



Geographies of science and technology III: Careful entanglements, responsible futures

Progress in Human Geography
2023, Vol. 0(0) 1–11
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DOI: 10.1177/03091325231165965
journals.sagepub.com/home/phg



Martin Mahony 

School of Environmental Sciences, University of East Anglia, Norwich, UK

Abstract

In my previous progress reports I suggested that geographers might attend more to the leaky boundaries of ‘science’ and ‘technology’ and to their imbrications in the mundane spaces of the everyday, and that stances of analytical critique might be joined by practices of engaged imagination of alternative lifeworlds in the shadow of the Anthropocene. In this final report, I zoom in on care as a ‘concept, emotion, practice, politics, moral exhortation’. This has recently provided a focus for much innovative and impactful research in critical geography. I explore the analytical and political potential of centring care within geographical engagements with science and technology, and suggest that nuanced engagements with the concept contain valuable insights into the everyday geographies of technoscience, and into how practices of care are central to – but not exhaustive of – political strategies for building alternative lifeworlds in uncertain times.

Keywords

Science, technology, care, responsibility, health, animal geographies

While interest in care as an (Atkinson et al., 2011: 563) aspect of the social life of science and technology is longstanding (Mahony, 2021, 2022; Martin et al., 2015), the recent surge of interest coincides with a wider embrace of the concept across geography and the wider social sciences and humanities (Hanrahan and Smith, 2020). This embrace is undoubtedly a response to conjoined crises of environmental degradation, to the social and racial injustices magnified by the COVID-19 pandemic, to growing political authoritarianism and state violence, and to transformations of practices of care wrought by new technologies and neoliberal politics. As Hi’ilei Hobart and Tamara Kneese put it, we’re arguably living through a significant ‘political and sociotechnical moment’ which raises profound

questions about ‘who cares, how they do it, and for what reason’ (Hobart and Kneese, 2020: 3). Caution is nonetheless required to ensure that a turn to ‘care’ as an analytical category and normative horizon does not treat it as a conceptual and practical panacea to complex political situations. Care is non-innocent: histories and geographies of violence enacted in the name of care are increasingly well-documented (e.g. Charles, 2020; Seiler, 2020); likewise how care is amenable to commodification and generative of new forms of surveillance and control (Sadowski et al., 2021).

Corresponding author:

Martin Mahony, School of Environmental Sciences, University of East Anglia, Norwich Research Park, Norwich NR4 7TJ, UK.
Email: m.mahony@uea.ac.uk

Hobart and Kneese's 'who', 'how' and 'why' questions are therefore deeply pertinent, and they're questions to which geographers of science and technology are offering important answers.

The lively interest in the manifold relations between science, technology, and the practices and politics of care has grown out of work in feminist geography and STS, which collectively seeks 'not only to critically engage and situate the making of technoscience objects but also to centre questions of social justice, inequality, and violence' (Schurr et al., 2023: 4; see also Liebman et al., 2023). Through the lens of 'intimate technologies', Schurr et al. (2023: 13) argue for a renewed geography of 'the mundane spaces in which technologies and bodies intersect'. Going beyond the intersection of technologies and *human* bodies, and shuttling between typically 'scientific' and extra-scientific spaces, I aim in this report to show how work across various subfields of human geography is adding important empirical and conceptual nuance to our understanding of care, and how mobilisation of the concept is inspiring increasingly collaborative and interventionist modes of research.

I Care displaced

Recent literature dealing with various aspects of human–non-human relations has documented how technoscientific practices, discourses and norms form part of wider 'processes eroding situated traditions of care' (Atkinson et al., 2011: 563). For example, in her study of plant breeding practices, Garret Graddy-Lovelace (2020) examines how new technoscientific techniques of pre-breeding – the phenotypic evaluation and development of crop varieties stored in gene banks – is leading to the displacement and devaluation of more traditional, intimate and emplaced agrarian knowledges and plant caring practices. Graddy-Lovelace points to the ironies of efforts to technologically recreate the field observation practices and careful attentiveness to plant well-being through which agricultural biodiversity has been cultivated by growers operating outside of industrialised agriculture. A technoscientific epistemology of plant breeding and cultivation is joined at the hip, in Graddy-Lovelace's analysis, with a political economy which favours the

accumulation practices of large agribusiness interests. Farmers are positioned as downstream 'users' or consumers of new products, rather than active '(re) generators of genetic diversity' (Graddy-Lovelace, 2020: 239). Reconstituting this landscape of care therefore requires not only recognition and epistemic justice for farmers' breeding practices, but also direct economic and political measures, such as greater support for participatory breeding programmes.

