interested me ever since I learnt what it was as an undergraduate in the mid-1970's at the University of the Witwatersrand in Johannesburg, South Africa. My final year design project was supervised by Dr Dave Chandler and dealt with modelling of the notch effect in low cycle fatigue. I developed a simple numerical algorithm to solve the analytical model and the program output was then assessed in experimental work during my final year laboratory project. This work was later published (James et al 1989, Fatigue and Fracture of Engineering Materials and Structures, 12 pp.213-225 doi:10.1111/j.1460-2695.1989.tb00528.x).

After graduating, and before going to Cambridge on a Beit Trust Fellowship, I had worked for several years as a mechanical engineer in the Ministry of Water Development and the Railways in Zimbabwe, and had observed fracture and its aftermath at first hand. The application of fatigue knowledge in industry, and in particular achieving fracture-safe and fatigue-reliable design (a term that I believe was first used by Pellini in his book Guidelines for fracture-safe and fatigue-reliable design of steel structures, published by the British Welding Research Association, Cambridge in 1983) therefore became a second major thrust of my research and this encompassed a number of other interesting areas of activity, including welding processes, residual stress and failure analysis.

Thus over the years I have written a number of the papers intended as fatigue and fracture guidance for specific industrial sectors and these often arisen out of a research relationship with particular industries. One of the most interesting and mutually productive areas of interaction with industry bodies has been work on liquid metal-assisted cracking (LMAC) with the Galvanizers Association in the UK and with the International Lead Zinc Research Organisation in the USA, which led to several papers that were well received by industry (e.g. James, 2009, Engineering Failure Analysis 16 4 pp.1051-1061 doi:10.1016/j.engfailanal.2008.05.019).

Work with Hoogovens (now Tata Steel Ijmuiden) that commenced in 1997 when it was the Dutch Steel and Aluminium manufacturer, introduced me to friction-stir welding (FSW) when it was in an early stage of development. Hoogovens was interested in the possibilities of FSW to fabricate marine vessels and the work used 6 mm thick panels of 5083-H321 aluminium. This work was performed in collaboration with Professor Danie Hattingh at the Nelson Mandela University in South Africa and led to an ongoing and highly productive partnership in the areas of friction stir processes and other advanced manufacturing techniques. Outcomes include development of a graphical user interface for FSW that can potentially be used to identify optimum FSW conditions (Hattingh, TI van Niekerk, C Blignault, G Kruger and MN

James (2004), *Analysis of the FSW force footprint and its relationship with process parameters to optimise weld performance and tool design*, Invited Paper (INVITED-2004-01), IIW Journal Welding in the World, 48 No. 1-2 pp.50-58). Other interesting results from the FSW collaboration include work on weld tool travel speed (James et al 2003, International Journal of Fatigue, 25 pp.1389-1398 doi:10.1016/S0142-1123(03)00061-6), and on optimising FSW parameters to minimise defects and maximise life (Lombard et al, 2008, Engineering Fracture Mechanics 75 pp.341- 354 doi:10.1016/j.engfracmech.2007.01.026).

Work on residual stresses really started when I met Professor Peter Webster (Salford University) who was trying to get engineers more interested in the possibilities offered by full-field neutron and synchrotron diffraction at the Grenoble site of the Institut Laue-langevin and the European Synchrotron Radiation Facility. This presented very interesting opportunities to better understand residual stresses, their modification during fatigue cycling and their possible influence on plasticity-induced shielding of a crack tip from the applied loads, and my papers have covered topics such as the redistribution of residual stress in FSW under fatigue cycling (James et al, 2004, Fatigue and Fracture of Engineering Materials and Structures, 27 pp.609-622, doi:10.1111/j.1460- 2695.2004.00789.x) and residual stresses near the bimetallic interface for a ferritic reactor pressure vessel (RPV) steel clad with a welded austenitic steel (James et al Nuclear Engineering & Design, 274 pp.56-65. doi.org/10.1016/j.nucengdes.2014.03.042. Interfacial residual stresses in an RPV can promote corrosion at the interface, and the work was collaborative with Professor David Smith at the University of Bristol, as it compared residual stress results obtained with neutron diffraction and those obtained from the deep hole drilling technique.

