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How Scientific Ignorance and Social Invisibility Shape the Issue of Occupational Health in France as a Nonproblem

Abstract

Rather than leading to the emergence of a problem, some processes contribute to limiting their scope and impeding agenda-setting. These "nonproblems" are situations that could have led to social mobilizations or public intervention but end up neither being publicized nor subject to strong policy. We use occupational health in France to illustrate these mechanisms. The social invisibility of work-related ill-health is linked to the joint contribution of two processes. Firstly, from the perspective of research on ignorance and undone science, scientific knowledge is under-developed compared to other public health issues. And even available knowledge is rarely used by policy-makers. Secondly, policies use underestimated numbers from the occupational diseases compensation system. This specific configuration of knowledge/ignorance and official counting plays a central role in the production of occupational health issues as a nonproblem. Their invisibility contributes to the production of inertia and public inaction that characterize public policy in this field.

Keywords: Agenda-setting; Expertise; Nondecision; Social problem; Epidemiology.

RESEARCH on the construction of public problems is now an important part of sociological studies. It has highlighted the roles played by both claimsmakers and collective action in the construction of social problems [Spector and Kitsuse 1977; Gusfield 1981] and the contribution of news media and other arenas of public debate in publicizing processes [Hilgartner and Bosk 1988]. However, it may in certain cases prove even more worthwhile to look at processes that, far from contributing to the emergence or publicization of a problem, instead limit its

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scope and lead to it being defined as a nonproblem, or even to forms of public inaction.

Yet studying these kinds of processes proves quite tricky. The main difficulty relating to research on nondecisions or nonproblems lies in working on processes that either do not emerge, or decisions that do not get debated [Rappert and Bauchspies 2014]. However, as work on ignorance [Gross and McGoey 2023] and non-decision [Bachrach and Baratz 1962] has shown, focusing reflection on other dimensions of knowledge and decision production processes can teach us a great deal. While research on ignorance and research on public inaction belong to different fields, in this article we propose to analyze how the two logics of ignorance production and public inaction interact with and strengthen each other. Our aim is first to understand how the logics of ignorance production stemming from the scientific field contribute to the definition and concealment of some issues. The second is to see how public policies and their instruments contribute to processes of invisibilization, and the synergies between these two logics.

We propose to designate as nonproblems situations that could potentially give rise to social movements or require public intervention—yet which, for various reasons, are neither constituted as public problems nor subject to public intervention. While the notion of nonproblem as such has not been widely used, some fairly similar approaches have been developed in order to understand the logics leading to either non-decision or a failure to take certain issues into account. In political science, Bachrach and Baratz conducted pioneering work on non-decision [Bachrach and Baratz 1962]. These two authors highlighted the power relations that enable certain actors (or groups of actors) to avoid certain problems being posed or certain decisions being taken. They are particularly insistent with regard to both the institutional logics of access to spaces in which decisions are made, and on the importance of social and political values that accompany the social construction of problems.

Their work continues the tradition of many sociological and political science studies that have highlighted the role of discreet spaces in public policymaking by differentiating these from more public spaces. Thus, from 1960, Schattschneider distinguished between negotiations that took place within the political framework of pressure groups (pressure politics) and what happened in the space of opposition between political parties (party politics) [Schattschneider 1960]. By systematizing these early intuitions, the punctuated equilibrium model put forward by Baumgartner and Jones distinguishes between periods in which

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problems are discreetly managed within public policy monopolies (or subsystems) and those in which some problems get public attention, are put onto the government's agenda, and are addressed publicly, resulting most often in a shift in policy aims [Baumgartner and Jones 1993]. These authors argue that the actors whose voices will be heard within a specific field of public policy hold this power only insofar as they control the definition of the problem. This definition, on which a group of actors agrees, is hence essential to the sustainability of power relations within a field of government intervention. Therefore, the degree of publicity granted to these issues has significant effects on the modalities of public intervention and some actors involved in a public policy sector may seek to deal with some issues discreetly so as to avoid controversy about problem definition, as has already been shown for public health issues [Gilbert and Henry 2012].

The notion of nonproblem is again being discussed with respect to environmental issues. Using the notion of non-problematicity, Freudenburg highlights the inequalities between actors around environmental issues and insists on the "privileged access" that economically dominant actors benefit from, in order to frame the issues in a way that both promotes their own interests and avoids excessive publicity [Freudenburg 2000, 2005]. From a more traditional perspective of construction of public problems and following research on agenda denial [Cobb and Ross 1997], McCright and Dunlap are interested in the role played by conservative movements in the construction of global warming as a nonproblem showing "how a countermovement successfully challenged the established problematicity of global warming by reframing it as non-problematic, particularly via skillful deployment of sympathetic scientific expertise in public arenas" [McCright and Dunlap 2003: 368]. This research highlights how powerful interests manage to prevent a problem from emerging in the public sphere or becoming the subject of public policy, either by intervening directly in its public career, or because the actors who would be berated by its publicity are able to prevent this situation from emerging as a problem. Similar dynamics have also been highlighted by Pepper Culpepper [Culpepper 2011] on issues of corporate control where key decisions are made quietly in a context of low political salience—what he called "quiet politics". In the case of occupational health hazards analyzed in this article, the publicization process relies heavily on scientific expertise, which thus becomes a preliminary stage in setting an issue on the agenda. It is therefore essential to look at the logics of knowledge and ignorance production in this field.

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We use the example of occupational health issues in France to bring to light these mechanisms. The US context is certainly different, yet may illustrate what we mean when we use the expression "nonproblem". Analysis of the elements that make it possible to describe the issue of workers' compensation in the US as a nonproblem could help us achieve a better understanding of the French situation, for readers less familiar with this national context. In both countries, these policies are among the oldest in the history of the construction of welfare states. A workers' compensation law for work accidents was adopted in France in 1898 whereas, in the United States, similar laws were passed in most states during the 1910s [Berkowitz 1987; Skocpol 1995]. Despite the issue having been debated regularly (in particular around the time of the adoption of the OSH Act in 1970), it is interesting to note that the question has always been kept within the competence of the states. It has never become a federal issue [Howard 2002], except in a few specific cases, such as the Black Lung Benefits Act, which allowed miners to be compensated for occupational hazards, or the Radiation Exposure Compensation Act (RECA) directed to people formerly employed in the uranium industry and those exposed to radiation released during nuclear weapons tests.

Though the rules governing compensation for occupational risks formed the basis of Western welfare states, they remain fairly limited in relation to the issues at stake, allowing only very partial compensation for victims of work-related accidents and occupational diseases. The US National Safety Council estimates that, of about 4.5 million medically-consulted workplace injuries recorded in 2019, around 4,500 resulted in death[1], and the figures are even higher when work-related diseases are included. One estimate put the number of fatal work-related diseases in the US at 96,000 in 2008 [Takala *et al*. 2014]. Furthermore, a 2012 study showed that although workers' compensation programs represent expenditure of about $50 billion in the United States, this amount represents only 20% of the estimated $250 billion cost of occupational accidents and diseases [Leigh and Marcin 2012]. This low level of compensation contrasts with what can be obtained in civil court cases involving product liability laws in the United States, based on different approaches to converting damage into monetary mitigation. Jain highlighted the enormous differences between workers' compensation and product liability laws, citing the example of a single workplace injury

[1] https://injuryfacts.nsc.org/work/work-overview/work-safety-introduction/, last visited on Feb 7 2024.

caused by a machine that was eligible for a maximum of $34,000 when filing a compensation claim against the employer (insurance system), but that obtained compensation of $3.5 million within the tort law framework (suing the machine manufacturer) [Jain 2006: 19]. Yet, despite its magnitude in both financial and public health terms, workers' compensation receives little public attention and is routinely handled by the administrations responsible for it. Mobilizations around this issue struggle to gain broader public attention, in stark contrast to high-profile court cases—such as those relating to asbestos in the 1970s [Brodeur 1985], or to glyphosate (produced by Monsanto) since complaints were filed in the late 2010s[2].

Though the rationales referred to are different, the situation in France is comparable, with a focus on issues such as the asbestos-related diseases that gave rise to major mobilizations in the 1990s [Henry 2007] or more recently with activism around the use of pesticides and their effects on farmers' health [Jouzel and Prete 2015]. Yet while asbestos and pesticides may have grabbed the headlines, that is by no means true of other occupational toxins—including the thousands of undocumented chemicals and numerous known industrial hazards, be they wood dust, silica, ionizing radiation or toxic chemicals. A number of EU directives (in particular the EU directive on carcinogens, mutagens or reprotoxic substances at work) and initiatives (like the "Roadmap on carcinogens initiative") that have been translated into regulations in the member states, addressing the protection of workers from the health and safety risks related to exposure to carcinogens. However, workplace exposures to chemical carcinogens are still highly prevalent in Europe, as shown by the new Workers' Exposure Survey conducted in 2023 by EU-OSHA across five countries [Cavet *et al*. 2023]. This is one example of an occupational health issue where regulation does exist but still fails to fully protect workers' health. In France, the 2017 national survey showed that as many as 11% (or 2.7 million) of salaried workers were thus exposed in their last working week (less than 3% in managers and almost 35% in qualified blue-collar workers) [Rosankis and Léonard 2023]. In analyzing the public trajectories taken by these problems, what is striking is the level of discretion surrounding the administrative and political trade-offs concerning them. The legitimacy of occupational health policies appears to stem from their being negotiated within a context of social discretion—with little publicity—and directly by the

[2] Patricia Cohen, 2020 (June 24) "Roundup Maker to Pay $10 Billion to Settle Cancer Suits", *The New York Times*.