Graddy-Lovelace's analysis offers a picture of dialectical struggle between the humane and the technological in efforts to determine the future of human-plant relations: 'If technologies supplant humans, then conditions of the mutuality of care are undermined; the networks of reciprocity and responsibility that comprise care become tangled and curtailed' (Graddy-Lovelace, 2020: 239). A similar picture emerges from Megan Martha Donald's work on care practices in veterinary medicine. A discursive analysis of the Code of Professional Conduct of the UK's Royal College of Veterinary Surgeons reveals how care in veterinary environments continues to be conceived in anthropocentric fashion, 'focused on a rational scientism that limits affective attunement with non-human animals and distrusts the role of emotion and affect' (Donald, 2019: 470). Donald argues instead for a more-than-human geography of empathy, attuned both to animals' agency in veterinary environments and to vets' own capacities for affective engagement that occurs 'beyond representation, through shared affective capacities and haptic communication' (Donald, 2019: 475). Similarly to the threatened mutualistic landscape of care Graddy-Lovelace identifies in farmer-plant relations, Donald argues that reductive and scientific guidelines on how to care for suffering animals risks undermining the delicate transspecies mutuality of care, empathy and subjectivity that exists in veterinary environments.

Donald's work forms part of a recent growth in interest within geography and STS in the performativity and liveliness of the 'little tools' (Asdal, 2008) – such as 'guidelines and handbooks, cultures of care, and licensing practices' (Davies et al., 2018: 615) – which govern human-human and human–non-human relationships, including in biomedical and bioscientific settings. In exploring the history

and evolution of principles governing animal research in laboratories, Gail Davies and colleagues nonetheless seek to counter assertions that ‘spatial and social divisions of labor simply separate practices of caring from the epistemic practices of science’ (Davies et al., 2018: 610); rather, ethnographic work has shown how practices of science and practices of care are mutually constitutive (Bellacasa, 2017; Friese et al., 2019) and, as such, ‘animal care is a crucial part of producing a scientific fact’ (Nuyts and Friese, 2021: 17). Like Donald (2019), Davies et al. (2018: 608) and the contributors to their special issue of *Science, Technology and Human Values* collectively explore how ‘personal capacities to care are articulated in and through complex encounters – not only with animals and infrastructures but also with an immense range of legal requirements and regulatory guidance’ – elements of scientific practice which have been largely absent from laboratory ethnographies.

II Care in technoscience

Attention to the ethical relations and intersubjectivities of animal research has grown since Haraway’s (2008) emphasis on laboratories as spaces not only where animal bodies are instrumentalized, but also as sites where cross-species empathy, respect and responsibility might be cultivated. Social science interest in these ethical entanglements has grown alongside the increasing professionalisation of laboratory care work, and the growing centrality of ‘administrative knowledge’ around care work in the conduct of bioscience (Valverde, 2003, cited in Davies et al., 2018). One way in which geographers have studied these intersecting changes is through close study of social practices and hierarchies in laboratory settings, as revealed, for example, in patterns of communication between groups of actors.

Geographers and sociologists of science have long shown an interest in talk and speech as means not only of communicating knowledge and constructing scientific authority (Finnegan, 2021), but also, in the form of laboratory ‘shop talk’ (Lynch, 1985), as a crucial element of the social practices by which scientific knowledge is produced. Communication is also a crucial relational element of landscapes and