My enduring interest in plasticity-induced crack tip shielding started to yield useful insights when I obtained an EPSRC grant in 1997 to use full field photoelasticity to determine the magnitude and variation in any wake contact force during fatigue. I knew that fatigue cracks could grow by plasticity mechanisms (crazing) in polycarbonate, which was also birefringent, and I approached Professor Eann Patterson (then at the University of Sheffield) to collaborate on the work, as he was an expert in full-field photoelasticity. This project successfully extracted a wake contact force through several fatigue cycles using a Muskhelishvili complex potential stress analysis and a genetic algorithm (doi:10.1177/0014485105050005). However, the wake contact force appeared to be random, rather than vary in a systematic way and this led me to consider what other influences might be at play in the plasticity-induced shielding phenomenon. The obvious ones were compatibility-induced residual stresses at the elastic-plastic interface along with a distribution of wake contact forces behind the crack tip. Assistance with the mathematical model was therefore sought from an applied mathematician, Dr Colin Christopher at Plymouth, and the Christopher, James-Patterson (CJP) model was born. Initially solved for crack tip stress fields using photoelasticity on polycarbonate CT specimens (doi:10.1007/s10704-008-9209-3), the model was then extended to displacement and strain fields using digital image correlation on aluminium and titanium CT specimens (doi.org/10.1016/j.ijfatigue.2012.04.015. The CJP model initially attracted some controversy, but has been shown to offer a more accurate characterisation of the crack tip elastic field and plastic zone than other standard elastic models. It also provides a wider range correlation of crack growth rates, as a function of stress ratio, than the Paris relationship and is independent of the requirement for a geometry calibration factor in the calculation of its stress intensity factors (doi.org/10.1016/j.ijfatigue.2018.05.027). It can provide some information on the contributions made by the various applied and induced forces on the shielding effect, and has also indicated that overload effects cannot be explained simply by plasticity-induced shielding leading to the possibility (as suggested by other work) that K_{max} and/or ratchetting effects also need to be considered (doi.org/10.1111/ffe.12840).

The International Journal of Fatigue (IJF) was first published in 1979 by Butterworths, with six issues a year, and I published my first IJF paper in 1983 (doi:10.1016/0142- 1123(83)90057-9). In 1997, I met the journal manager at Fatigue 87 in Charlottesville, Virginia and suggested that a South African representative on the Editorial Board would enhance the world-wide coverage. Subsequent to joining the Editorial Board, I organised a Special Issue of IJF to publish selected papers from 4th South African National Conference on Fracture, held in Johannesburg in 1994 (doi:10.1016/0142- 1123(95)90043-8). IJF had now been acquired by Elsevier and Dean Eastbury subsequently approached me in 1998 to enquire whether I was interested in becoming Acting Editor of the journal, taking over from Professor Les Pook, while they sought a new Editor-in-Chief. It has to be acknowledged that this came as surprise to Les, so I visited him in London to explain that this change had not been instigated by me and we remained friends, although a number of years passed before he published any papers in IJF. When Professor Ken Reifsnider became Editor-in-Chief, covering the Americas, I was appointed in January 1999 as Regional Editor for Europe and the rest of the World with Professor Huiji Shi (Tsinghua University) covering some of the Chinese submissions.

When Ken Reifsnider resigned as Editor-in-Chief in 2007, I suggested a reorganisation of Editorial roles from Editor-in-Chief and Regional Editors to two Co-Editors, one covering the Americas and one covering the rest of the World. Professor Dave McDowell became the American Editor and I became the Editor covering the rest of the world from January 2008. Dave and I re-visited the aims and objectives of the journal with input from the Editorial Advisory Board and this revitalised *raison d'etre* led to a steadily increasing number of submissions and associated impact factor in the new age of digital submissions.

The increase in output from Asia, particularly China, necessitated the appointment of a Chinese Co-Editor and, after consultations with the journal manager and the fatigue community Professor Guozheng Kang was appointed to the post in 2017. My contract as Co-Editor ended in December 2020, and after a significant level of consultation, Professor Michael Vormwald was appointed as an Editor to replace me.

I have greatly enjoyed editing IJF papers and interfacing with authors around the world, making a number of friends in the process. I have also been pleased that while I have been an Editor, IJF has moved to 12 issues a year and now publishes numerous Special Issues on specific fatigue topics. It has become the most highly ranked fatigue journal in the World with a rigorous review process and fast publication times. In the knowledge that the future of IJF is in expert hands, I can look back with satisfaction on the time that I was an Editor of this prestigious journal.