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very actors that are in charge of implementing them [Gilbert and Henry 2012]. We assume that becoming the subject of close attention from a large and undifferentiated public may instead challenge the sustainability of these policies.

In order to understand the logics of production of the nonproblem of occupational health in France, this article shows that social invisibility and public inaction are notably sustained by a combination of two factors: a long-standing deficit of knowledge, and even scientific ignorance of the actual extent of the impact of work on public health, and the persisting undercompensation of occupational diseases and work accidents through the existing schemes that provide a biased estimation of the number of work-related diseases. We argue that, in spite of a large body of scientific evidence accumulated about work hazards [Bültmann and Siegrist 2020], translating this knowledge into population health impact measures has remained a difficult exercise, the outcome of which has tended to undercount and overshadow the real burden, hence contributing to minimizing the problem.

Our original contribution builds on long-term empirical work on the definition of occupational health issues and on their related policies carried out in each of the authors' disciplinary fields (epidemiology and political science/sociology). Over the past decade, the various research programs carried out separately and together have led us to conduct interviews with scientists and policy-makers involved in informing and implementing these policies, and more broadly to analyze the documents and the different kinds of scientific expertise related to these policies. More recently, as part of a research program dealing specifically with attributable risk in epidemiology, we have conducted a campaign of interviews with epidemiologists in Europe and in North America who have dedicated efforts over the past decade to measure the contribution of work to the cancer burden.

A scientific quantification of work-related health issues producing ignorance

Ignorance and undone science in the occupational health field

Within occupational health—and, to a large extent, also for environmental health—knowledge always has economic implications and is therefore subject to close scrutiny by economic actors. New knowledge on

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occupational hazards can lead to restrictions or even bans on the use of certain products. It may also increase production costs as a result of the implementation of new protective measures. Issues concerning knowledge are therefore highly sensitive for the companies concerned and hence, they seek to control them as much as possible [Henry *et al*. 2021]. Unlike research carried out by companies to create, design and market new products (as in the case of pharmacology R&D, for the development of new medicines), research concerning occupational risks, especially toxicological research, *a priori* has no positive impact on profits. On the contrary, it is likely to have a negative effect and may even stop or slow down certain economic activities. This kind of scientific research, which has been defined as impact science, to distinguish it from production science [Schnaiberg 1977], is a field in which the relations between science and economic activity are the opposite of those observed by the sociology of science—which generally highlights the links between scientific dynamics and economic, military or political interests [Gibbons *et al*. 1994; Pestre 2013]. Here, it is therefore in the interests of industries and other economic actors to slow scientific activity down, to ensure that scientific progress is as slow as possible, or even to remain in a state of ignorance and failure to appreciate the dangers of a particular product or industrial process.

In recent years, the issue of the production of ignorance has grown significantly in the sociology of science, especially since the publication of a collective volume designed to promote this type of research through "agnotology" (neologism) [Proctor and Schiebinger 2008]. More recently, the publication of the second edition of a handbook on this theme has confirmed the strength of this field of research [Gross and McGoey 2023]. Rather than offering a representation of the progress of science as flowing directly from ignorance to knowledge, it emphasizes the different logics at play in the production of ignorance, from the deliberate intervention of economic actors to the effects of more structural inequalities.

The most obvious way to understand how companies shape ignorance about the negative impacts of their activity is by resisting the spread of new knowledge, often by concealing or distorting information. The most well-known and widely documented example is the US tobacco industry with its efforts to weaken and cast doubt on the link between cigarette smoke and lung cancer, famously encapsulated in the phrase "Doubt is our product" [Proctor 2011]. Numerous scholars, such as Naomi Oreskes and Erik Conway in the case of climate change [Oreskes and Conway 2010] or David Michaels in the case of public health issues

[Michaels 2008, 2020] have extensively examined these mechanisms. The approach suggested by these authors is a highly political reading of the conflicts between companies wanting to format and conceal scientific knowledge in order to minimize negative consequences for their own interests, and government services or regulatory agencies (supported by social movements and unions) seeking to thwart such strategies in order to regulate or even ban dangerous activities.

In the case of occupational hazards, many studies have been carried out on companies that seek to downplay the toxicity of products to which their employees (and sometimes the environment) are exposed. One of the most emblematic cases is asbestos, which has been studied in various national contexts [Brodeur 1974; Proctor 1995; Tweedale 2000; Henry 2007]. It is important to bear in mind that, in this case, industrial investment into hiding scientific evidence was made very early and lastingly, covering the whole of the 20th century and indeed still exists in many countries worldwide [McCulloch and Tweedale 2008]. Gerald Markowitz and David Rosner's research on the lead and vinyl chloride industries highlights the industrial strategy of opposing the production of scientific knowledge with the aim of maintaining dangerous industrial activities [Markowitz and Rosner 2002]. It details numerous cases in which companies have refused to publish certain results, encouraged research that promoted their own interests, or concentrated research on subjects that either did not directly challenge their economic interests or did directly fund scientists, so that they could publicly criticize academic research threatening to prove their public health impacts.

Research on the tobacco industry as well as other industries dealing with toxic substances (asbestos, lead, vinyl chloride) clearly demonstrates the intentional dimensions of industrial strategies to produce ignorance. Alongside this pioneering body of research, it is however also important to highlight the more structural dimensions of the production of ignorance, especially the more discreet power plays at work. Such a change of perspective can be facilitated using the concept of undone science developed in the sociology of science studies [Frickel *et al*. 2010]. This line of research positions that, in addition to direct pressure exerted by industry, many other factors also explain the uneven development of scientific knowledge, depending on which economic or social interests are involved. Speaking of undone science thus means emphasizing the structural inequalities between groups mobilized in order to denounce a danger, and the companies producing that danger [Hess 2015]:

> When social movement leaders and industry reformers who wish to change our societies look to "Science" for answers to their research questions, they often find an empty space—a special issue of a journal that was never edited, a conference that never took place, an epidemiological study that was never funded—whereas their better-funded adversaries have an arsenal of knowledge to draw on [Hess 2007, 22].

These approaches insist, then, on the fact that the production of knowledge and ignorance is strongly correlated with the resources of those actors likely to be interested in the results of the research. The case of occupational health highlights a dimension of the power of industry that is not sufficiently analyzed by studies on ignorance and undone science, i.e. industry's ability to prevent the development of knowledge through its passive attitude. While these studies insist primarily on the active participation of industrial firms in the production of artificial controversies, in many cases they simply refuse to give access to their employees' health data or to provide product samples for toxicological studies. This capacity to produce ignorance through abstention is linked to the position occupied by these actors, whose agreement is an essential step in the implementation of a scientific study. More broadly, research into occupational health policies has shown that this is an area where legal rules are applied less systematically than in other areas of labor law, and where employers are able to use various strategies to make the damaging effects of work on health less visible, such as subcontracting or failing to report work-related accidents [Henry 2017; Daubas-Letourneux 2021].

Difficulties in quantifying the impacts of work on public health

Among studies focusing on the production of ignorance or undone science, some work has sought to highlight how regulatory processes could be based not just on the absence of knowledge [Rayner 2012; McGoey 2012] but also on specific forms of knowledge [Kleinman and Suryanarayanan 2013]. In this broader sense, ignorance refers more precisely to specific forms of knowledge. Suryanarayanan and Kleinman showed that the *epistemic forms* of toxicology promoted by pesticide producers focused research on some risk types (often the most immediate) while maintaining forms of uncertainty on others—particularly longer-term risks, or those at lower doses that are always more difficult to measure [Suryanarayanan and Kleinman 2017]. This work is quite similar to that carried out by Scott Frickel on post-Katrina pollution risk assessment in New Orleans [Frickel and Vincent 2007; Frickel and Edwards 2014] and to that of Richter *et al*. on the knowledge induced

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by the regulation of chemicals in relation to products containing PFAS [Richter, Cordner and Brown 2021].