ecologies of care (Bowlby and McKie, 2019). Nuyts and Friese (2021) use surveys, interviews and social network analysis to understand communicative behaviour within animal research institutions in the UK, with the aim of understanding how social hierarchies and power relations shape ‘cultures of care’ in laboratory settings. They find the persistence of a clear division of labour between researchers and animal technicians, with the consequence that conversations about experimental design and the morality of animal research (beyond codified ethics frameworks) happen between scientists, rather than between scientists and technicians, where conversations tend to focus on practical operational issues. Nuyts and Friese attribute this to a hierarchical division of labour and authority between experimental and care work. But the authors also uncovered another explanation for the lack of communication: some scientists saw technicians as occupying an authoritative moral high ground in relation to animal care ethics, and scientists were thus reluctant to broach uncomfortable topics which could open themselves up to criticism and negative judgement (Nuyts and Friese, 2021). Nuyts and Friese’s work depicts animal research institutions as spaces structured by persistent social hierarchies which are reproduced through uneven patterns of communication. These micro-geographies of talk can be deeply consequential: the authors cite the controversy around animal care standards at Imperial College London in the early 2010s as a motivation for their project, and join others in arguing that more equitable social structures and communicative behaviours could build more humane environments and ‘cultures’ for animal research.

A groundswell of interest in ‘cultures of care’ has taken the notion both as an actors’ category (e.g. in relation to efforts to institutionalise a ‘culture of care’ in healthcare systems), and as a useful analytical category. The papers gathered together by Greenhough et al. (2022) range across animal, social and health geographies, and collectively show how local, institutional cultures of care emerge from particular socio-material contexts, and evolve in relation to broader economic, social and political forces. Such forces are reflected in Davies et al.’s (2018) description of animal laboratories as spaces governed, shaped and

experienced through a multitude of ‘feelings that matter’ – the feelings of animals, the feelings of researchers and of concerned publics, and of those charged with performing care and responsibility for animals’ welfare (such as ‘animal technologists’). Similarly foregrounding the emotional and affective aspects of care work, Annabella Williams (2021) argues that a ‘culture of care’ must attend to human-to-human relationships by better valuing care labour, offering practical and emotional support to animal carers, and enabling better mutual recognition and attentiveness to the respective work of scientists and animal and lab technicians (see also Roe and Greenhough, 2021). As summarised by Schurr et al. (2023: 14) in relation to human biology contexts, ‘the work of those performing tasks of care, cleaning, and organising in the laboratory...must be considered just as technical in nature as the forms of labour and skills commonly associated with (traditionally White male) technicians, engineers and scientists’. Such arguments echo foundational feminist calls for the re-valuation of care and social-reproductive work, calls which originally concerned domestic spaces, gendered divisions of labour, and their transformations by technology (Cowan, 1983) – questions also very much at the forefront of recent work on the geographies of technoscience.

III Care with technoscience

Recent work in health geography has documented landscapes of care which are rapidly shifting under the ongoing politics of neoliberalism (Jupp, 2022), colonialism (Hirsch, 2020), and militarism (McCormack, 2022), as well as the structural violences and upheavals of the COVID-19 pandemic (Bowly and Jupp, 2021; Neely and Lopez, 2022). In particular, a growing body of work is examining the ‘ambivalent effects of digital technologies’ (Schwiter and Steiner, 2020: 1) on geographies of care at scales from the body (Schurr et al., 2023) and the household (Jackman and Brickell, 2022) to transnational spaces of migration and mobility (Acedera and Yeoh, 2021), mapping a spatial politics which troubles assumed

notions of distance and proximity in relations of care (Hanrahan and Smith, 2020)

For example, Louise Reid’s work on ‘technology-enabled care’ (TEC) has focused on how both practices of care and notions of home are being transformed by new and emerging healthcare technologies. Reid (2021) explores how the home is increasingly being governed as a riskscape, whether through ‘smart’ technologies of constant monitoring which aim to anticipate and minimise health risks, or through the apparent riskiness of healthcare technologies themselves. The latter category includes technologies that are formally commissioned as part of TEC packages (such as personal alarms or wearable vital signs monitors), and consumer devices (such as closed-circuit television or smart speakers) that are re-purposed for TEC purposes, perhaps by concerned family members or by residents themselves. TEC devices can help manage health risks to the benefit of both care-givers and receivers, but can also create new risks (concerning errors, data privacy or ingrained biases, for example) as well as exacerbating digital inequalities. As such, the governance of TEC is a complex future-oriented exercise, wherein anticipated needs are bound-up with performative assumptions and expectations about technological change, sociocultural differences in ways of relating to technology, and about the ontology of ‘home’ itself. Reid (2022) further shows how the riskscape of home is increasingly being constructed as amenable to prediction, with health-care in the home becoming a further site of algorithmic governance (Del Casino et al., 2020; Maalsen, 2023).

