

Beyond withdrawal, rethinking innovation in society: introductory considerations

Frédéric Goulet and Dominique Vinck

In May 2018, the French daily newspaper *Le Monde* reported that the European Commission had unveiled a plan to ban non-reusable plastic objects. Another article in the same issue mentioned the good results of the fight against tobacco in France and the success of e-cigarettes as a substitute, despite the reluctance of public authorities to consider it as harmless due to the lack of available expertise. A guide to avoiding supermarkets appeared in the book review section that accused supermarkets of jeopardising farmers' survival by appropriating the added value of the agrifood sector. Yet another article referred to a possible law banning mobile phones in schools to minimise the hypothesised negative effects of phones on socialisation and on the attention span of pupils in class. The Economy and Business section mentioned the new Agriculture and Food Law and the fact that it fails to include a ban on glyphosate-based herbicides, despite the fact that a ban was called for by a broad coalition of stakeholders and even announced by the French President of the Republic "as soon as alternatives are ready." Likewise, this law does not include the measure aimed at making meat-free vegetarian menus compulsory in school canteens, although this was also called for by several political groups and associations.

These examples, all published in the same issue of the French leading national daily newspaper, underline the omnipresence of a set of phenomena that intersect different spheres of social life: public health, the environment, food, consumption, education, law, industry, science and technology, transport, and probably many others. Behind this set of phenomena is a principle: a call to do *without*, or to do *with less*, substances or entities incriminated for their negative effects on living organisms, socio-economic balances or natural environments. These assumed or proven effects are the starting point for quests aimed at reorganising our way of life and methods of production. These attempts to do without, or with less, reflect a desire to do better in the face of major societal challenges including mitigating climate change, the fight against the erosion of biodiversity, the fight against inequality, improving the health of populations and many others. Beyond these global challenges, the trend to do *without* or *with less*, to get rid of certain problematic presences,

can also be observed at the level of individuals and their lifestyles. The trend applies to available methods and attempts to break free from certain addictions, for example psychoactive substances [Gomart, 2002]. Regarding digital technologies, individual and collective actions are also underway for digital disengagement, temporary and permanent disconnection, and the right to opt out and to withdraw one's own data. It is a question of digital sobriety, of a sustainable and responsible electronics industry, denumerisation, dismantling, and the responsible use of digital devices.

These processes are political in the sense that they involve prohibiting or restricting the existence of certain entities for the good of others or for the common good, but they are also technological, since alternatives are required that make it possible to minimise the negative effects of existing products, practices or production systems. The processes are also economic and commercial in the case that commercial chains have to be reconstructed to bypass undesirable entities or intermediaries. But they are also cultural, and even anthropological, as they question the ways in which humans are used to solve problems. In a behavioural science study, Adams and others (2021) showed that to improve an existing situation, individuals systematically consider an additive, not a subtractive, solution. Removing or withdrawing something seems radically opposed to the way we approach problems and possible solutions.

Be that as it may, doing without, or doing with less, seem to have become new and unavoidable horizons for innovation, to which this book is devoted. Composed of a series of theoretical reflections based on case studies, the book takes stock of the mechanisms involved in these innovative processes. However, the structuring characteristic of these innovations is not the introduction of a novelty, but the withdrawal of existing entities; and almost ironically, it is this withdrawal that is the basis of the added value promised by these innovations. The book consequently invites us to examine how the horizons of the without or the less transform the socio-technical dynamics of innovation and constitute specific drivers of change for actors; how they have become, to borrow the expression used by Nicolas Dodier, "goods in themselves" [Dodier, 2003] and are no longer simply collateral damage, destruction caused by the creations inherent in innovation [Schumpeter, 1942]. Since these dynamics constitute the starting point of innovation processes, in what way do they lead us to rethink, or more modestly to refine, the analytical frameworks offered by the social sciences for reflecting on innovation?

This book is therefore a contribution to social science research on innovation and its mechanisms. The choice of contributions and authors gathered here means the focus is on science and technology studies (STS), but also, through the position it adopts, partly inherited from classic works linked to actor-network theory (ANT) and to what this theory inspired [Akrich et al., 2006].

In particular, it is a question of paying attention to all the entities involved in these processes, without prejudging their nature, whether they are humans who promote the without and the less, frame it, or experience it, or other biological or technological entities at work, whether doomed or emerging.

This introduction to the book has a double ambition. The first is to position the reflection in the sociological literature, and more broadly in STS, on innovation. The exercise, which is not exhaustive, helps position the book's contribution by identifying avenues of analysis that have been little explored until now. The second ambition is to introduce the different contributions and the empirical studies on which they are based. The main results of these contributions are reviewed in the conclusion.