Attempts to measure the impacts of work on ill-health shed new light on these issues. This deals primarily with epidemiology, whereas most work on these issues deals with toxicology, except in the field of drug-related risks, where clinical trials are the norm [Sismondo 2018]. The other main difference lies in the fact that biases in the form of knowledge production seem to derive more directly from the forms of structuring of the epidemiological discipline itself, rather than being linked to a particular regulatory system. Workers exposed to high doses of toxic substances have historically been particularly subject to observation by epidemiologists. William Hueper, a pioneer of this discipline, played an important role in the development of occupational epidemiology in the United States from the 1930s onwards, and was the first director of the Environmental Cancer Section of the National Cancer Institute from 1938 to 1964 [Sellers 1997]. In fact, "with the notable exception of tobacco smoking, most of the other carcinogens that were recognized during the 19th to mid-20th centuries were discovered through [studies of workers]" [Loomis, Hall and Straif 2018: 593]. However, since the 1950s, the development of risk factor epidemiology has led to the expansion of new kinds of investigation (notably cohort studies) that are better suited to the measurement of risks affecting very large populations (like tobacco-, alcohol- or diet-related diseases) than occupational risks, which are localized to specific groups. Epidemiologists themselves have referred to this evolution as the beginning of "Modern Epidemiology" [Rothman, Greenland, and Lash 2012], which promoted the idea that the main role of epidemiology was to identify risk factors that would affect the health of a large proportion of a population [Aronowitz 1998; Berlivet 2005; Giroux 2013]. This dominant epidemiologic paradigm certainly affects the ability of the discipline to discover new hazards in the workplace, which has notably been shown for Gulf War related illnesses [Zavestoski *et al*. 2002] and discussed regarding occupational cancer [Counil 2019]. What's more, the very fact that most of the epidemiologic evidence about workplace hazards comes from large cohorts of workers with stable jobs in big companies that characterize the economic center, with overall better socio-economic benefits and higher health selection at hire, certainly leads to a healthy worker selection bias that is stronger than usually acknowledged in existing studies [Wilcosky and Wing 1987]. However, the kind of epidemiology-embedded ignorance that we would like to highlight here is further entrenched in the way in which that discipline is

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developing methods to quantify the proportion of work-related diseases at the population level, retrospectively.

As we will show using the example of occupational cancers, epidemiology actually meets the challenges of assessing the burden of occupational disease only partially. The quantification of that burden is the subject of enduring although currently discreet scientific controversy, both in France and internationally. Despite the conceptual and methodological criticism leveled at it by some epidemiologists [Greenland and Robins 1988; Greenland and Robins 2000; Poole 2015], the main method for quantifying occupational cancers gradually became the calculation of the fractions of cancers attributable to known occupational carcinogens in a population. In order to calculate this population attributable fraction (PAF), two elements must be known: the relative risk associated with exposure to a known hazard (i.e. the additional proportion of cases of a disease that will be observed compared to an unexposed population) and the prevalence of exposure in a population (i.e. the proportion of people exposed to this product in a population) [Counil and Henry 2019; Counil 2021]. In the 1970s, when this method was in the process of being institutionalized, and environmental concerns were central, some actors tried to draw attention to this burden of environment- and work-related cancers. These debates were both scientific and political, and led to major controversies such as the one in the United States which began with a report issued by scientists from different federal health agencies; it stated that at least 20% of cancer deaths were work-related [Bridbord *et al*. 1978], which gave rise to a strong mobilization of unions and environmental activists as well as vivid public debate with contradictory figures (usually lower) provided both by other scientists and industry bodies [Jasanoff 1990: 29-32; Proctor 1995: 54-74]. To put an end to this controversy, Congress asked two British epidemiologists, Richard Doll and Richard Peto, to write a report on the causes of cancers. It established the proportion of cancer deaths attributable to work at 4% (ranging from 2 to 8% due to uncertainties [Doll and Peto 1981]), a figure that has become a permanent fixture in the cancer prevention research community.

The French example

In France, even though the debate has been far less acute, disparities persist in the evaluation of the contribution of occupational and environmental factors to the burden of cancers. One example of a project that was singled out for minimizing the impact of occupational and environmental factors was published by the International Agency for Research

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on Cancer (IARC) [International Agency for Research on Cancer 2007] and disseminated in French in a short version by the *Académie des sciences* in 2007. This report stressed the role of tobacco and alcohol while emphasizing the limited contribution of occupational factors, and the even more limited contribution of environmental factors: "Occupational exposure accounts for just under 4% of cancers in men and 0.5% in women. This percentage is tending to decline in industrialized countries, thanks in particular to better occupational hygiene. [...] Contrary to certain allegations, the number of cancers related to pollution of water, air and food is low in France, around 0.5%; it could reach 0.85% if the effects of the atmospheric air pollution were confirmed" [*Académie nationale de médecine et al*. 2007: 3]. This report has been criticized by French specialists in occupational and environmental epidemiology for significantly downplaying these risks [Salines *et al*. 2007; Goldberg and Imbernon 2008]. One concern raised by these experts related to the dissemination and public communication regarding these numbers which suggested that occupational and environmental risk factors were negligible, without accounting for the many sources of uncertainties acknowledged in the full report. According to them, "This message results in the delaying of the development of risk and health impact assessment tools, as well as the implementation of policies designed to guarantee a protective environment for health" (authors' translation) [Salines *et al*. 2007]. Despite these warnings, the results were soon after published in a peer-reviewed international journal and they did not raise further public scientific debate [Boffetta *et al*. 2009].

However, when it came to updating these figures, one important concern was to avoid such criticisms and develop an approach that would prove more difficult to challenge. In 2015, the French National Cancer Institute asked the IARC to carry out a new study, which was ultimately published in 2018. Again, this was a general study evaluating the percentage of cancer attributable to avoidable causes [Soerjomataram *et al*. 2018]. This time around, however, different groups of cancer causes were addressed by a specific group of experts, each producing one or two scientific papers. In the case of the study devoted to occupational carcinogens, the results were quite similar to the previous study, with 2.3% of all cancers attributed to occupational exposures (3.9% in men and 0.4% in women) in the main analysis [Marant Micallef *et al*. 2019].

Even though this study was one of the most comprehensive to date, its results reveal how the knowledge produced with respect to these issues can be analyzed as a kind of ignorance. In order to calculate an attributable fraction, there must be a causal relationship between exposure to an

agent or product and the occurrence of cancer. A scientifically established convention is to limit such calculations to agents whose carcinogenicity has been classified by the IARC monograph program based on strong evidence—in most cases as a confirmed carcinogen, Group 1, and in some other instances, here as an annex to the main results, adding probable carcinogens, Group 2A. While relatively few agents have been classified by the IARC compared to the number of products used in industry (118 classified as Group 1 and 78 classified as Group 2A at the time of publication of the 2018 study), only 23 agents in Group 1 were used by the scientists for their study. Indeed, 48 agents were excluded on the basis that they are not found in the workplace, and all other agents were excluded due to lack of data that could lead to the calculation of an attributable fraction [Marant Micallef *et al*. 2018]. Most of the remaining 23 carcinogens are agents whose carcinogenicity has been known for several decades—such as asbestos, benzene, silica and other products used in the chemical industry since the early 20th century [Marant Micallef *et al*. 2019]. Thus, what is presented as the number of cancers attributable to occupational exposures, and estimated as 2.3% of all cancers, is in fact only the number of cancers attributed to the 23 products that are definitely carcinogenic to humans, and for which the exposure data and relative risk are well-documented: a drop in the ocean among the tens of thousands of chemicals used daily in industry.

Beyond the mere size of the public health impact that is being made partly visible through these calculations, it is interesting to look at the trajectory of these numbers in documents that were issued in order to inform cancer prevention policies at that time, in particular cancer plans and their evaluation report that structured cancer prevention over more than 15 years in France, from 2003 to 2019[3]. While these figures are repeatedly cited in these sources, their limitations are also widely acknowledged. Therefore, their use has mostly fueled recommendations aimed at improving their measurement. Focusing on the necessity to inform decision-making through such instruments, even when they knowingly do not meet quality standards, tends to lock intervention on these issues towards the *status quo* rather than prevention.

One important feature of these scientific constructs is that, while their assumptions and limitations are transparently conveyed by the scientific reports and publications that first expose them to peer review, a large part of the precautions taken to avoid reifying these numbers as reflecting the

[3] https://www.e-cancer.fr/Institut-national-du-cancer/Strategie-de-lutte-contre-les-cancers-en-France/Les-Plans-cancer, last visited Feb. 7 2024.

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actual burden are lost when they are used to build a narrative about prevention strategies and they become available to a broader audience. One good example of this can be found in the graphical representations adopted in public health communication media [Rogel and Hamers 2018]. In such infographics, every risk factor (or group of risk factors) is presented on the same scale and ranked by decreasing order of attributable burden, hence explicitly building up a hierarchy, as if each of them had been assessed based on the same amount of knowledge and data. Moreover, the very wording "attributable" suggests that the output of the calculations succeeded in capturing an underlying fact, whereas these numbers were actually "attributed" through a scientific process fraught with difficulties. This contributes further to what could qualify as a form of hidden reductionism.