Reid’s work shows how technologies of care further reveal the home to be a relational space, neither wholly public nor private, and shared by residents, kin, carers, and a variety of more-than-human actors. It contributes to a growing geographical and sociological literature on ‘smart’ homes, and the assemblages of power, desire and practice which determine how technological interventions in the home are reshaping domestic life in domains of both care work and, increasingly, sustainability concerns (Hargreaves et al., 2018; Leszczynski, 2020; Reid and Ellsworth-Krebs, 2019; Woods and Kong, 2020). Collectively this work is

showing the home to be a site not only of profound sociotechnical change, but as being part of a broader infrastructure of scientific and technical knowledge production.

Historians and historical geographers have long emphasised the significance of domestic spaces in the governing practices and imaginaries of experimental and observational science (Withers and Mayhew, 2020). Shapin (1988) demonstrates the significance of gentlemanly houses to the development of a credible experimentalism in 17th century Britain, while Schaffer (1998) shows the continuing significance of domestic space, particularly of a rural, pastoral variety, to the authority of science in the 19th century. But while it may be largely true in the experimental sciences that the ‘disjunction between places of residence and places where scientific knowledge is made is now almost absolute’ (Shapin, 1988: 404), historical geographers have helped complicate that dichotomy. For example, Morris and Endfield (2016) investigate the spatialities of ‘homemade’ meteorology, arguing that domestic, ‘amateur’ meteorology is an important window into the manifold and emplaced cultural meanings of weather and climate, and that weather knowledges and notions of home are co-produced. Simon Naylor has examined that co-production through the case of Britain’s Meteorological Society and its efforts to overcome the idiosyncrasies of geography and technological diversity in 19th century thermometry, showing that the agreed design of the Stevenson Screen did not override geographical diversity but rather embodied ‘a particular geography: the aesthetic and moral codes of the suburban domestic garden’ (Naylor, 2019: 203)

These examples contribute to a wider recognition of the long history and diverse geographies of domestic science (Gibson, 2020; Johnson, 2020; Opitz, 2022), and of ‘lay’, ‘amateur’ and ‘citizen’ contributions to scientific knowledge production (Coen, 2019). Geographers have contributed to the analysis of ‘citizen science’ ventures, exploring the practical and ideational motivations of both citizen-participants and project instigators (Skarlatidou and Haklay, 2020; Van Noordwijk et al., 2021). While ‘smart’ health or energy technologies generate flows of data from the home to distant centres of calculation and

capitalisation, citizen science projects represent a rather more voluntary enrolment of the home into distributed infrastructures of knowledge production. But both smart tech and citizen science (such as distributed computing or data collection and tabulation) bring the practices, discourses and material artefacts of technoscience into domestic spaces, often with similar governmental motivations. For example, citizen science projects are often motivated not just by epistemic aims of furthering science, but by ambitions to cultivate awareness and behaviour change around issues like environmental change and disaster risk (Hicks et al., 2019; Van Noordwijk et al., 2021), similarly to how smart energy technologies, for example, are hoped to encourage behaviour change in energy consumption.

Citizen science initiatives can be critiqued for being extractive, and perhaps for harnessing participants’ care for the object of study while limiting their capacities to shape project designs and research questions (Lorimer et al., 2019; Moore and Strasser, 2022; Pallett, 2018). Potentially more radical forms of epistemic democratisation can be observed in parts of the ‘DIY-biology’ and ‘biohacking’ communities, and work on the geographies of science has been influential in how these phenomena have been studied (Meyer, 2013; Santos, 2021). Meyer characterises the movement as ‘an increasing number of enthusiasts who, in rudimentary laboratories created in garages, kitchens, or basements’, or in communal settings such as hackerspaces and community labs, ‘experiment with molecular or synthetic biology’ (Meyer, 2013: 118). In so doing, such communities reconfigure boundaries ‘between amateurs and experts, scientists and citizens, universities and homes’ (ibid), often informed by principles shared with open-source, hacker and maker communities concerning openness, decentralisation and flat hierarchies (Meyer, 2021). Meyer foregrounds the material geographies of DIY biology, locating it within the historical geographies of urban and suburban science (cf. Vitale, 2017) and following the transmutation of discarded ‘professional’ laboratory equipment and consumer goods into new forms of experimental apparatus, while tracking the communicative devices by which an increasingly international ‘epistemic collective’