INNOVATIONS THROUGH WITHDRAWAL: THE DETACHMENT IS ON THE FRONT LINE

Given that much has been said and written about innovation and the ways in which it can be analysed, it is difficult to claim one is contributing something new to the subject. However, the literature is constantly changing. In recent years, for example, the late Benoît Godin and Dominique Vinck revisited the pro-innovation bias in the literature in various disciplines [Godin & Vinck, 2017], and even more recently, with Gérald Gaglio, they looked at alternative theories of innovation [Gaglio et al., 2021]. As Godin [2015] remarkably showed, the very notion of innovation is old, but its meaning and the value attached to it have changed considerably over time. Once seen as a threat to society, it is now presented as the solution to all evils. Despite these historical reversals, one constant emerges: innovation is thought to involve the introduction of something new, and hence the disappearance of whatever was previously in place. Yet we live in a period in which the withdrawal of existing entities and configurations has taken on considerable importance in the dynamics of world transformation. The mechanisms at work, while perhaps not completely new, remain to be explored and qualified.

The starting point of our reflection more than ten years ago, concerned the dynamics of the development of no-till agriculture in France [Goulet, 2008]. The case studied could have been analysed as the introduction of a new technology in French agriculture, namely the diffusion of direct seeding, a technology that allows crop seeds to be planted without prior tillage. Our attention was nevertheless drawn to the fact that the actors devoted at least as much energy to getting rid of ploughing as to introducing direct seeding. Getting rid of ploughing appeared to be more about structuring the dynamics of change than the introduction of a new technology, which seemed to be only a secondary effect, or at best one option among the available resources that would enable the end of ploughing. This opened up an original perspective:

it was no longer a question of examining how actors adopted a new practice or a new technology, or how it spread [Rogers, 1962], but rather how they ‘de-adopted’ an existing practice to which they were attached sometimes by strong ties. We consequently approached the case from the perspective of the sociology of translation, returning to the symmetrical examination of associations and dissociations, attachments and detachments [Goulet & Vinck, 2012]. The argument was thus that, while the ANT framework did consider the importance of both attachments and detachments [Callon, 1999], of associations and dissociations, detachments and dissociations related to the establishment of new attachments and associations remained largely understudied. The case of innovation by withdrawal, which has as its starting point the detachment from existing entities, offered a particularly favourable framework for qualifying these processes of dissociation and detachment and the mechanisms they involve. In the case of the abandonment of ploughing, we highlighted four mechanisms that contributed to farmers’ detachment from ploughing: (1) centrifugal association, i.e. the problematisation of the entity or practice to be withdrawn in order to make it a point of passage to be avoided, symmetrical to Michel Callon’s famous obligatory point of passage [1984]; (2) the making visible of entities and associations that, although they had previously been present, were not brought to the attention of the actors – even though they helped fulfil functions that had previously been fulfilled by the withdrawn entity, making the ‘doing without’ possible and credible; (3) making other entities and associations invisible, which, in the case of the introduction or increased use of controversial substances – making it possible to at least partially replace the withdrawn practice – can undermine the attachment to the new practices and entities; and (4) the association of new entities of all kinds that allow the establishment of new sociotechnical collectives [Barbier & Trépos, 2007], ensuring the functionalities of the new set obtained once withdrawal has been accomplished.

These four steps provided a generality that is relative. In particular, the fact certain entities and associations remain invisible is not necessarily true in all removal processes. For example, the work carried out on making sports equipment lighter to improve its portability reveals the importance of removing certain components from existing equipment, without there being any need to make sure the new associations remain invisible [Soulé et al., 2017]. The case of no-till was – and still is – characterised by its dangerous links with glyphosate, a controversial herbicide, and, behind this invisibility, the communication strategies used by agrochemical firms and by the agricultural profession as a whole, who were anxious to improve their environmental image. The conceptualisation produced around innovation by withdrawal from no-till owed much to a consideration of the political and professional context of the French agricultural sector, and was in itself a contribution to rural sociology. In this

sense, the 2012 article published in the *Revue française de sociologie* proposed a model that owed much to its empirical anchoring and, in this respect, offered a much more modest contribution than the one it took as a model, namely the article published in *L'Année sociologique* in 1986 by Michel Callon on the domestication of scallops and fishermen in the Bay of Saint-Brieuc. Nevertheless, readers of our article found it provided a framework to think about other innovation dynamics underway at the time. The phenomenon thus appeared to be more widespread than we had thought.

While the four mechanisms identified above are not necessarily present in all cases of withdrawal-based innovation, they provide a framework for thinking about detachment. In so doing, they clearly suggest that innovation based on withdrawal and detachment also involves the creation of new attachments and associations. This duality between attachments and detachments had already been identified by ANT, and emphasised that innovations, which at that time were thought of as involving the introduction of novelties, did indeed include detachment processes; but these had previously been little documented, remaining in the shadow of attachments.

In the spirit of defending the symmetry of the attention to be paid to attachments and detachments in ANT, we shifted our reflection to the analysis of market activities. After science and technology, in the 1990s, markets and market work became one of the new playing fields of ANT, leading to the proposal of a sociology of market “agencements” [Callon et al., 2013]. Based on an earlier article by [Callon et al., 2000] on the economics of qualities, we therefore put our thinking on detachment to the test in agricultural input markets [Le Velly & Goulet, 2015]. By choosing a borderline case, that of the sale of fertilisers with uncertain properties to farmers, we revealed the importance of the activities that fertiliser sellers gave to detaching farmers from traditional fertilisers and from input sellers, in order to better attach them to the goods and advice they themselves provided. This highlighting of detachments in commodity work was subsequently re-emphasised in the context of food markets [Le Velly et al., 2021], and more broadly that of different commodity sectors [Bembreck et al., 2021].