A legal quantification of occupational diseases and injuries producing social invisibility

The patchwork of occupational public health surveillance tools and systems

Although attributable cases of cancer are discussed within public health institutions—like the French Institute of Cancer (Inca)—to inform prevention campaigns, these quantifications are seldom used by the French Ministry of Labor when it comes to highlighting the key outcomes of occupational health and safety policies. Instead, the definition used is the number of claims for occupational cancer admitted within the legal framework for occupational disease compensation. This is consistent with a historical definition of occupational health issues that were initially seen as a matter for social negotiation, but whose public health dimensions are gradually taking on greater proportions. Until the mid-1990s, when the asbestos crisis redefined occupational risk management as a public health mandate, occupational health issues remained primarily a matter of social negotiation. Yet research in the sociology of the state has shown how public policy implementation initially requires the creation of quantification devices that provide a cross-cutting view of the issues to be addressed [Desrosières 1993; Scott 1998]. Thus, tax systems, for example, could only be deployed once the state had a relatively clear picture of both the population, and the wealth produced on its territory. Similarly, the statistical surveys on working conditions created from 1978-1982 onwards were administrative statistical surveys aimed at providing data to feed social negotiations, and were not conceived in

relation to public health goals. Since then, the Ministry of Labor has conducted periodic cross-sectional surveys based on representative samples of the working population that monitor working conditions—*enquêtes CT (Conditions de travail)*—and exposure to occupational hazards—*enquêtes SUMER (Surveillance médicale des expositions des salariés aux risques professionnels)*. These have provided a range of standard indicators by industry sector and occupational group [Henry 2011].

More recently, since the 1990s and the redefinition of occupational health as partially part of public health policies, new initiatives have appeared. Occupational public health surveillance systems are meant to track work-related fatalities, injuries and illnesses as well as the presence of workplace hazards and exposures to inform prevention efforts. A distinction is generally made between compensation-based systems—relying on legally notified and compensated diseases and accidents—and non-compensation-based systems [European Agency for Safety and Health at Work *et al*. 2017]. In France, a large number of institutional actors contribute to this task, and they rely on heterogeneous sources of information with large differences in scope, scale and coverage (both in space and time) [Henry 2011]. Since the 1990s, an agency currently called *Santé Publique France* (SPF) has been in charge of population health surveillance, including a directorate dedicated to occupational and environmental health issues. However, it has not developed a systematic tool for the epidemiological monitoring of these risks; instead, specific programs have been targeting certain risks—for instance in relation to asbestos or nanoparticles—and work-related health outcomes—such as traffic injuries, musculo-skeletal disorders (MSDs) and occupational asthma. Among the many systems, one is dedicated to the surveillance of non-compensated Work-Related Diseases (WRDs or, in French, *Maladies à caractère professionnel*); every six months, volunteer occupational physicians report for a two-week period any disorder that they suspect could be linked to work. This type of system helps assess the extent of under-notification and under-compensation of some common conditions already included in occupational disease tables—typically MSDs. It also brings to light health issues that are still largely excluded from compensation—like mental health disorders. An early warning system, the RNV3P, coordinated by the Agency for Food, Environmental and Occupational Health & Safety (ANSES) is also dedicated to the detection of emerging WRDs[4]; it operates through the systematic

[4] https://www.anses.fr/fr/content/réseau-national-de-vigilance-et-de-prévention-des-pathologies-professionnelles-rnv3p, last visited on Feb 7 2024.

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collection of information by physicians during consultations held at OD centres in teaching hospitals. Examples of data usage for informing policy and prevention include the detection of allergies to methylisothiazolinone in hairdressers and beauticians, and of asthma related to a certain mould in coffee machine maintenance industry [European Agency for Safety and Health at Work 2018].

The French occupational public health surveillance system is hence complex, consisting of several schemes implemented by different institutions, and there is currently no shared data infrastructure and general coordination that would be able to serve as a platform for a comprehensive surveillance system or allow for its regular evaluation, as recommended by experts in the field [Yang, Branscum, and Kincl 2022].

Counting occupational diseases, discounting the bigger picture?

In the absence of a coherent, structured statistical system for quantifying the impacts of work on public health, the figures readily available to the French Ministry of Labor are those stemming from the French national health insurance system, namely the number of illnesses or conditions compensated as an occupational disease or work injury. In France, the compensation system covering the vast majority of the workforce—salaried workers mostly in the private sector—is unified and managed by a specific branch of the French national health insurance system dedicated to the compensation of occupational risks.

Like any insurance institution, this system regularly releases statistics on the number of occupational diseases compensated, and these are republished by the Ministry of Labor every year. These occupational health insurance statistics have become instrumental to the Ministry of Labor. Though never intended to become instruments by which the population's health could be measured, these statistics have, until recently, been the only ones used by the Ministry of Labor notably to produce its annual report on working conditions, that serves labor relations. In 2017, the section on occupational diseases began with the following presentation of health insurance figures producing ambiguity between the number of compensated occupational diseases and their total number:

> The number of occupational diseases decreased by 1.3% between 2014 and 2015. The inversion of the trend that began in 2012 thus continued in 2015 and is explained by a decrease in the number of "new" work-related diseases (OD) covered by the national health insurance occupational risks branch (author's translation) [*Conseil d'orientation sur les conditions de travail* 2017, 211].

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The section continues with the following statement: "Knowledge of the number of occupational diseases (excluding the public, agricultural, mining and transport sectors) is based on statistics provided by the [health insurance system]" (authors' translation) [*Conseil d'orientation sur les conditions de travail* 2017: 211][5]. This statement shows how the lack of better data led to reliance on these figures, in an attempt to steer public policy—even when these data significantly misrepresent reality, starting with the exclusion of a substantial part of the workforce. Since the early 1990s, the total number of occupational diseases recognized annually has grown substantially, primarily because of a few specific pathologies. The main increase is indeed related to muscular-skeletal disorders (MSD) and the rewriting of the major occupational disease table (ODT) defining these conditions in 1991. Back in 1990, 1,040 MSDs were recognized yearly as occupational disease via this table, whereas there were 19,804 in 2000, 43,359 in 2011 and 40,220 in 2015. The 1991 revision of the table broadened the possibilities of recognizing these pathologies; however, some authors commented that the gradual rise in recognition preceding this period is also strongly suggestive of an effect of the intensification of work [Gollac and Volkoff 1996; Hatzfeld 2006]—knowing that the first ODT dedicated to an MSD was created in 1972. In fact, the recent decline in the number of MSDs compensated reflects a restriction on the possibilities of recognition rather than any improvement in working conditions. This was brought about by a change to the table introduced in 2011, which imposed the condition that an activity must involve "movement or holding of the shoulder at an angle greater than or equal to 60° for at least 3.5 hours per day".

Including all MSDs, those diseases accounted for 44,349 compensated cases in 2015 (87% of all compensated diseases) [*Conseil d'orientation sur les conditions de travail* 2017: 220]. Other pathologies whose recognition increased steeply since the mid-1990s are diseases related to exposure to asbestos—for which there were 3,696 compensated cases in 2015. Thus, if we subtract from the 50,960 occupational diseases recognized in 2015 the 44,349 MSDs and the 3,696 diseases related to asbestos, there are only 2,915 people suffering other types of eligible diseases who received compensation in France; this is a very small figure. More than 19 million salaried workers depend on this system of

[5] In reports published from 2018 onwards, the confusion between the category of occupational disease as a work-related disease and a compensated occupational disease is gradually disappearing, with the annual report merely reporting the statistics on compensation without drawing any more general conclusions.

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compensation, for conditions that are potentially extremely numerous. Another 2 million people are covered by the agricultural workers' insurance system that is quite similar, while the remaining 10 million are either voluntarily self-insured (self-employed workers) or depend on systems (civil servants) that may be even less effective in granting social benefits [Gaboriau 2020]. Thus, if we exclude MSDs and asbestos-related diseases, which are treated differently from other occupational diseases, then the inability to recognize the pathologies induced by work during the latter half of the 20th century is starkly obvious. What we see emerging is a neglected area of public policy: a system that has scarcely been modified, whereas the pathologies related to work are constantly in flux, especially with the proliferation of work-related cancers—very few of which are eligible for compensation—and now mental health disorders.

Provided that asbestos-related cancer is considered separately, this structural under-recognition of occupational diseases is even worse in the case of cancer. Several classifications exist allowing determination of whether or not a substance is carcinogenic. Scientifically speaking, the most well-known is that of the IARC, since the others are essentially intended for regulatory purposes (e.g., European Union classifications). The underestimation of occupational cancers stems above all from the fact that, for many known carcinogens, no occupational disease table exists. A study identifying the list of carcinogens (IARC Group 1) used in the workplace estimated them at 47 in 2018, which is a very conservative figure. Yet, because there are only 22 tables of occupational cancers, there is no table at all for many occupational carcinogens—some of which are very well-known indeed. These include crystalline silica—when the cancer is not preceded by a silicosis; cadmium; beryllium; unrefined mineral oils; coal gasification; the rubber and leather industries [Imbernon 2003: 11].

Until 1990, then, only just over one hundred cancers a year were recognized as occupational diseases. Mainly tumor sites well known to be caused by occupational carcinogens were granted compensation, including mesothelioma, leukemia (due to benzene and to ionizing radiation) and cancers of the ethmoid and the sinus (due to wood dust) [Thébaud-Mony 1991: 43]. Even today, compensation for occupational cancer remains at a very low level in France. In 2015, people suffering cancers entitled to receive occupational compensation totaled 1,804—of which 1,469 (81%) were asbestos-related—compared to at least 7,905 cases attributed to Group 1 carcinogens estimated by IARC the same year [Marant Micallef 2019]. This means that, apart from asbestos-related cancers, only 335 cancers were recognized as occupational diseases—a

figure that is progressing only very slightly each year. If we look closely at the figures, we see that, of the 22 ODTs for cancer, 12 allow for compensation of just one or two cancers per year, since most recognized cancers (excluding those that are asbestos-related) are included in just four tables: coal tar (83 cases in 2015), aromatic amines and their salts (80 cases), wood dust (72 cases), benzene (44 cases)—so a total of 279 cancers altogether [*Conseil d'orientation sur les conditions de travail* 2017: 220-225]. This is very far from the evaluations on which epidemiologists now agree, even given the restrictive way of evaluating this number, as shown above [Counil and Henry 2019].