seeks to create ‘a new, collective and open economy’ of science (Meyer, 2013: 117).

Biohacker communities have over the past decade engaged in heterogeneous projects and innovations which intersect with practices of care for human and ecosystem health. Geiger counters, ultrasound probes, malaria detectors, biosensors for toxic substances and open insulin production protocols have become new actors in varied landscapes of care (Meyer, 2021; Santos, 2021).

However, such innovations have not always been matched by open consideration of the new vulnerabilities they can create, or the political worlds and forms of citizenship that they might summon into being (Delgado and Callén, 2017). The work of Jennifer Gabrys and colleagues on ‘citizen sensing’ is instructive here (e.g. Pritchard et al., 2018): the deployment of air pollution monitoring kits for the use of residents in fracking regions in US, for example, can be read as enabling participants to express care about environments and community health. But they are also, Gabrys (2017: 172) argues, crucial speculative and political means of making relevant ‘unrecognised and overlooked considerations of the need for care’ by more powerful actors. Here, the aim is not simply to inculcate care among citizens, nor to democratise the production of epistemic things; rather, new modes of sensing environments can aid political struggles to make known the absence of, and need for, radically new forms of care for peoples and environments (Gabrys, 2022). Care emerges here as both a means and an end of political struggle.

IV From careless technoscience to responsible futures?

As in other geographical engagements around care (e.g. Kallio, 2020), important conversations have developed about how the engagements of critical geographers and social scientists with the practices, discourses and lifeworlds of science and technology can move beyond a stance of critique ‘and explore how to enact more responsible practices’ within science and technology (Davies et al., 2018: 615). Moves in this direction in the animal geographies literature are mirrored in debates about, for example,

theoretical reflexivity and responsibility in critical physical geography (Tadaki, 2017), and about reflexive practices and responsible innovation in modes of public engagement with technoscience (Chilvers and Kearnes, 2020). While many such moves have been informed as much by work on ‘responsible research and innovation’ (RRI) frameworks (Stilgoe et al., 2013) as by feminist theorisations of care and relational responsibilities, ontological and ethical commonalities exist, and have motivated critical geographers and STS scholars to seek new relationships of mutuality and reciprocity with research participants and informants.

Earlier notions of ‘responsibility’ sought to counter carelessness in technoscientific innovation by relying on a retrospective, consequentialist gesture of ‘taking responsibility’ for unforeseen side-effects of the products of innovation processes. More recent reformulations of responsibility have added *process* and *purpose* to *product* in the list of sites where new responsibilities need to be enacted, as a means of ‘taking care of the future through collective stewardship of science and innovation in the present’ (Stilgoe et al., 2013: 1570). Such formulations have been co-produced by STS scholars – including many geographers – and the givers and receivers of funding for technoscience. Nonetheless, issues abound around how RRI has become ritualised as a means of performing responsibility while arguably avoiding deeper consideration of structural inequalities, reflection on the framings of the problems innovations are presumed to solve, or about genuinely practicing care with and for communities and environments (Frahm et al., 2022).

Efforts to push notions of ‘responsibility’ further than their institutionalised manifestations form part of a broader interventionist and collaborative turn in STS (Farias, 2016), whereby guiding conceptual frameworks such as actor-network theory are being explicitly re-oriented from a stance of agnosticism to one of care (López-Gómez, 2020), and lab ethnographies, for example, have moved from passive observation to the active fostering of reflexivity and ethical and social consideration in laboratory sciences (Lippert and Mewes, 2021). As Davies et al. (2018) note, the ‘feelings that matter’ within spaces and cultures of care increasingly include the feelings

of wider publics, and geographers of technoscience have positioned themselves not just as spokespeople for diverse publics and value systems, but as politically-engaged ‘mapmakers’ of the manifold ways in which publics are engaging with technoscientific issues and controversies (Pallett et al., 2019).