Three phenomena emerged from these investigations into agricultural technologies and markets that called for an in-depth investigation of the processes of attachment and detachment in innovation: (1) the mechanisms of detachment and withdrawal *per se*; (2) the mechanisms involved in re-attachment to new entities and making withdrawal feasible and viable; and finally (3) the forms of arrangements and accommodations that can exist between attachments and detachments, between associations and dissociations. The analysis of the cases dealt with in the first studies made it possible to provide some initial, albeit partial, answers. Since then, various phenomena have already been identified [Goulet & Vinck, 2016], and several authors have examined similar phenom-

ena, thereby allowing us to progress in our analysis. This progress is what prompted us to undertake this collective work with the aim of shedding more light on the three phenomena – detachments, attachments, agencies between attachments and detachments – and more broadly, to articulate the analytical frameworks of ANT with other conceptual and theoretical resources.

THINKING ABOUT INNOVATION THROUGH THE LESS AND THE WITHOUT: CONCEPTUAL RESOURCES

Although since the work of Schumpeter [1942], classical studies have evoked the idea of innovation as creative destruction, as mentioned above, these studies mainly concerned the introduction of something new, its adoption and its diffusion. They analysed destruction, which was assumed to be the other side of the coin [Goulet & Vinck, 2017], and what Schumpeter referred to, namely the elimination of existing products and their replacement by new ones, the modification of production processes, the destruction of existing industrial structures and practices, or the weakening of their positions. In this proposal, which considers innovation as a two-sided phenomenon – the introduction of something new and the simultaneous destruction of something that already exists – destruction is thought of only as a consequence or as a collateral effect [Gaglio & Vinck, 2021], and not as a constitutive process of change *per se*. As a result, we know little about this aspect of innovation. Although the Oslo Manual [OECD, 2005] is based on Schumpeter's ideas, innovation is only presented as the introduction of something new, involving new knowledge and competitive advantage, while the destructive process is not documented. This is the hidden side, rarely thought of as constitutive of the innovation process. Subsequently, with the notion of responsible innovation [Stilgoe et al., 2013], the theme of destruction and the negative impacts of innovation is certainly making a comeback, but is limited to the concern of avoiding these negative consequences by better steering technological development in an acceptable direction.

The literature on technological transitions [Geels, 2002] takes into account the processes of reconfiguration, including downsizing and withdrawal, as components of global and systemic dynamics associating cultural, political, technological and institutional dimensions. The multilevel perspective [Geels, 2002] approaches transition from the point of view of the destabilisation of a dominant regime [Freeman & Perez, 1988], for example under the effect of niches protecting emerging novelties [Kemp et al., 2001], radical transformations at the level of the landscape, or internal movements within the regime itself. Different types of pathways that enable these transformations are thus envisaged [Geels & Schot, 2007], embodying more or less brutal ruptures,

ranging from pure and simple technological substitution to a more incremental model of transformation of existing technologies or industrial sectors. The transition may also be the product of technological obsolescence and associated skills, increased vulnerability of the knowledge base or business models, societal pressure against certain problematic technologies, or the emergence and rise of alternative technologies that make it possible to relegate certain dominant technologies to decline. There are many different scenarios, motives and trajectories, but this particular framework for analysing transitions and for multilevel analysis is important for thinking about the less and the without, in the sense that it is based on the very idea that certain actancial configurations and certain dominant technologies can be made to disappear. The idea itself is not new, and in the field of technology, obviously refers to life cycle approaches [Taylor & Taylor, 2012]. However, it invites us, as we hope to achieve in this book, to better identify, in one and the same movement, what does or does not lead to the withdrawal of certain technologies, to consider the role played by the emergence of alternatives, and to examine the possible relationships and dealings between what declines and what emerges. These three elements are no more and no less than an extension of what we mentioned earlier in the grammar of ANT, namely the three fronts of understanding detachments, attachments, and arrangements between detachments and attachments. The clear and definitive withdrawal, as well as the absolute disruption, are ultimately only very uncertain configurations, not to say rare. It is therefore necessary to identify how alternatives can find a place within existing configurations, which are certainly put to the test, but are rarely suddenly shaken [Goulet & Hubert, 2020]. Figures such as those of coexistence [Shove, 2012], recuperation and capture [Pel, 2016], diversification of technologies [Ho & Chen, 2018], or accumulative creation [Bergek et al., 2013], are all the more important when we consider the time scale. Indeed, many obstacles slow down or even prevent the emergence of alternatives [Bakker et al., 2012; Rogers, 2000], or the decline of the existing [David, 1985; Liebowitz & Margolis, 1995].