A quantification of occupational diseases embedded in strong inequalities

The occupational diseases category used by the workers' compensation system condenses both the debates and the compromises pertaining to the definition of what can be considered as belonging to the field of occupational health. Through the study of what is defined as an occupational disease (and what is not), it is possible to analyze the power relations between the various social groups engaged in this area of public policy. The history of this category is directly linked to that of work accidents, which in France appeared as a specific legal object in the law of 9 April 1898, which provided for a system of insurance and compensation [Ewald 2020]. Thanks to this law, work accidents, for which compensation had formerly been obtained through the civil courts (on condition that the employers' responsibility for the accident could be proved), were set up under a specific insurance scheme. To benefit from this new system, it was no longer necessary to prove the employer's responsibility for the accident, only that it was work-related. Work accidents were henceforth considered as consubstantial to a specific job or industry and presumed to be exclusively due to the "occupational risk" for which society had decided to pay compensation. The dimension of compromise that this law represented is obvious: employers agreed to automatic compensation via an insurance scheme funded exclusively by their own contributions. In exchange, their responsibility was no longer sought in civil court cases. Employees, on the other hand, agreed to be compensated within the framework of "presumption of imputability" (or presumption of origin)—but with lower benefits.

Following on from this 1898 law, another was passed on 25 October 1919, extending the legal system compensating work accidents to certain occupational diseases. Through the notion of "presumption

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of imputability", this law transposed the automatic nature of compensation in the field of occupational diseases. Ever since, the French system of compensation for occupational diseases has been based on tables that link pathologies with the work situations likely to cause them. These tables of occupational diseases tables (OD tables), of which there are about one hundred, are included in an appendix to the Social Security Act. Under this law, a worker suffering from a pathology described in a table, and who has worked in a job involving activities likely to have exposed them to the listed hazards for a minimum duration defined *a priori*, is recognized as suffering from an occupational disease. The cause of the disease is then imputed to the identified job in question. This legal definition of occupational disease is clearly apparent in Article L.461-1 of the Social Security Code that indicates that "any disease is presumed to be an occupational disease if it is listed in a table of occupational diseases and was contracted in the conditions mentioned in this table".

These OD tables are the outcome of negotiations characterized by opposition between workers' representatives and employers' organizations, in a zero-sum game. The addition of a new combination of hazard and occupational disease to the list of tables opens up the possibility for workers exposed to the risk to access compensation—but it also means an increase in employer contributions in cases where workers receive actual compensation. These negotiations are organized within the Ministry of Labor via a committee that is part of the *Conseil d'orientation sur les conditions de travail* (COCT). Even though its status is purely consultative, it is in this committee that compromises are in fact reached. The OD tables are then drawn up or amended by the Ministry of Labor administration to reflect what has been agreed on within labor relations [Henry 2017].

The production of this type of compromise is one of the key elements that made it possible to lastingly enter a phase of pacification in social conflicts about occupational health. This phenomenon is clearly visible in the transformation of labor relations that followed enactment of the 1919 law. Until then, labor disputes had tended to crystallize around demands for the banning of dangerous substances [Devinck and Rosental 2009; Rainhorn 2019; Devinck 2010]. However, once this law was passed, demands instead became part of a movement calling for improvements to the newly-instituted compensation system. The occupational diseases compensation system set up in 1919 thus constituted the foundation on which relations between social partners in the occupational health field continue to be built, even now. This definition of occupational disease as a negotiated compromise, formalized in regulations, corresponds to a

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definition of the problem that sustains the power imbalance between the actors engaged in dealing with it.

In the long term, one of the main effects of this law has been to produce a systematic failure to compensate for occupational diseases. There are two explanations for this: first, as a result of the restrictive way the tables are drawn up—with the definition of the disease or the list of jobs providing entitlement to compensation often being written in such a way as to limit the possibilities of compensation; and second, because of various other factors, including the complexity of administrative procedures and doctors' limited awareness of these issues [Cavalin *et al*. 2020]. This under-recognition of occupational diseases helps keep in place the hierarchies and power relations between the groups of actors involved in these negotiations, primarily by consolidating the employers' position of power. Yet even though these definitions of occupational diseases have slowly widened over recent decades, in part due to the introduction of a complementary system meant to open compensation to people falling outside of the OD tables [Platel 2014], the essence of the compromise between these actors has not been challenged, and this has largely contributed to near-invisibility of the impacts of work on public health.

When attributable fractions undermine the presumption of imputability

A rare point of connection between attributable risk and public policies addressing occupational health lies in the progressive introduction of the epidemiologic, probabilistic reasoning into the social dialogue and negotiations around compensation schemes in France. Starting from the late 1980s, at the initiative of employer representatives, there was an attempt to move the system from presumption of imputability to a shared causality paradigm that would likely be more favorable to employers. The first official evidence of this is found in the Dorion Report [Dorion and Lenoir 1991], established for the adoption of the 1993 complementary compensation system—dedicated to expanding access to compensation in cases where OD table criteria are not fully met or when specific hazard-condition pairs do not appear in an existing OD table. More recently, from the late 1990s onwards, an implicit rule seems to have gradually emerged from the examination of the expertise reports of the *Commission des Pathologies Professionnelles* of the *Conseil supérieur de la prévention des risques professionnels* (CSPRP), the former name of the COCT, suggesting that the creation of a table should be conditioned on demonstrating, in epidemiological investigations, a relative risk greater than 2 (or an

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attributable fraction in the exposed greater than 50%) [Cavalin and Rosental 2016], and even 3 [Henry 2017]. This condition related to the magnitude of a relative risk seems to be a direct importation of legal debates initiated in the late 1970s in the United States regarding environmental health issues, in a very different institutional context. The system for recognizing occupational diseases is indeed very limited in the United States and effectively pushes complainants to file lawsuits.

In North American toxic tort litigation, the examination of causal links at the individual level is built on the legal principle of "more likely than not," wherein the plaintiff must demonstrate that it is *more likely* that their illness is related to their occupational exposure to a known hazard at some employer, than to another cause. Translating this principle into the required standard for proof involves two conditions: the plaintiff must have a disease that could be linked to work (general causality condition), and the plaintiff must prove that work (or the employer, due to a lack of prevention) caused the disease in their specific case (proximate causality condition) [Black and Lilienfeld 1983]. Demonstrating this specific causality at the individual level is an exercise that, except for well-established poisoning cases, remains practically impossible to establish scientifically. To overcome this difficulty, the "doubling dose," i.e. the exposure dose (to the workplace hazard) at which the risk of developing the disease would be doubled compared to the risk in the unexposed population, has gradually become a criterion for evaluation. In the 1980s, new statistical tools were developed that strengthened the connections between population-based and individual etiological approaches. The probability of causation (PC), in particular, was developed in the context of compensating energy sector workers suffering from radiation-induced cancers. Beyond the population-based estimation of the dose-response curve, calculating this probability also relies on estimating the cumulative exposure dose received by the plaintiff and strong biological assumptions about the underlying mechanism of action. Moreover, the use of this tool, aside from its high technical complexity and limited applicability outside the process of carcinogenesis associated with ionizing radiation and some chemical risks, does not inherently resolve the question of the decision rule to be applied subsequently in terms of compensation. Thus, in addition to "all-or-nothing" approaches, often based on the 50% threshold, proportional approaches ("proportional recovery") are being considered, where the amount of compensation increases as the PC increases.

The use of such quantification tools in the compensation of environmental and occupational diseases has faced numerous criticisms from

specialists in statistical and epidemiological methods in the United States [Greenland and Robins 1988; Greenland 1999; Greenland and Robins 2000]. They have pointed out the frequent confusion between two tools with different purposes: the attributable fraction in the exposed, based solely on the relative risk, applies at the population level to people sharing a certain exposure; whereas PC, based on the dose-response relationship, mechanistic assumptions, and the reconstruction of the individual dose received, applies at the individual level. In addition to the many sources of underestimation of the RR value well known to epidemiologists [Carruth and Goldstein 2001], a significant source of underestimation of PC when confused with attributable fraction in the exposed is that the latter quantifies only the proportion of people who would never have fallen ill in the absence of exposure (all-or-none occurrence). Hence, it should be noted that falling ill earlier than expected (the advancement of the age at which the disease occurs or death due to exposure, also referred to as accelerated occurrence) remains unquantified. From there, alternative quantification tools, such as the number of years of healthy life lost due to exposure, have been proposed, although rarely used in practice, often due to a lack of specific data [Robins and Greenland 1991; Boshuizen and Greenland 1997].

