A Year of "Very Historic Breakthroughs"?

Scientific Breakthrough Claims and Narratives in the Public Reporting of Coronavirus Research in 2020

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"A Very Historic Breakthrough"–Not?!

On August 24, 2020, both *Science* magazine and the *New York Times* reported on "a highly unusual Sunday night press conference," during which "U.S. President Donald Trump revealed what he described as 'a very historic breakthrough' in the fight against COVID-19'" (Kupferschmidt and Cohen 2020). In view of this breakthrough, it was announced, the U.S. Food and Drug Administration was authorizing a new type of treatment, "issu[ing] an emergency use authorization (EUA) for convalescent plasma to treat people with severe COVID-19" (Kupferschmidt and Cohen 2020). The reports and comments in *Science* magazine and the *New York Times* were decidedly critical, and both of them pointed out two major considerations that called the announcement into question. First, the claim "that the plasma therapy could save the lives of 35 out of every 100" critically ill patients was inflated in consequence of misinterpreted statistics, as the F.D.A.'s commissioner subsequently conceded: "the number is much closer to three to five out of every 100." In addition, "even that lower estimate is questionable," since the "data came from an observational study, not a rigorous clinical trial," as the *New York Times* stressed ("Politicizing Medical Science Will Cost American Lives" 2020). *Science* magazine reported further criticism from independent scientists who denounced the measure as an instance of political interference in scientific decisions: "Eric Topol, a cardiologist who directs the Scripps Research Translational Institute, says the EUA 'again represents the FDA caving directly to Trump pressure,' as he believes it did when it issued an EUA (later rescinded) for hydroxychloroquine treatment for COVID-19. 'It sadly and unacceptably exemplifies loss of independent FDA assessment of evidence and data overridden by political pressure,' Topol says" (Kupferschmidt and Cohen 2020).

In this situation, falsely proclaiming a scientific breakthrough was not simply an academic matter. There are potentially severe real-life consequences to the propagating of exaggerated, misguided, and potentially harmful breakthrough claims,

and a responsible science journalism must see cause for concern about the relationship between science and politics: "Many scientists worry the same could happen in future decisions about EUAs for COVID-19 vaccines–with far greater potential consequences because vaccines presumably will be given to hundreds of millions of healthy people" (Kupferschmidt and Cohen 2020). That later worry, however, would disappear from breakthrough reporting by the end of the year, when the conflicting breakthrough claims advanced by different political and scientific agents had given way to a celebration of the surprisingly quick development of effective vaccines. But the question of authority over the public designation of an aspect of scientific research as a breakthrough in relation to the COVID-19 pandemic remained virulent throughout the year.

The reports in fact illustrate a number of points that will be relevant to this essay. To begin with, they put into evidence the set of players involved in making, confirming, or rejecting claims about scientific breakthroughs: scientists, science journals, general media, and political agents each claim their share of authority in deciding about whether a scientific breakthrough has occurred or not. Secondly, the reports appear to lend plausibility to those scientists who claim that situations such as the COVID-19 pandemic take societies beyond the operations of what we have come to know as 'normal science' (Kuhn 1962). That is, that the situation poses challenges that can no longer be addressed through the processes reaching solutions through iterative cycles of puzzle-solving within the framework of an established scientific paradigm. The pandemic should instead be conceptualized as a time of 'post-normal science,' creating a crisis in the conditions of knowledge production, and calling for a "new understanding of science for situations when facts are uncertain, stakes high, values in dispute and decisions urgent" (Waltner-Toews et al. 2020). Finally, the reports also put into evidence the one point that appears to be accepted by all involved: a true 'scientific breakthrough' would allow societies to deal effectively with the situation that arose with the spread of the coronavirus in the winter of 2019/2020.

Throughout the first year of the pandemic, the questions of whether a breakthrough had occurred and what it consisted in, received a sustained, if not always extensive, amount of attention in the public reports on scientific research. This contribution will review the evidence of the often contested 'breakthrough coverage' during the first year of the pandemic. Its goal is to shed light on the particular varieties of 'breakthrough narratives' that were being constructed by different agents and voices in the arena of public discourse on science.

As a first working conception I posit that each breakthrough claim, however great or small the detail in which it is presented, contains at least an implied narrative. The breakthrough represents a turning point, a point that introduces a radical difference between whatever situation existed before, and whatever new situation is created by the event that is characterized as a breakthrough. Those who engage in breakthrough discourse, whether by making breakthrough claims or by reporting,

assessing, or contesting them, will give more or less detailed, more or less established versions of the difference between the pre- and post-breakthrough situations, and of the quality of the event that effected the shift between the two situations. But the very pattern of perception that the scientific breakthrough narrative establishes is a narrative pattern. To focus on the occurrence of breakthrough discourse and on the different, more or less elaborate forms of narrative that are connected to it, may help us better understand both the modes of construction and the functions of this particular kind of science narrative. It may offer, at the very least, a retrospective account of how the public debates around scientific breakthroughs in COVID-19-related research contributed to the cultural process of coming to terms with the Covid crisis.