However, let us now return to the mechanisms of withdrawal and detachment, which are at the heart of our reflection on the less and the without. Since withdrawal is a constituent force behind various innovative dynamics, the challenge is to establish it as an object of attention in its own right, so as to document and better conceptualise the mechanisms at work, in particular delegitimation, disqualification, devaluation, dissociation or emancipation [Boltanski, 2009]. The expansion of these withdrawal phenomena in different fields and their treatment by different authors offer an interesting range of situations from which it is possible to collectively advance conceptualisation. Doing without or with less is not a simple return to the past – without preventing forms of resurrection of older technologies [Shove, 2012] – but the inven-

tion of new things and the construction of new arrangements – ‘without X’, ‘zero Y’, ‘slow Z’ – of which it seems we are only at the onset. Social movements or policies are at work, producing new discourses that value withdrawal, which was once seen as a failure. From a theoretical point of view, research, which was mainly concerned with understanding the mechanisms at work in order to support innovation policies and strategies by overcoming resistance to the introduction of novelties, is now confronted with the need to consider withdrawal as an innovation process in its own right. Some works can be exploited in this sense, insofar as they have looked at similar phenomena. Thus, in line with works on frugal innovation, grassroot innovation, Jugaad innovation [Gaglio, 2017], innovation for the BOP (bottom of the pyramid) [Cholez et al., 2012], innovation is considered around the idea of doing with little, with less or without certain resources. In a completely different field, other works have advanced and documented the notion of deinstitutionalisation [Maguire & Hardy, 2009], to identify how a technology that is *a priori* indispensable can be ousted under the effect of various types of problematisation. In recent years, the field of transition studies has also contributed to qualifying the processes of destabilisation (Turnheim & Geels, 2012), exit, phase out [Rinscheid et al., 2021] and decline of certain technologies [Koretsky & van Lente, 2020; Koretsky et al., 2022], and to exploring questions of governance of discontinuity in large sociotechnical systems [Stegmaier et al., 2014]. These works address phenomena that converge with those studied in this book, doing without or with less, even if they sometimes focus on quite different scales. As with the notion of innovation by withdrawal, they propose new notions to account for the specificity of the innovations, for example out-innovation [Levain et al., 2015], or ex-innovation [David, 2017].

In the light of these approaches and proposals, it is clear that a new collective research programme can be envisaged in the field of innovation studies [Fagerberg & Verspagen, 2009]. The present book may only be a modest contribution to this edifice, but at least it brings together different authors looking at a variety of empirical situations and making use of a variety of analytical frameworks.

DOING WITHOUT, DOING WITH LESS: A SET OF EMPIRICAL CASES OF INNOVATION

Withdrawal, stopping, ban, suppression, reduction, eviction, abandonment, abolition, alleviation, disinvestment, erasure: these are some of the terms used by the authors of this volume to refer to the movements that lead to the without or to the less. The chapters in this volume obviously go beyond compiling a collection of synonyms to describe the phenomena at work. They bring together works resulting from the use of different analytical and conceptual

frameworks, present contrasting views on the processes at work, and bring together empirical case studies from different fields. This diversity underlines the relevance of the issue at stake, i.e. understanding the mechanisms of innovation associated with the less and the without. Indeed, a wide range of sectors and fields is scrutinised under the microscope of sociologists or historians. They propose different analyses with a generic purpose.

The scales used in the different fields are also diverse, ranging from the individual to large sociotechnical groups, and invite us to consider the extent of the factors that need to be taken into account in the social world to understand these phenomena. Of these chapters, several deal at least partially with objects related to agriculture, livestock breeding or food, demonstrating that these are areas where, *par excellence*, the 'no' flows freely. These areas include plant and animal health, with injunctions to reduce the use of pesticides and antibiotics; the organisation of short food value chains; meat-free or gluten-free food; bulk marketing with no packaging; and the management of farmers' data. Other areas covered include religion, energy, plastics, computing and advertising, the chemical industry and its products, health through vaccines and medicines, and data management infrastructures.

The book is organised in five parts. The first part is devoted to analysis frameworks to approach the dynamics of without or with less innovation. While this introduction has already helped shed light on this field of analysis, two contributions take a critical look at the historical and conceptual aspects, and above all, present opposing views on a number of ideas. The first, written by Benoît Godin, is resolutely in line with the rich work he has devoted to the history of the notion of innovation. He takes us to the unexpected terrain of the Reformation in sixteenth-century religious England, to question the value given to innovation and withdrawal. Today, innovation has positive connotations; it has become a fixture on economic and political agendas. Consequently, at first sight, withdrawal is counter to the imaginary of progress. By transporting us back a few centuries and taking us on an inspired journey through the sometimes dry texts of religious history, Benoît Godin shows that things were quite different at that time. In a contemporary register, Pierre-Benoît Joly, Bruno Turnheim and Marc Barbier take us to the conceptual terrain mentioned in the previous section, that of transitions and modes of governance of major sociotechnical systems. These authors ask themselves, and the reader, about the possibility of organising the termination of large sociotechnical systems. To this end, they use examples drawn from agriculture and its dependence on pesticides, or energy and its dependence on carbon sources. More precisely, they invite us to consider a change of scale: is the withdrawal of a given technology a necessary and sufficient starting point for wider disruption at the scale of a whole sociotechnical system? This question is important, and the answers even more so, because they shed new light on previous thinking about

innovation through withdrawal. Finally, Zahar Koretsky addresses the issue of technological decline, which can be seen as a variant of withdrawal, or at least as a key mechanism in the process towards less or without. He uses technological decline as an umbrella term for complex processes of scaling down the use of a given technology over time and space towards a niche and/or to achieve complete abandonment. He reviews the literature on the main currents in STS, transition studies and innovation studies to analyse how they approach the subject of decline. The literature he reviewed helps characterise the phenomenon as something decreasing in size, being scaled down, in a slowdown, senescence, exnovation, withdrawal, discontinuation, destabilisation and, indeed, decline. He shows that in previous studies, technological decline has often been implicitly trivialised by sheer omission, preference being given to emergence. Destabilisation and decline are therefore under-conceptualised.