In the French regulatory context, these criticisms are even more justified since the system is based on several dimensions that are in clear opposition to US environmental civil law. Firstly, it relies on the presumption of origin, in contradiction with the "more likely than not" concept. Secondly, it guarantees lump-sum compensation within an insurance framework, diverging from potentially full compensation within a civil jurisdiction. This led the French scientific expert body now in charge of proposing evidence-based rules for compensation at ANSES to reject the use of these tools for its own work and to take a general stance against their use within the scope of this regulation, especially in the creation or modification of OD tables [*Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail* 2020].Whether or not this recommendation will be followed in future regulations is still questioned.

Conclusion

The joint processes producing scientific ignorance (or weakness of scientific knowledge) and social invisibility (or structural underestimation of

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the effects of work on health by public institutions) are essential factors in the production of occupational health as a nonproblem. These are long-lasting features and key factors both in permitting public inaction on these issues and in making it more difficult to take them into account. As a large body of literature showed, this situation of institutional inertia refers directly to the question of power in the production of public policies. Of course, the power of economic actors over economic or social policies is a major factor in understanding this situation [Hacker and Pierson 2002; Culpepper 2015]. Similar discrepancies between the scientific knowledge (which may or may not lead to forms of ignorance) and the forms of knowledge mobilized for public action have been observed with economic policies, particularly on the question of public debt [Lemoine 2017].

However, it is also important to note that the construction of occupational health policies as nonproblems, even if this serves industrial interests and highlights explicit strategies on their part, cannot be reduced to a mere manipulation by the most powerful actors. On the contrary, it can be analyzed as the manifestation of interlocking mechanisms of domination that refer to structural inequalities between social groups and manifest themselves in various forms, including forms of public inaction. The example of occupational health analyzed in this article is important in this perspective, as this public policy sector is characterized by strong inequalities that have also remained particularly stable over time. The relative weakness of any counter-power (trade unions or associations) leads to victories that are only partial. The ban on asbestos in France and better compensation for asbestos-related occupational cancers have not led to better recognition of, or compensation for, other occupational carcinogens. More recently, the adoption of an occupational disease table for prostate cancers linked to pesticide exposure, in connection with the chlordecone scandal in the French West Indies, may be seen as a step forward, but one that remains very limited despite significant collective action in recent years [Jouzel and Prete 2024].

What's more, while it is important, as we have done in this article, to analyze the effects of scientific ignorance and undone science on public policy, we should not conclude that, conversely, the production of scientific knowledge is sufficient to initiate any kind of public policy. On the contrary, as we have also pointed out, there are many scientifically well-documented issues that do not give rise to public intervention, as in the case of substances recognized as carcinogens by the IARC and not giving rise to compensation for work-related cancers. This example and others confirm what has been shown by research into the agenda-setting process and public policy, namely that it is primarily mobilization and

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collective action that are capable of modifying specific ways of public intervention, in particular by altering power relations. If scientific knowledge plays a role in these processes, it is more by consolidating or weakening the arguments of some stakeholder groups. From this point of view, it would be interesting to extend the research carried out on occupational health issues to see to what extent they provide a better understanding of environmental health issues, a sector in which the balance of power could be analyzed as being more fluid. Environmental health issues are also now increasingly documented with alternative scientific tools, such as community-based participatory research (CBPR), that have been specifically designed to empower underserved populations and improve knowledge parity and consequently, health outcomes [Davis and Ramírez-Andreotta 2021]. The way in which power relations structure the ability, or inability, to bring a problem publicly to the fore and take charge of it, or not, should then be more directly analyzed by the literature on social problems and public policy [Brown *et al*. 2012]. As we hope to have underlined in this article, and as research on ignorance and non-decisions has shown, looking at the processes that contribute to making it difficult, or impossible, for problems to emerge and be publicly addressed, could be a very fruitful line of enquiry.

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BIBLIOGRAPHY

Académie nationale de médecine, Académie des sciences, Centre international de recherche sur le cancer, and Fédération nationale des centres de lutte contre le cancer, 2007. *Les Causes du cancer en France. Rapport – version*

abrégée (Paris, Académie nationale de médecine).

AGENCE NATIONALE DE SÉCURITÉ SANITAIRE DE L'ALIMENTATION, DE L'ENVIRONNEMENT ET DU TRAVAIL, 2020. *Guide méthodologique pour l'élaboration de l'expertise en vue de la création ou de la modification de tableaux de maladies professionnelles, ou de recommandations aux comités régionaux de reconnaissance des maladies professionnelles* (Maisons-Alfort, Anses).

ARONOWITZ Robert A., 1998. *Making Sense of Illness* (Cambridge, UK, Cambridge University Press).

BACHRACH Peter and Morton S. BARATZ, 1962. "Two Faces of Power," *The American Political Science Review*, 56 (4): 947–952.

BAUMGARTNER Frank R. and Bryan D. JONES, 1993. *Agendas and Instability in American Politics* (Chicago, University of Chicago Press).

BERKOWITZ Edward D., 1987. *Disabled Policy. America's Programs for the Handicapped* (Cambridge, Cambridge University Press).

BERLIVET Luc, 2005. "'Association or Causation?' The Debate on the Scientific Status of Risk Factor Epidemiology, 1947-c.1965," *in* Virginia Berridge, ed., *Making Health Policy. Networks in Research and Policy after 1945* (Amsterdam, New York, Rodopi: 39–74).

BLACK Bert and David E. LILIENFELD, 1983. "Epidemiologic proof in toxic tort litigation," *Fordham L. Rev.*, 52: 732–785.

BOFFETTA Paolo, Maurice TUBIANA, Catherine HILL, Mathieu BONIOL, André AURENGO, Rolland MASSE, Alain Jacques VALLERON, Roger MONIER, Guy DE THÉ, Peter BOYLE and Philippe AUTIER, 2009. "The causes of cancer in France," *Annals of Oncology*, 20 (3): 550–555.

BOSHUIZEN H. C. and S. GREENLAND, 1997. "Average age at first occurrence as an alternative occurrence parameter in epidemiology," *Int J Epidemiol*, 26 (4): 867–872.

BRIDBORD K., P. DECOUFLE, J FRAUMENI, D. HOEL, R. HOOVER, D. RALL, A. SAFFIOTTI, M. SCHNEIDERMAN and A. UPTON, 1978. "Estimates of the fraction of cancer in the United States related to occupational factors," *Post-hearing testimony to Hearings of the US Congress on the Occupational Safety and Health Administration*, Bethesda, National Cancer Institute, National Institute of Environmental Health Sciences and National Institute for Occupational Safety and Health.

BRODEUR Paul, 1974. *Expendable Americans* (New York, Viking Press).

—, 1985. *Outrageous misconduct: the asbestos industry on trial* (New York: Pantheon Books).

BROWN Phil, Rachel MORELLO-FROSCH, Stephen ZAVESTOSKI and CONTESTED ILLNESSES RESEARCH GROUP, eds, 2012. *Contested Illnesses. Citizens, Science, and Health Social Movements* (Berkeley/Los Angeles, Univ of California Press).

BÜLTMANN Ute and Johannes SIEGRIST, eds, 2020. *Handbook of Disability, Work and Health* (Cham, Springer International Publishing).

CARRUTH Russellyn S. and Bernard D. GOLDSTEIN, 2001. "Relative Risk Greater Than Two in Proof of Causation in Toxic Tort Litigation," *Jurimetrics*, 41 (2): 195–209.

CAVALIN Catherine and Paul-André ROSENTAL, 2016. "Reconnaître, évaluer et indemniser les préjudices de santé liés au travail. Entretien avec Roland Masse," *Incidence*, (12): 171–185.

CAVALIN Catherine, Emmanuel HENRY, Jean-Noël JOUZEL and Jérôme PÉLISSE, eds, 2020. *Cent ans de sous-reconnaissance des maladies professionnelles* (Paris, Presses des Mines).

CAVET Marine, Xabier IRASTORZA, Elke SCHNEIDER, Nadia VILAHUR and EUROPEAN AGENCY FOR SAFETY AND HEALTH AT WORK (EU-OSHA), 2023. *Workers' Exposure Survey on cancer risk factors in Europe – first findings*, European Agency for Safety and Health at Work.

COBB Roger W. and Marc H. ROSS, eds, 1997. *Cultural Strategies of Agenda Denial, Avoidance, Attack, and Redefinition* (Lawrence, University Press of Kansas).

CONSEIL D'ORIENTATION SUR LES CONDITIONS DE TRAVAIL, 2017. *Conditions de travail. Bilan* 2016 (Paris, Ministère du Travail, de l'Emploi, de la Formation professionnelle et du Dialogue social).

COUNIL Émilie, 2019. "Le travail comme analyseur des tensions dans la construction épidémiologique de causes et de responsabilités," *Sociologie du travail*, 61 (2). [http://journals.openedition.org/sdt/18116; https://doi-org/10.4000/sdt.18116].

—, 2021. "Contribution of causal factors to disease burden. How to interpret attributable fractions," *Breathe (Sheff)*, 17 (4): 210086.

COUNIL Émilie and Emmanuel HENRY, 2019. "Is It Time to Rethink the Way We Assess

the Burden of Work-Related Cancer?," *Current Epidemiology Reports*, 6 (2): 138–147.