Prior to engaging in this examination, it may be helpful to outline a preliminary heuristic for the following analysis. In examining breakthrough discourse (i.e., any instance in which a scientific breakthrough is mentioned in any form), I will distinguish between 'breakthrough claims' as instances when something is explicitly described as a breakthrough by a given source, 'breakthrough reports' as instances when a breakthrough claim is reported but not necessarily embraced and endorsed, and 'breakthrough narratives' as the implicit narrative dimensions of a given breakthrough claim, whether embraced or merely reported, which elaborates in greater or lesser detail the events and factors that led up to the breakthrough or stood in its way, as well as the changes of situation that the breakthrough is likely to effect or has already effected.

The account of breakthrough discourse that will emerge in the course of this chapter will trace the several trajectories, shifts of direction, and various players in breakthrough debates through the course of the year 2020. It will record the changing constellations of breakthrough skepticism, breakthrough controversies, and tentative hopes for scientifically substantiated breakthrough claims. In the process, we will see considerable variation in the degree of elaboration, the temporal focus, as well as in the implied argument of the narratives. The multiple agonisms in breakthrough coverage throughout the year give way to a range of celebratory breakthrough narratives that dominated science reporting toward the end of 2020. Those retrospective narratives, in contrast, will be selective in that they leave out most of the controversial claims, as they leave out the story of careful monitoring, insistent warning, and even determined resistance against misleading breakthrough bids that these required at the time. In a field marked by contested and disputed claims, the leading media in science reporting draw on scientific breakthrough narratives that seek to offer orientation and authority, calling for trust in the scientific process by concentrating on the steps that brought about the improbable breakthroughs in the prevention and treatment of COVID-19.

Backgrounds and Frameworks

On Scientific Breakthroughs and Breakthrough Narratives

The 'scientific breakthrough narrative' forms one of the major tropes in popular representations of the history of science. There is no shortage, in popular science writing, of accounts of the "scientific breakthroughs that changed the world" (see Horvitz 2002). But the scientific breakthrough narrative is by no means limited to historical accounts of science or to the sphere of popular science writing. 'Breakthrough discourse' occurs across a wide range of public as well as specialist discourses of science, from science journalism and science communication to the discourse of the sciences themselves.

Notwithstanding the long tradition and ongoing relevance of breakthrough narratives in the perception and mediation of events and developments in the sciences, only a comparatively small body of work has been done on the phenomenon in science studies. In the history, the philosophy, or the sociology of science, 'breakthrough discourse' is rarely employed. But neither, as a rule, is it studied. As Nik Brown ([2000] 2016) notes in one of the few academic engagements with breakthrough discourse, the 'breakthrough' trope has often been criticized for being overused. While there are, no doubt, many valid arguments in favor of developing other and more appropriate concepts for representing the processes of scientific knowledge production and specifically the innovative dynamics in science, there is also a case in favor of research on how these dynamics are represented, conveyed, and contested in public discourses in and about the sciences. A clearer insight into the deployment, the functions, and effects of breakthrough discourse in the representation and mediation of science is desirable, if only because scientific breakthrough narratives continue to be used in the context of the public mediation of scientific work and its results. For all its widespread occurrence, we know very little about the varieties, the functions, and the specific distribution of breakthrough discourse and breakthrough narratives across the discursive landscape in and around the sciences.

The same is true, incidentally, for the occurrence of scientific breakthrough narratives in literary fiction, despite the significant number of novels whose plots are clearly constructed around scientific breakthroughs. Contested or hypothetical breakthroughs in contemporary science novels, significant breakthroughs in the history of science in historical fiction, or indeed hypothetical breakthroughs and their potential effects and consequences in speculative fiction, all would de-

serve closer critical attention in the context of an examination of public science narratives.[1]

I would like to propose, as a more general working hypothesis, that scientific breakthrough narratives tend to be concerned with assessing and negotiating the *transformative dynamics of scientific innovation*. On the evidence of a cursory review of instances of the breakthrough narrative across literary fiction, popular science writing, and science journalism,[2] it appears to be one of the fundamental convictions in modern societies that scientific innovation leads to changes not just in the sciences but also in society. As the popular title quoted above indicates, the assumption is that scientific breakthroughs have the power to "change the world" (Horvitz 2002), and one of the points of interest and engagement with them lies in the exploration of the ways in which they are said to do so. As in popular science writing, but arguably with a decidedly different range and set of perspectives, historical breakthrough narratives in literary fiction provide accounts of how, for better or worse, human thought and human societies have been transformed in consequence of scientific innovation. Similarly, contemporary or near-future breakthrough narratives address how, again for better or worse, current or future scientific innovation may transform life in contemporary societies, or in the societies of the more immediate or more distant future. The idea that "[s]cientific and technological innovation has always created social and economic transformation" is also shared by leading science journals ("Scientific Events That Shaped the Decade" 2019, 337). Modern societies, it appears, understand themselves as shaped, in vital dimensions, through the processes of a transformative dynamics of scientific innovation.