The second part of the book explores the mechanisms involved in the detachment of certain entities. We refer to the idea of release, or more precisely to the action taken by actors to release, or to free themselves from, substances or problems with which they are associated. When we talk about withdrawals and detachments, the notion is self-evident in English. For example, products ‘without’ are ‘free of’: pesticide-free for organic food, paraben-free for certain cosmetics, etc. This section helps explain the reasons for this liberation, or the debates it raises. It explores several facets of the mechanisms involved and the different types of actors. The chapter by Grégori Akermann and Paul Cœuquertin analyses the practice of avoiding food components such as gluten in diets. In particular, they focus on the resources that individuals use in their personal trajectories to identify the substance as problematic, and then to free themselves from it. Next, Gay Hawkins and Anisah Madden analyse the current reduction in the use of plastic. They look at how the material and its social and economic life are being requalified in attempts to use less of it. Going beyond a reductive problem–solution approach, they consider the plurality of possible problematisations around a single technology, and the modes of withdrawal promoted. Their contribution is based on two case studies: a supermarket chain in Australia that is replacing plastic labels with cardboard, and the development of the bioplastic industry. Jocelyne Porcher and Sébastien Mouret’s contribution, in the field of food, focuses on the question of a meat-free diet and, more broadly, animal-free agriculture. These authors approach the problem from the historical dynamics of the development of meat substitutes and the industrial fronts that have successively formed around these alternatives. The movements of industry and the economic sectors that have entered the ‘less or no’ gap are also addressed by Thomas Reverdy in his chapter on reducing the consumption of electricity. Using the original Negawatts movement as a starting point, he examines the challenge of giving value to what is not consumed in order to promote and encourage reduced electricity consumption. In so

doing, the chapter explores the heated debates that are shaking up the relations between legislators, regulatory agencies and industrial operators, questioning the mechanism that aims to transform less into more.

The third part of the book explores the intensity of the detachment and withdrawal in the field of care and health, whether it concerns humans, animals or plants, but also the bleaching process used in paper mills. The field of care and health is particularly marked by a powerful paradox, a symbol if ever there was one of the development of a risk society in which science and technology can be both the solution and the cause of our problems [Beck, 1992]. What cures can also cause damage and lead to massive phenomena of distrust, mobilisation and supervision to reduce the use of – or even prohibit – the use of the substances concerned. The chapters in Part III therefore look at the care sector, identifying its specificities, or nuances in the forms or ‘intensities’ of withdrawal. Laurence Monnais’ chapter opens this section by looking back at the movements of ‘selection’ or ‘hesitation’ in vaccination that have shaken Quebec since the 1960s, skilfully unravelling the historical forces and the imaginaries mobilised. The text by Frédéric Goulet, Alexis Aulagnier and Matthieu Hubert is a trinational comparison between France, Argentina and Brazil to explore the emergence of technological alternatives to the use of pesticides in agriculture. Their angle of attack against the processes involved focuses on the question of the varying intensity of the withdrawal encouraged in the situations considered; they question the way in which these intensities influence – or fail to influence – the nature and scope of the technological alternatives advocated. The chapter by Nicolas Fortané, Florence Hellec, Florence Beaugrand, Nathalie Joly and Mathilde Paul sheds light on the processes that are accompanying the reduction in the use of antibiotics by French farmers. While this reduction has been the subject of an ambitious public action plan, which appears to have partially borne fruit, the authors question the capacity of this reduction to challenge the system of industrial livestock farming, thereby echoing the question raised in the first part of the book by Pierre-Benoît Joly, Bruno Turnheim and Marc Barbier. As we shall see, the field of animal and plant care provides enlightening answers on this subject. With the withdrawal of chlorine formerly used to bleach kraft pulp, Nicolas Baya-Laffite reports how the challenge was to meet the new effluent quality targets – without using, or using a less problematic substance – while still being able to meet the quality standards of the market in terms of brightness and fibre strength. This chapter explores how alternatives compete between companies that favour less expensive solutions and environmentalists who call for more radical alternatives. It reports on scientific controversies concerning the dangerousness of substances and how technologies co-exist in limited technological pluralism.