Nonetheless, ‘interventionist’ approaches – whether the sites of intervention are the laboratory or public technoscientific controversies – can be deeply challenging. Martin (2016) recounts his efforts to intervene in highly charged public debates over vaccines in Australia, and reports that STS literature provided little guidance for his practical navigation of the situation. Liboiron (2016), drawing from their work as an activist as much as an STS scholar, argues that effective networks of care and solidarity among researchers are a vital precondition to conducting interventionist work that can result in deeply challenging and unsettling experiences for the researcher. Here, interventionist and activist geographers of technoscience might draw inspiration from work on ‘radical care’ as a sustaining practice and strategy within social movements (Hobart and Kneese, 2020); care as a means to more radical ends.

This kind of inter-human care, what Tronto (2013, cited in Corwin and Gidwani, 2021: 13) calls *nurturant* caring, is in turn dependent on *non-nurturant* caring: ‘that is, caring directed at the physical world’. That ‘physical world’ can mean biophysical environments, and it can mean technology itself. An emerging geography of technology-in-use has joined work on infrastructural geographies (e.g. Ramakrishnan et al., 2021) in emphasising the life of technological artefacts beyond or alongside circuits of capital and commodification, through the study of practices of care, maintenance and repair (e.g. DeLyser and Greenstein, 2017).

Corwin and Gidwani (2021), for example, direct our attention to sites like a printer repair shop in New Delhi, where highly skilled labour and expert knowledge is deployed to diagnose and fix malfunctioning printers and to give new life to disposable ink cartridges, much to the chagrin of manufacturers who depend on technological obsolescence (see also Taffel, 2022). This kind of care-full

repair work is instructive not only for understanding the economic geographies of everyday technologies, but also offers profound normative lessons for life on a troubled planet. ‘[G]rounded in collaboration and creative labour practices’, this work ‘demonstrates the inseparability of ourselves and our work from the world at hand’. It points to the ‘webs of interdependence that sustain life’, in all their complexity and impermanence, and to the ‘importance of care-full work with others: human and non-human, material and systemic’, to ensure their continued functioning and flourishing (Corwin and Gidwani, 2021: 12–14; see also Parsons, 2023). As such, Corwin and Gidwani suggest that work on the geographies of care, maintenance and repair in and around technoscience has much to contribute to a speculative ethics of what it means to live ‘as well as possible in’, or perhaps beyond, the ‘Capitalocene’ (Bellacasa, 2017; Moore, 2022).

V Conclusion

The increasing attention to care in the geographies of science and technology is a timely development. In a moment of widespread crises of care, studying the situated and multiscalar intersections and entanglements of technoscience, human and non-human bodies, and practices and discourses of care can provide important answers to the questions of ‘who cares, how they do it, and for what reason’ (Hobart and Kneese, 2020: 3) – and, we might add, ‘with what effects’. Answers to such questions promise not just better descriptions of the social life of science and technology and of the complexities, contradictions and co-optations of care. They also promise vital contributions to the praxis of radical care, conceived not so much as a goal of political struggle but as a ‘collective capacity’ to build alternative lifeworlds beyond capitalism and colonialism; a ‘roadmap to an otherwise’ (Hobart and Kneese, 2020: 8–13). By directing the ‘who cares?’, ‘how?’ and ‘why?’ questions not only at our research subjects but also reflexively at ourselves and our networks, institutions and modes of research, we might identify on that roadmap new ways of collaboratively working towards new lifeworlds with, against, and through technoscience.

Acknowledgements

I'm greatly indebted to Helen Pallett, Andra Sonia Petrutiu and Noel Castree for their suggestions and provocations as this essay came together.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Martin Mahony  <https://orcid.org/0000-0002-6377-413X>

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Author biography

Martin Mahony is a Lecturer in Human Geography and member of the Science, Society and Sustainability (3S) Research Group at the University of East Anglia, UK.