Neil James
Plymouth, UK
October 2022

Professor David L. McDowell

Quite naturally, I am both honored and humbled to have the opportunity to thank all those who organized, edited, and participated in contributing to this special issue. We share kindred spirits in this field of fatigue. With that context, I will share some of the elements of own back story.

My principal interests as an undergraduate at the University of Nebraska-Lincoln in the 1970s included mechanical engineering systems analysis, materials science, and mathematics. Having an extended family involved in midwestern farming with only one member of the prior generation having pursued higher education, my father following World War II, the purposes and machinations of graduate school were vague to me. But I was attracted by the prospect of learning how to advance knowledge, not just applying it. As is often the case for aspiring students interested in many things, my entry into graduate school at the University of Illinois at Urbana-Champaign (UIUC) in 1979 served as a serendipitous early fork in defining my career path. At UIUC I was embedded within one of the most active international groups in mechanics of cyclic deformation and fatigue research at the time, led by well-known faculty such as JoDean Morrow, Fred Leckie, and my PhD advisor Darrell Socie. Program alumni were well-respected in the field, particularly within industry. I was exposed to fatigue as a matter of critical industry need, demanding clarity in framing algorithms and methods that would be of practical utility. I also learned that fatigue is a subject that is rich in complexity and opportunities for new understanding, with many aspects well beyond the reach of the correlations and experimental techniques available at that time.

Owing perhaps to my interest in applied mechanics and penchant for theoretical modeling, I was advised by Darrell Socie to explore cyclic nonproportional deformation and fatigue, which was an emerging research area in the late 1970s owing to the emergence of computer-controlled servo-hydraulic multiaxial load frames. Naturally, this demanded that attention be placed on combined stress and strain states, leading to an early interest in more critical examination of how fatigue cracks might form and develop on various planes/orientations. My early works along these lines were pursued jointly with Fash and Socie on biaxial loading of notched components and with Leckie and Hayhurst on stress state sequence effects in low cycle multiaxial fatigue.

Upon joining Georgia Tech as an Assistant Professor in late summer 1983, I became acquainted with Stephen Antolovich, who had also just arrived from the University of Cincinnati as a Professor in materials engineering at Georgia Tech. Steve later became the first Chair of the new School of Materials Science and Engineering. His expertise at the intersection of dislocation mechanisms in fatigue, materials physics, and TEM helped foster my interests in study of dislocations, cyclic irreversibility, and micromechanics of fatigue, scaffolding on my earlier academic foundations of fatigue correlations, multiaxial cyclic plasticity, and mechanics of materials. In 1984 I was appointed as the Associate Director of the Fracture and Fatigue Research Laboratory (later the Mechanical Properties Research Laboratory), which I directed from 1992-2012.

One of my new areas of endeavor in the mid-1980s arose in collaboration with Ashok Saxena who joined the Georgia Tech faculty from Westinghouse Corporation; this spurred my early computational efforts to model transient and steady state crack tip creep fields and various candidate driving force parameters for correlation of creep and creep-fatigue crack growth. It also clarified for me practical limits on exploring crack growth processes using macroscale constitutive laws and related crack tip parameters based on fracture mechanics approaches.

Having worked on nonproportional cyclic plasticity, creep damage accumulation under nonproportional loading, creep-fatigue crack growth, and thermomechanical cyclic deformation and fatigue by the early 1990s, the issue of combined initiation and propagation approaches attracted my focus; specifically, a desire to address more realistic aspects of microstructure-scale cyclic deformation and behavior of small crystallographic fatigue cracks. A sizeable body of experimental work conducted in the 1980s and new insights into cyclic microstructure evolution and impact on slip irreversibility offered considerable insight in this regard. Moreover, it was clear that high-performance computing, micromechanics, and computational materials science would be transformational in facilitating approaches that explicitly consider microstructure. There seemed to be a "disconnect" between simplified macroscopic fatigue crack initiation and growth correlations, of high utility to industry, and the richness of the complex, path-dependent processes evident at the level of slip bands and crack tips in alloys subjected to fatigue and fracture. Full field simulations of fairly realistic microstructures with regard to various material phenomena/responses would emerge within a decade or so.