The fourth part of the book deals with the problem of disintermediation – mainly of markets – and of economic ‘reajustements’. In the collectives

involved in the development of a technology or a market, in the relational chains that constitute sociotechnical networks, actors are sometimes mobilised in favour of the withdrawal of an actor or a device considered as an intermediary. As A, B and C are aligned in an existing configuration, B being an obligatory passage point between A and C, the latter may indeed denounce B's position and claim a relationship 'without intermediary'. The intermediary would in fact deprive them of part of their freedom, their autonomy or even part of the wealth created. It is in this type of situation that the notion of 'direct' is generally invoked, as it represents added value. This is the case of direct sales, of short food value chains, and of service markets based on so-called 'direct' contact with consumers, without any agency or physical interlocutor (Le Velly et al., 2021). Disintermediation also occurs in 'live' television programmes, which are thought to guarantee quality and authenticity due to the absence of studio editing. To return to our original example, this is also the case of 'direct' sowing without ploughing, which is believed to have many benefits for the soil, the crops and the farmers. The chapter by Léa Stiefel and Dominique Vinck tackles the case of centralised data management systems where intermediation appears to be the norm. In the case of data sharing between actors in the agricultural sector in Switzerland, the authors report on the work involved in and the tragedy of freeing oneself from a sociotechnical intermediary who intends to centralise data on a national scale. They examine the development of a competing project to promote peer-to-peer management and control as an alternative to the centralised management model. Finally, Franck Cochoy, Cyrus Eugenio and Alexandre Mallard conclude this part of the book with a case study on bulk food sales, i.e. without packaging. As per short food value chains, their contribution is rooted in a sociology of market 'agencements', and draws attention to the comings and goings that have marked the sometimes coupled, sometimes uncoupled, history of organic product distribution and unpackaged sales. With the appearance and then the disappearance of packaging, of salespeople in shops and other intermediary devices between products and customers, when studying market 'agencements', rather than considering a particular withdrawal, they recommend analysing a set of shifting relationships that comprise detachments and attachments.

The fifth and final part of the book deals with resistance against banning, evicting or banishing, and the difficulties involved in locking the withdrawal. These phenomena are in fact only the outcome of particularly long processes, marked in particular by long-term controversies concerning the dangerous nature (or not) of the incriminated substances and technologies. Industries clearly play an essential role in these struggles. It is their products and innovations, brought to market after costly research and development and lengthy approval processes, that are threatened, and with them the profitability of their operations and the jobs they generate. The chapters by Henri Boullier and

Niels Kessel use the chemical and pharmaceutical industries to analyse the strategies they deploy in the face of public policies aimed at better controlling the dangerousness of their products. Henri Boullier looks more specifically at the resistance of the phthalate industry – a certified endocrine disruptor – to the European REACH (Registration, Evaluation and Authorisation of Chemicals) regulation, which is intended to provide a better framework for their activities. Niels Kessel looks at the strategies of the German and Swiss pharmaceutical industries in the face of health scandals that have affected the markets for certain categories of treatments such as sleeping pills, anorectics and painkillers. These two chapters reveal the ingenuity and the practices used by the firms to support their activity and their products to circumvent orders to withdraw the product issued by public authorities. These practices are varied and the two chapters provide a remarkable account of them; they remind us, in comparison with other contributions marked by relatively successful cases of withdrawal, of the difficulty involved in achieving the detachment necessary for the advent of the without or the less. Donald MacKenzie examines the difficulties and possibilities of abolishing nuclear weapons and the social conditions – and difficulties – that underpin them. He points to the risk of re-building new weapons because existing knowledge will allow this to happen. However, considering the dependency of this technology on tacit knowledge and its transmission to new generations, he suggests focusing on the decline of knowledge transmission as a way to lock the withdrawal. Finally, Peter Stegmaier looks at aftercare, the stage that follows discontinuation and dismantling; aftercare starts when the phase-out period has ended, and deals with persisting remnants of a discontinued sociotechnical system. Abandoned sociotechnical systems do not disappear completely. Further governance efforts are required after the systems are almost completely phased out. In his chapter, Stegmaier focuses on two contrasting examples: nuclear power as extreme aftercare, and incandescent bulb lamps as a ‘light’ version of aftercare. In both cases, he stresses the importance of materialities in the process of locking the withdrawal.

This is the path we propose to the reader through the five parts of this book. As mentioned at the beginning of the introduction, the aim of a foreword is to review the empirical fields covered and the questions raised by the different chapters. The conclusion reviews the main individual and cross-cutting contributions of these chapters, and outlines possible avenues of research to pursue these reflections.

REFERENCES

- Adams, Gabrielle S., Converse, Benjamin A., Hales, Andrew H. and Leidy E. Klotz (2021), ‘People systematically overlook subtractive changes’, *Nature*, 592 (7853), 258–261.