CULPEPPER Pepper D., 2011. *Quiet Politics and Business Power: Corporate Control in Europe and Japan* (New York, Cambridge University Press).

—, 2015. "Structural power and political science in the post-crisis era," *Business and Politics*, 17 (3): 391–409.

DAUBAS-LETOURNEUX Véronique, 2021. *Accidents du travail: Des morts et des blessés invisibles* (Paris, Bayard).

DAVIS Leona F. and Mónica D. RAMÍREZ-ANDREOTTA, 2021. "Participatory Research for Environmental Justice: A Critical Interpretive Synthesis," *Environmental Health Perspectives*, 129 (2): 26001.

DESROSIÈRES Alain, 1993. *La Politique des grands nombres. Histoire de la raison statistique* (Paris, La Découverte).

DEVINCK Jean-Claude, 2010. "La lutte contre les poisons industriels et l'élaboration de la loi sur les maladies professionnelles," *Sciences sociales et santé*, 28 (2): 65–91.

DEVINCK Jean-Claude and Paul-André ROSENTAL, 2009. "'Une maladie sociale avec des aspects médicaux': la difficile reconnaissance de la silicose comme maladie professionnelle dans la France du premier XXe siècle," *Revue d'histoire moderne et contemporaine*, 56 (1): 99–126.

DOLL R. and R. PETO, 1981. "The Causes of Cancer: Quantitative Estimates of Avoidable Risks of Cancer in the United States Today," *Journal of the National Cancer Institute*, 66 (6): 1191–1308.

DORION Georges and Daniel LENOIR, 1991. *La Modernisation de la réparation des accidents du travail et des maladies professionnelles* (Paris, Ministère des affaires sociales et de l'intégration).

EUROPEAN AGENCY FOR SAFETY AND HEALTH AT WORK, 2018. *Alert and Sentinel Approaches to Detect Work-Related Diseases. RNV3P: National Network for Monitoring and Prevention of Occupational Diseases in France (Réseau national de vigilance et de prévention des pathologies professionnelles)*, European Agency for Safety and Health at Work.

EUROPEAN AGENCY FOR SAFETY AND HEALTH AT WORK, Jelena BAKUSIC, Annet LENDERINK, Charlotte LAMBREGHTS, Sofie VANDENBROECK, Jos VERBEEK, Stefania CURTI, Stefano MATTIOLI, and Lode GODDERIS, 2017. *Methodologies to identify work-related diseases – Review of sentinel and alert approaches*, Publications Office of the European Union.

EWALD François, 2020. *The Birth of Solidarity. The History of the French Welfare State* (Durham, Duke University Press).

FREUDENBURG William R., 2000. "Social Constructions and Social Constrictions: Toward Analyzing the Social Construction of 'the Naturalized' as Well as 'the Natural'," in Gert Spaargaren, Arthur P. J. Mol and Frederick H. Buttel, eds, *Environment and Global Modernity* (London, Thousand Oaks, Calif., Sage Publications: 103–120).

—, 2005. "Privileged Access, Privileged Accounts: Toward a Socially Structured Theory of Resources and Discourses," *Social Forces*, 84 (1): 89–114.

FRICKEL Scott and M. Bess VINCENT, 2007. "Hurricane Katrina, Contamination, and the Unintended Organization of Ignorance," *Technology in Society*, 29 (2): 181–188.

FRICKEL Scott and Michelle EDWARDS, 2014. "Untangling Ignorance in Environmental Risk Assessment," in Soraya Boudia, and Nathalie Jas, eds, *Powerless Science? Science and Politics in a Toxic World* (New York, Oxford, Berghahn Books: 215–233).

FRICKEL Scott, Sahra GIBBON, Jeff HOWARD, Joanna KEMPNER, Gwen OTTINGER and David HESS, 2010. "Undone Science: Charting Social Movement and Civil Society Challenges to Research Agenda Setting," *Science, Technology & Human Values*, 35 (4): 444–473.

GABORIAU Marion, 2020. "De la fabrication de la preuve à la décision. Reconnaissance, droit et usage de la maladie professionnelle dans la fonction publique territoriale," *in* Catherine Cavalin, Emmanuel Henry, Jean-Noël Jouzel, and Jérôme Pélisse, eds, *Cent ans de sous-reconnaissance des maladies professionnelles* (Paris, Presses des Mines: 235–253).

GIBBONS Michael, Camille LIMOGES, Helga NOWOTNY, Simon SCHWARTZMAN, Peter SCOTT and Martin TROW, 1994. *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies* (London, Sage Publications).

GILBERT Claude and Emmanuel HENRY, 2012. "Defining Social Problems: Tensions between Discreet Compromise and Publicity," *Revue française de sociologie*, 53 (1): 31–54.

GIROUX Élodie, 2013. "The Framingham Study and the Constitution of a Restrictive Concept of Risk Factor," *Social History of Medicine*, 26 (1): 94–112.

https://doi.org/10.1017/S0003975624000109 Published online by Cambridge University Press

GOLDBERG Marcel and Ellen IMBERNON, 2008. "Cancers professionnels. L'estimation de leur nombre reste à faire," *Le Concours médical*, 130 (2): 50–52.

GOLLAC Michel and Serge VOLKOFF, 1996. "Citius, altius, fortius. L'intensification du travail," *Actes de la recherche en sciences sociales*, 114: 54–67.

GREENLAND Sander, 1999. "Relation of probability of causation to relative risk and doubling dose: a methodologic error that has become a social problem," *Am J Public Health*, 89 (8): 1166–1169.

GREENLAND Sander and James M. ROBINS, 1988. "Conceptual Problems in the Definition and Interpretation of Attributable Fractions," *American Journal of Epidemiology*, 128 (6): 1185–1197.

—, 2000. "Epidemiology, Justice, and the Probability of Causation," *Jurimetrics*, 40 (3): 321–340.

Gross MATTHIAS and Linsey MCGOEY, eds, 2023. *Routledge International Handbook of Ignorance Studies. Second Edition* (Abingdon, New York, Routledge).

GUSFIELD Joseph R., 1981. *The Culture of Public Problems: Drinking-Driving and the Symbolic Order* (Chicago, London, University of Chicago Press).

HACKER Jacob S. and Paul PIERSON, 2002. "Business Power and Social Policy: Employers and the Formation of the American Welfare State," *Politics & Society*, 30 (2): 277–325.

HATZFELD Nicolas, 2006. "L'émergence des troubles musculo-squelettiques (1982-1996)," *Histoire et Mesure*, 21 (1): 111–140.

HENRY Emmanuel, 2007. *Amiante : un scandale improbable. Sociologie d'un problème public* (Rennes, Presses universitaires de Rennes).

—, 2011. "Nouvelles dynamiques de savoirs et permanence des rapports de pouvoir. L'impact – limité – des transformations – importantes – de l'expertise en santé au travail," *Revue française de science politique*, 61 (4): 707–726.

—, 2017. *Ignorance scientifique et inaction publique. Les politiques de santé au travail* (Paris, Presses de Sciences Po).

HENRY Emmanuel, Valentin THOMAS, Sara Angeli AGUITON, Marc-Olivier DÉPLAUDE and Nathalie JAS, eds, 2021. "Beyond the Production of Ignorance: The Pervasiveness of Industry Influence Through the Tools of Chemical Regulation," Special Issue *Science, Technology, & Human Values*, 46(5): 911–1020.

HESS David J., 2007. *Alternative Pathways in Science and Industry: Activism, Innovation, and the Environment in an Era of Globalization* (Cambridge, Mass., MIT Press).

HESS DAVID J., 2015. "Undone Science: A Review and Typology," *in* Matthias Gross and Linsey McGoey, eds, *Routledge International Handbook of Ignorance Studies* (Abingdon, New York, Routledge: 141–154).

HILGARTNER Stephen and Charles L. BOSK, 1988. "The Rise and Fall of Social Problems: A Public Arenas Model," *American Journal of Sociology*, 94 (1): 53–78.

HOWARD Christopher, 2002. "Workers' Compensation, Federalism, and the Heavy Hand of History," *Stud. in Am. Pol. Dev.*, 16 (01): 28–47.

IMBERNON Ellen, 2003. *Estimation du nombre de cas de certains cancers attribuables à des facteurs professionnels en France* (Paris, Institut de veille sanitaire).

INTERNATIONAL AGENCY FOR RESEARCH ON CANCER, 2007. *Attributable Causes of Cancer in France in the Year 2000* (Lyon, IARC (WHO)).

JAIN Lochlann, 2006. *Injury. The Politics of Product Design and Safety Law in the United States* (Princeton, NJ, Princeton University Press).

JASANOFF Sheila, 1990. *The Fifth Branch: Science Advisers as Policymakers* (Cambridge, Harvard University Press).

JOUZEL Jean-Noël and Giovanni PRETE, 2015. "Becoming a Victim of Pesticides: Legal Action and Its Effects on the Mobilisation of Affected Farmworkers," *Sociologie du Travail*, 57: e63–80.

—, 2024. *L'Agriculture empoisonnée. Le long combat des victimes de pesticides* (Paris, Presses de Sciences Po).