The decomposition of fatigue life into "initiation" and "propagation" phases required further insights and elaboration in view of its often imprecise and user-dependent definition. Not only a challenge to application of combined initiation-propagation approaches, it served to obfuscate the interpretation of experimental information in the literature. In the mid-1990s I was involved in a consulting role with Sandia National Labs in a program called USCAR, sponsored by a U.S. Department of Energy program, which aimed to develop simulation-supported process-structure-property relations for cast aluminum alloys in automotive applications. My former PhD student Mark Horstemeyer served as Sandia program lead for our team; my role was to guide the technical effort in developing microstructure-sensitive multistage fatigue crack formation and growth relations that would properly reflect the levels of material structure hierarchy. The intent was to provide information of use to foundries that would couple casting processes with resulting structure and projected fatigue response to ultimately reduce weight and achieve cost savings. Concurrently, I had ventured with my PhD student Valerie Bennett into modeling transgranular fatigue cracks in idealized polycrystals using crystal plasticity, and we introduced the concept of computable Fatigue Indicator Parameters (FIPs) to relate to mixed mode crack tip displacement as a focal point for bridging with related fracture mechanics concepts and crack tip damage process zone mechanics in microstructures. Meanwhile, with Ted Nicholas at AFRL and my student Ryan Morrissey, we used microstructure-sensitive computational methods to build understanding of failure mode transitions from fatigue to ductile rupture in a-b TI alloys as a function of mean stress. This was followed up in work on fretting fatigue in the late 1990s and early 2000s in early collaborations with my colleague Rick Neu at Georgia Tech and several joint PhD students.

Even as high performance computing and micromechanics continued to ramp up to enable new kinds of studies in fatigue of materials, the late 1990s witnessed something of a "migration" of fatigue research in the USA from structural materials towards the emergent fields of nanomechanics and biomaterials. By the early 2000s, fatigue research on structural alloys was increasingly perceived by many funding agencies to have reached a "plateau of diminishing return on investment." Indeed, the availability of combined initiation-propagation protocols, codes and standards, and textbooks codifying stress-life, strain-life, notch analysis, and fracture mechanics methods tempted even seasoned researchers to look into new fields to contribute. In part, this was due to the success of fracture mechanics and its practice in industry applications, and in part due to the fact that metal fatigue had been studied experimentally for over a century. But the field of fatigue was becoming ripe with opportunities to reveal new understanding at the intersection of computational mechanics/materials science and advanced experimental techniques.

In many respects, the computing and data science revolutions held promise to usher in a new era of fatigue research, especially when combined with new experimental methods such as electron backscatter diffraction and Orientation Imaging Microscopy that facilitated much more detailed full field characterization of microstructures, as well as synchrotron tomography, including *in situ* techniques. This all came into focus in the first decade of the 21st century and became ubiquitous in the second decade.

My personal research journey took a turn towards systems-based engineering approaches for materials design for multifunctional property targets from 2000-2008, in part due to involvement in early stages of the Integrated Computational Materials Engineering (ICME) initiation in the USA in programs such as the DARPA Accelerated Insertion of Materials (AIM). This motivated a closer look at the rare event fatigue microstructure-sampling problem around 2006, initially addressing behavior of multiphase steels with inclusions in collaboration with QuesTek materials design company and co-founder Greg Olson. This became more important with the advent of ICME and the USA Materials Genome Initiative (MGI) in 2008 and 2011, respectively, since ideas for accelerated materials improvement and new materials discovery came front and center. With support of a U.S. Office of Naval Research/DARPA D3D tools program and the joint Penn State-Georgia Tech Center for Computational Materials Design, initial progress was made towards formulating strategies and digital workflows that compile simulated extreme value distributions of driving forces for fatigue crack formation and early growth in polycrystalline microstructures. Several advanced alloy systems were addressed in this regard, including Ni-base superalloys, a-b Ti alloys, and aluminum alloys. The PhD work of Craig Przybyla in 2010, now at the Air Force Research Laboratory, was an important advance in this regard.

Through successive generations of research effort from 2010 through the present, our approaches to methods for comparing driving forces to form and grow microstructurally small fatigue cracks have been developed with a focus on computational sampling of driving force parameters in sub-grain scale damage process volumes that link to distributions of responses. Gustavo Castelluccio extended this to microstructurally small crack growth during his years in my group at Georgia Tech. In the spirit of ICME, the idea of formalizing digital workflows of such fatigue methodologies to support materials improvement and development has received recent attention in PhD theses of Gary Whelan, who incorporated machine learning methods for uncertainty propagation, and Kris Stopka, who spurred collaboration with the University of Michigan Department of Energy-funded PRISMS Center to develop PRISMS Fatigue, an open-source digital workflow that integrates with a massively parallel open-source crystal plasticity finite element platform. Such open-source platforms have potential to evolve over time with contributions of many other investigators as the field continues to develop.