- Akrich, Madeleine, Callon, Michel and Bruno Latour (2006), *Sociologie de la traduction. Textes fondateurs*, Paris: Presses des Mines.
- Bakker, Sjoerd, Van Lente, Harro and Remko Engels (2012), 'Competition in a technological niche: the cars of the future', *Technology Analysis and Strategic Management*, 24 (5), 421–434.
- Barbier, Rémi and Jean-Yves Trépos (2007), 'Humains et non-humains: un bilan d'étapes de la Sociologie des collectifs', *Revue d'Anthropologie des Connaissances*, 1 (1), 35–58. URL: <http://journals.openedition.org/rac/20690>
- Beck, Ulrich (1992), *Risk Society: Towards a New Modernity*, London and New York: Sage.
- Bembreck, Helen, Cochoy, Franck and Gay Hawkins (2021), 'Letting go: economies of detachment', *Consumption, Markets and Culture*, 24 (4), 307–312.
- Bergek, Anna, Berggren, Christian, Magnusson, Thomas and Michael Hobday (2013), 'Technological discontinuities and the challenge for incumbent firms: destruction, disruption or creative accumulation?', *Research Policy*, 42 (6), 210–224.
- Boltanski, Luc (2009), *De la critique. Précis de sociologie de l'émancipation*, Paris: Gallimard.
- Callon, Michel (1984), 'Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay', *The Sociological Review*, 32 (1), 196–233.
- Callon, Michel (1999), 'Ni intellectuel engagé, ni intellectuel dégage: la double stratégie de l'attachement et du détachement', *Sociologie du travail*, 99 (1), 1–13.
- Callon, Michel, Akrich, Madeleine, Dubuisson-Quellier, Sophie, Grandclément, Catherine, Hennion, Antoine, Latour, Bruno, Mallard, Alexandre, Méadel, Cécile, Muniesa and Vololona Rabeharisoa (2013), *Sociologie des agencements marchands. Textes choisis*, Paris: Presses des Mines.
- Callon, Michel, Méadel, Cécile and Vololona Rabeharisoa (2000), 'L'économie des qualités', *Politix*, 13 (52), 211–239.
- Cholez, Céline, Trompette, Pascale, Vinck, Dominique and Thomas Reverdy (2012), 'Bridging access to electricity through BOP market: between economic equations and political configurations', *Review of Policy Research*, 29 (6), 713–732.
- David, Martin (2017), 'Moving beyond the heuristic of creative destruction: targeting exnovation with policy mixes for energy transitions', *Energy Research and Social Science*, 33, 138–146.
- David, Paul A. (1985), 'Clio and the economics of QWERTY', *The American Economic Review*, 75 (2), 332–337.
- Dodier, Nicolas (2003), *Leçons politiques de l'épidémie de Sida*, Paris: Editions de l'EHESS.
- Fagerberg, Jan and Bart Verspagen (2009), 'Innovation studies: the emerging structure of a new scientific field', *Research Policy*, 38 (2), 218–233.
- Freeman, Christopher and Carolota Perez (1988), 'Structural crisis of adjustment, business cycles and investment behaviour', in Giovanni Dosi, Christopher Freeman, Richard Nelson, Gerald Silverberg, and Luc Soete (eds), *Technical Change and Economic Theory*, London: Pinter, 38–66.
- Gaglio, Gérald (2017), "'Innovation fads" as an alternative research topic to pro-innovation bias: the examples of Jugaad and reverse innovation', in Benoît Godin and Dominique Vinck (eds), *Critical Studies of Innovation: Alternative Approaches to the Pro-Innovation Bias*, Cheltenham, UK, and Northampton, MA, USA: Edward Elgar Publishing, 33–47.

- Gaglio, Gérald, and Dominique Vinck (2021), 'Collateral innovation: renewing theory from case-studies', in Gérald Gaglio, Benoît Godin, and Dominique Vinck (eds), *Handbook of Alternative Theories of Innovation*, Cheltenham, UK, and Northampton, MA, USA: Edward Elgar Publishing, 387–403.
- Gaglio, Gérald, Godin, Benoît and Dominique Vinck (eds) (2021), *Handbook of Alternative Theories of Innovation*, Cheltenham, UK, and Northampton, MA, USA: Edward Elgar Publishing, 387–403.
- Geels, Frank W. (2002), 'Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study', *Research Policy*, 31 (8), 1257–1274.
- Geels, Frank W. and Johan Schot (2007), 'Typology of sociotechnical transition pathways', *Research Policy*, 36 (3), 399–417.
- Godin, Benoît (2015), *Innovation Contested: The Idea of Innovation over the Centuries*, London: Routledge.
- Godin, Benoît and Dominique Vinck (2017), *Critical Studies of Innovation: Alternative Approaches to the Pro-Innovation Bias*, Cheltenham, UK, and Northampton, MA, USA: Edward Elgar Publishing.
- Gomart, Émilie (2002), 'Methadone: six effects in search of a substance', *Social Studies of Science*, 32, 93–135.
- Goulet, Frédéric (2008), *L'innovation par retrait. Recomposition des collectifs sociotechniques et de la nature dans le développement de techniques culturelles sans labour*, Doctorat de sociologie, Université Pierre Mendès France, Grenoble.
- Goulet, Frédéric and Dominique Vinck (2012), 'Innovation through withdrawal : contribution to a sociology of detachment', *Revue française de sociologie*, 53 (2), 117–146.
- Goulet, Frédéric and Dominique Vinck (2016), 'Expansion des innovations par retrait: éléments de caractérisation et de réflexion', *Courrier de l'Environnement de l'INRA*, 66, 35–42.
- Goulet, Frédéric and Dominique Vinck (2017), 'Moving towards innovation through withdrawal: the neglect of destruction', in Benoît Godin and Dominique Vinck (eds), *Critical Studies of Innovation: Alternative Approaches to the Pro-Innovation Bias*, Cheltenham, UK, and Northampton, MA, USA: Edward Elgar Publishing, 97–114.
- Goulet, Frédéric and Matthieu Hubert (2020), 'Making a place for alternative technologies: the case of agricultural bio-Inputs in Argentina', *Review of Policy Research*, 37 (4), 35–55.
- Ho, Jonathan C. and Hongyi Chen (2018), 'Managing the disruptive and sustaining the disrupted: the case of Kodak and Fujifilm in the face of digital disruption', *Review of Policy Research*, 35 (3), 352–371.
- Kemp, René, Rip, Arie and Johan Schot (2001), 'Constructing transition paths through the management of niches', in Raghu Garud and Peter Karnoe (eds), *Path Dependence and Creation*, Mahwah, NJ: Lawrence Erlbaum Associates Publishers, 269–299.
- Koretsky, Zahar and Harro van Lente (2020), 'Technology phase-out as unravelling of socio-technical configurations: cloud seeding case', *Environmental Innovation and Societal Transitions*, 37, 302–317.
- Koretsky, Zahar, Stegmaier, Peter, Turnheim, Bruno and Harro van Lente (eds) (2022), *Technologies in Decline: Socio-Technical Approaches to Discontinuation and Destabilisation*. Abingdon: Routledge.