KLEINMAN Daniel L. and Sainath SURYANARAYANAN, 2013. "Dying Bees and the Social Production of Ignorance," *Science, Technology & Human Values*, 38 (4): 492–517.

LEIGH J. Paul and James P. MARCIN, 2012. "Workers' compensation benefits and shifting costs for occupational injury and illness," *J Occup Environ Med*, 54 (4): 445–450.

LEMOINE Benjamin, 2017. "Measuring and Restructuring the State. Debt Metrics and the Control of Present and Future Political Order," *in* Patrick Le Galès, and Desmond King, eds, *Reconfiguring European States in Crisis* (Oxford, Oxford University Press: 313–330).

LOOMIS Dana, Neela GUHA, Amy L. HALL and Kurt STRAIF, 2018. "Identifying occupational carcinogens: an update from the IARC Monographs," *Occup Environ Med*, 75 (8): 593–603.

MARANT-MICALLEF Claire, Kevin David SHIELD, Isabelle BALDI, Barbara CHARBOTEL, Béatrice FERVERS, Anabelle GILG SOIT ILG, Pascal GUÉNEL, Ann OLSSON, Lesley RUSHTON, Sally J. HUTCHINGS, Kurt STRAIF and Isabelle SOERJOMATARAM, 2018. "Occupational exposures and cancer: a review of agents and relative risk estimates," *Occupational and Environmental Medicine* 75 (8): 604.

MARANT-MICALLEF Claire, Kevin David, SHIELD Jérôme VIGNAT, Isabelle BALDI, Barbara CHARBOTEL, Béatrice FERVERS, Anabelle GILG SOIT ILG, Pascal GUÉNEL, Ann OLSSON, Lesley RUSHTON, Sally J. HUTCHINGS, E. CLÉRO, Dominique LAURIER, Pascale SCANFF, Freddie BRAY, Kurt STRAIF and Isabelle SOERJOMATARAM, 2019. "Cancers in France in 2015 attributable to occupational exposures," *Int J Hyg Environ Health*, 222 (1): 22–29.

MARKOWITZ Gerald E. and David ROSNER, 2002. *Deceit and Denial: The Deadly Politics of Industrial Pollution* (Berkeley, CA, University of California Press).

MCCRIGHT Aaron M. and Riley E. DUNLAP, 2003. "Defeating Kyoto: The Conservative Movement's Impact on U.S. Climate Change Policy," *Social Problems*, 50 (3): 348–373.

MCCULLOCH Jock and Geoffrey TWEEDALE, 2008. *Defending the Indefensible: The Global Asbestos Industry and Its Fight for Survival* (New York, Oxford University Press).

MCGOEY Linsey, 2012. "The logic of strategic ignorance," *Br J Sociol*, 63 (3): 553–576.

MICHAELS David, 2008. *Doubt is Their Product: How Industry's Assault on Science Threatens Your Health* (Oxford, New York, Oxford University Press).

—, 2020. *The Triumph of Doubt. Dark Money and the Science of Deception* (Oxford, New York, Oxford University Press).

ORESKES Naomi and Erik M. CONWAY, 2010. *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York, Bloomsbury Press).

PESTRE Dominique, 2013. *A contre-science. Politiques et savoirs des sociétés contemporaines* (Paris, Le Seuil).

PLATEL Sylvie, 2014. "Connaissance, expertise et reconnaissance des maladies professionnelles : système complémentaire et cancers en Seine-Saint-denis," Diss., Université Paris 13.

POOLE Charles, 2015. "A history of the population attributable fraction and related measures," *Annals of Epidemiology*, 25 (3): 147–154.

PROCTOR Robert N., 1995. *Cancer Wars: How Politics Shapes What we Know and Don't Know about Cancer* (New York, Basic Books).

—, 2011. *Golden Holocaust: Origins of the Cigarette Catastrophe and the Case for Abolition* (Berkeley, University of California Press).

PROCTOR Robert and Londa L. SCHIEBINGER, eds, 2008. *Agnotology: The Making and Unmaking of Ignorance* (Stanford, Calif., Stanford University Press).

RAINHORN Judith, 2019. *Blanc de plomb. Histoire d'un poison légal* (Paris, Presses de Sciences Po).

RAPPERT Brian and Wenda K. BAUCHSPIES, eds, 2014. "Absences," Special Issue *Social Epistemology*, 28(1): 1–95.

RAYNER Steve, 2012. "Uncomfortable knowledge: the social construction of ignorance in science and environmental policy discourses," *Economy and Society*, 41 (1): 107–125.

RICHTER Lauren, Alissa CORDNER and Phil BROWN, 2021. "Producing Ignorance Through Regulatory Structure: The Case of Per- and Polyfluoroalkyl Substances (PFAS)," *Sociological Perspectives*, 64 (4): 631–656.

ROBINS James M. and Sander GREENLAND, 1991. "Estimability and estimation of expected years of life lost due to a hazardous exposure," *Stat Med*, 10 (1): 79–93.

ROGEL Agnès and Françoise HAMERS, 2018. "Les cancers attribuables au mode de vie et à l'environnement en France en 2015," *Bulletin épidémiologique hebdomadaire*, 21: 429–448.

ROSANKIS Élodie and Martine LÉONARD, 2023. "Les expositions des salariés aux produits chimiques cancérogènes," *Dares Focus*, 34: 1–2.

ROTHMAN Kenneth J., Sander GREENLAND and Timothy L. LASH, 2012. *Modern Epidemiology* (Philadelphia, Lippincott Williams and Wilkins).

SALINES Georges, Daniel EILSTEIN, Joëlle LE MOAL, Juliette BLOCH, and Ellen IMBERNON, 2007. "Point de vue sur le rapport "Les causes du cancer en France"," *Revue*

d'épidémiologie et de santé publique, 55 (6): 423–424.

SCHATTSCHNEIDER Elmer Eric, 1960. *The Semisovereign People: a Realist's View of Democracy in America* (New York, Holt, Rinehart and Winston).

SCHNAIBERG Allan, 1977. "Obstacles to Environmental Research by Scientists and Technologists: A Social Structural Analysis," *Social Problems*, 24 (5): 500–520.

SCOTT James C., 1998. *Seeing like a state how certain schemes to improve the human condition have failed* (New Haven, Yale University Press).

SELLERS Christopher C., 1997. "Discovering environmental cancer: Wilhelm Hueper, post-World War II epidemiology, and the vanishing clinician's eye," *Am J Public Health*, 87 (11): 1824–1835.

SISMONDO Sergio, 2018. *Ghost-Managed Medicine. Big Pharma's Invisible Hands* (Manchester, Mattering Press).

SKOCPOL Theda, 1995. *Protecting Soldiers and Mothers: The Political Origins of Social Policy in the United States* (Cambridge, Belknap Press of Harvard University Press).

SOERJOMATARAM Isabelle, Kevin David SHIELD, Claire MARANT-MICALLEF, Jérôme VIGNAT, Catherine HILL, Agnès ROGEL, Gwenn MENVIELLE, Laure DOSSUS, Jean-Nicolas ORMSBY, Jurgen REHM, Lesley RUSHTON, Paolo VINEIS, Max PARKIN, and Freddie BRAY, 2018. "Cancers related to lifestyle and environmental factors in France in 2015," *Eur J Cancer*, 105: 103–113.

SPECTOR Malcolm and John I. KITSUSE, 1977. *Constructing social problems* (Menlo Park, Cummings).

SURYANARAYANAN Sainath and Daniel Lee KLEINMAN, 2017. *Vanishing Bees Science, Politics, and Honeybee Health* (New Brunswick, NJ, Rutgers University Press).

TAKALA Jukka, Päivi HÄMÄLÄINEN, Kaija Leena SAARELA, Loke Yoke YUN, Kathiresan MANICKAM, Tan Wee JIN, Peggy HENG, Caleb TJONG, Lim Guan KHENG, Samuel LIM and Gan Siok LIN, 2014. "Global estimates of the burden of injury and illness at work in 2012," *J Occup Environ Hyg*, 11 (5): 326–337.

THÉBAUD-MONY Annie, 1991. *De la connaissance à la reconnaissance des maladies professionnelles en France. Acteurs et logiques sociales* (Paris, La Documentation Française).

TWEEDALE Geoffrey, 2000. *Magic Mineral to Killer Dust: Turner & Newall and the Asbestos Hazard* (Oxford, Oxford University Press).

WILCOSKY Timothy and Steve WING, 1987. "The healthy worker effect. Selection of workers and work forces," *Scand J Work Environ Health*, 13 (1): 70–72.

YANG Liu, Adam BRANSCUM and Laurel KINCL, 2022. "Understanding occupational safety and health surveillance: expert consensus on components, attributes and example measures for an evaluation framework," *BMC Public Health*, 22 (1): 498.

ZAVESTOSKI Stephen, Phil BROWN, Meadow LINDER, Sabrina MCCORMICK and Brian MAYER, 2002. "Science, Policy, Activism, and War: Defining the Health of Gulf War Veterans," *Science, Technology & Human Values*, 27 (2): 171–205.