Naturally there remain many opportunities to address persistent limitations of such mesoscopic microstructure-sensitive approaches to metal fatigue including, among others,

- Coupling with point defects and environmental effects.
- Explicitly considering detailed mechanisms and processes of slip irreversibility related to fatigue crack formation and growth as a function of microstructure.
- Clarifying the role of environment in transgranular and intergranular fatigue processes, and failure mode transitions.
- Comparing candidate computed mesoscale FIPs with results of *in situ* experiments.
- Building material-specific subscale models for crack formation.
- Building multiscale models for computable mesoscale FIPs that related to subscale mechanisms and processes.
- Using machine learning techniques to provide objective evaluation of likelihood of hypotheses and to fuse experimental and computational information in mechanistic fatigue modeling.

It was my privilege to have served as a co-editor of the International Journal of Fatigue (IJF) from 2007-2020, alongside Neil James of Plymouth university and with the later addition of Guozheng Kang from Southwest Jiaotong University. As already mentioned, the field of fatigue evolved substantially during the first two decades of the 21st century, and IJF was able to respond and adapt, generalizing its scope to include computational studies, data science methods, *in situ* experimental studies, and the notion that fatigue includes cyclic degradation of functionality of broad classes of materials.

About a quarter of my graduate students over the years have worked on fatigue of materials. Naturally, I owe them a debt of gratitude for attending to many details of the work. At the risk of exclusion, I mention Kee-Boon Yoon, Jean-Yves Berard, Matt Miller, Valerie Bennett, Ryan Morrissey, Chun-Hyun Goh, Mahesh Shenoy, Rajesh Prasannavenkatesan, Ming Zhang, Craig Przybyla, Gustavo Castelluccio, Bill Musinski, Ben Smith, Matthew Priddy, Conor Hennessey, Noah Paulson, Paul Kern, Adrienne Muth, Gary Whelan, Kris Stopka, and Ted Zirkle. I have been fortunate to have had talented faculty colleagues as fatigue collaborators at Georgia Tech, including Steve Antolovich, Rick Neu and Ting Zhu. Post docs and visiting researchers in this subject have included Jinghong Fan, Fionn Dunne, Jixi Zhang, Florent Bridier, Jagan Padbidri, Myungsoo Kang, and Hisao Matsunaga. My other students have worked primarily on various aspects of multiscale modeling of the inelastic behavior of materials, materials design, and atomistic and coarse-grained atomistic modeling methods. There are, of course, many common elements of these fields.

Over the years I recall several key bits of insight that helped me, not so much in technical terms as in personal habits and style of learning. Early in my career, a wise person posited that it is a good idea to avoid reading seminal papers in a given field until one has read enough to form his/her own views. Then by placing these existing prevalent views alongside one's own logic and understanding, it may be possible to grapple with any differences and gain perspective regarding opportunities for new contributions. The indominable late Keith Miller of Sheffield University also provided valuable encouragement from time to time. Finally, I have benefitted from the perspectives of like-minded researchers such as Fionn Dunne at Imperial College and Somnath Ghosh at The Johns Hopkins University regarding philosophies and strategies for tackling microstructure-sensitive fatigue. Of course, many ongoing researchers continue to inspire in this regard.

It is my sincere desire that the current rapid trajectory of development of *in situ* experimental methods, high performance computing, and materials data science will bear much fruit in advancing the field to new generations of fatigue models and life prediction methods. I am excited by how much the field of fatigue has moved forward just in in the 21st century and the quality of young investigators and new ideas being pursued. As I mentioned in a plenary session at the 12th International Fatigue Congress in France in 2018, emerging research in fatigue of materials has elements of "big science", with an increasing number of papers authored by teams of 10 or more investigators. The interdisciplinary nature of fatigue beckons young researchers and places a premium on sharing of data and codes, along with experimental results, to promote exchange of ideas and approaches. I expect this will continue to transform the subject in the next decade and will find its way into industry practice. Indeed, fatigue has its rightful place as an important 21st century field of research and academic inquiry with a strong and timely connection to industry needs for new and improved fatigue-resistant materials.

David L. McDowell
Atlanta, Georgia
September 2022