- Le Velly, Ronan and Frédéric Goulet (2015), 'Revisiting the importance of detachment in the dynamics of competition: lessons from the marketing of an uncertain product', *Journal of Cultural Economy*, 8 (6), 689–704.
- Le Velly, Ronan, Goulet, Frédéric and Dominique Vinck (2021), 'Allowing for detachment processes in market innovation: the case of short food supply chains', *Consumption Markets & Culture*, 24 (4), 313–328, <https://doi.org/10.1080/10253866.2020.1807342>
- Levain, Alix, Joly, Pierre-Benoît, Barbier, Marc, Cardon, Vincent, Dedieu, François and Fanny Pellissier (2015), 'Continuous discontinuation – the DDT ban revisited', *International Sustainability Transitions Conference: Sustainability transitions and wider transformative change, historical roots and future pathways*, University of Sussex, Brighton, UK, August 25.
- Liebowitz, Stan J. and Stephen E. Margolis (1995), 'Path dependence, lock-in and history', *Journal of Law, Economics and Organization*, 11 (1), 205–226.
- Maguire, Steve and Cynthia Hardy (2009), 'Discourse and deinstitutionalization: the decline of DDT', *Academy of Management Journal*, 52 (1), 148–178.
- OECD (2005), *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, third edn, Paris: OECD and Statistical Office of the European Communities.
- Pel, Bonno (2016), 'Trojan horses in transitions: a dialectical perspective on innovation "capture"', *Journal of Environmental Policy and Planning*, 18 (5), 673–691.
- Rinscheid, Adrian, Rosenbloom, Daniel, Markard, Jochem and Bruno Turnheim (2021), 'From terminating to transforming: the role of phase-out in sustainability transitions', *Environmental Innovation and Societal Transitions*, 41, 27–31.
- Rogers, Everett (1962), *The Diffusion of Innovation*, New York: Free Press.
- Rogers, Patricia L. (2000), 'Barriers to adopting emerging technologies in education', *Journal of Educational Computing Research*, 22 (4), 455–472.
- Schumpeter, Joseph (1942), *Capitalism, Socialism, and Democracy*, New York: Harper and Row.
- Shove, Elizabeth (2012), 'The shadowy side of innovation: unmaking and sustainability', *Technology Analysis and Strategic Management*, 24 (4), 363–375.
- Soulé, Bastien, Vignal, Bénédicte and Brice Lefèvre (2017), 'Innovation sportive et relation au marché. Analyse des trajectoires sociotechniques de sacs à dos ultralégers', *Revue Française de Socio-Économie*, 18 (1), 165–183.
- Stegmaier, Peter, Kuhlmann, Stefan and Vincent R. Visser (2014), 'The discontinuation of socio-technical systems as a governance problem', in Susana Borrás and Jakob Edler (eds), *The Governance of Socio-Technical Systems: Explaining Change*, Cheltenham, UK, and Northampton, MA, USA: Edward Elgar Publishing, 111–131.
- Stilgoe, Jack, Owen, Richard and Phil Macnaghten (2013), 'Developing a framework for responsible innovation', *Research Policy*, 42 (9), 1568–1580.
- Taylor, Margaret and Andrew Taylor (2012), 'The technology life cycle: conceptualization and managerial implications', *International Journal of Production Economics*, 140 (1), 541–553.
- Turnheim, Bruno and Frank Geels (2012), 'Regime destabilisation as the flipside of energy transitions: lessons from the history of the British coal industry (1913–1997)', *Energy Policy*, 50, 35–49. <https://doi.org/10.1016/j.enpol.2012.04.060>.