Against this background, I propose a further working conception: the scientific breakthrough narrative may be understood as *an established discursive tool, deployed across a wide spectrum of public and specialist discourses in and around the sciences, for negotiating the transformative dynamics of scientific innovation*. As such, the scientific breakthrough narrative may be said to have a distinctly *diachronical diagnostic* dimension. It proposes a specific assessment that not only claims to define a situation but also positions it at one specific juncture within the succession of three distinctly constellated states: a first and third state which differ radically from each other in some specific ways posited by the narrative, and an intervening breakthrough event or phase, in which the factor causing the radical change emerges. The scientific breakthrough narrative therefore enables the discursive positioning of propositions concerning

1 A more comprehensive project, still evolving, of which this chapter is a facet, is designed to look at scientific breakthrough narratives in literary fiction, as well as, contrastively, at breakthrough discourse across a range of public media.

2 I am indebted to the research assistance of Sina Rothert and Mark Kitchingman for gathering the materials for this cursory review.

the transformative potential of individual cases of scientific innovation. The narrative point of view from which the breakthrough is presented may be aligned with any of the three phases: looking back to define a radical shift that has occurred and identify the breakthrough event responsible (narrative perspective associated with 'phase 3'); or identifying a new breakthrough to assess its anticipated consequences and recapitulate the steps and factors that made it possible or contesting a breakthrough claim by calling into question its transformational qualities (narrative perspective associated with 'phase 2'); anticipating a breakthrough that has not yet occurred and describing its potential consequences (narrative perspective associated with 'phase 1'). Scientific breakthrough narratives may thus involve–potentially controversial–evaluations of the specific types of transformation that have taken place or may be expected, as well as of the factors that have enabled such transformative moments or are likely to enable them. Which of these angles and perspectives predominates is contingent on where in the spectrum of public and specialist discourses in and around the sciences the narrative is put forward, and also contingent on the specific positioning of a discursive agent within that particular discourse. At any rate, in a toolbox of public and specialist discourses in and about the sciences, which a more comprehensive research on the narrative mediation of science might aim to establish, the scientific breakthrough narrative will need to be included as one of the prominent components.

Approaches to Breakthrough Coverage in Science Reporting and Science Journalism

The current contribution undertakes a case study in the field of science reporting in the media, examining the 'scientific breakthrough' coverage in leading science journals and leading news media as it relates to the coronavirus and the disease it causes in humans. Specifically, I trace the occurrence, the varieties, and the functions of the 'scientific breakthrough narrative' in public representations of scientific research relating to the coronavirus. I review the coronavirus coverage in science journals as well as in general journalism, drawing on the *Lancet* and *Science* magazine as well as *Nature* for the former, and on the *Guardian* and the *New York Times* for the latter. I am conscious of the limitations of this choice of media and the fact that the choice is somewhat slanted towards quality journalism. But in the polarization of the landscapes of journalism and public media that has occurred at least in the course of the 2010s, these newspapers and their media presence have also come to be identified as 'liberal' in outlook–an outlook that has been contested as biased by public voices classified as 'very conservative' or right-wing, corresponding to a new division of the public sphere that has emerged or at least become considerably less marginal during the past decade or so. The mediated voices catering to this kind of counter-public are not represented in my sample, nor, indeed, are non-Western media channels repre-

sented, resulting in a narrative that privileges US-American and Western European research and coverage. Both absences must be acknowledged as a limitation of the current sample of discourse, to be remedied in the course of future research. This is especially true for the question to what degree the course of breakthrough debates in science journalism and the leading media may have been affected by the pressures exerted through the existence of these other media and discourses.

The following guiding questions will help orient the analysis: How have scientific breakthrough narratives been part of the public representation and public perception of the Covid crisis? Which findings, events or developments precisely are being designated as 'breakthroughs' at a given point, what backstories are presented and what future consequences are anticipated? Who draws on this narrative pattern in discussing the design, the results, and the developments in scientific research relating to the coronavirus? Which of the voices and players in this field propose or rely on them? Which call them into question? And more generally: What are the discursive contexts in which the narrative pattern is employed, in what variations does it occur, and what functions are associated with it in each context?

My contribution will focus chiefly on the first year of the pandemic. This choice is based on the evidence gathered through searches of the selected media for the years 2020 and 2021, relying on the search engine offered by each of the media, and for the terms 'breakthrough' and 'Covid' or 'breakthrough' and 'corona.' All in all, the material returned by that search is not extensive. It yielded around 60 results for the year 2020, in all four media, distributed somewhat unevenly across the timeline and the different media, suggesting that breakthroughs remain a special and exceptional concern, rather than the day-to-day business of science reporting. The amount is still significantly higher than the number of items found for the following year, when breakthrough coverage in terms of scientific discoveries played a decidedly minor role (while the rather unrelated problem of 'breakthrough infections,' infections suffered by persons who had been vaccinated, became a matter of concern). I will return to the question of distribution and frequency of breakthrough references in more detail below.

It must be stressed that the material and its analysis cannot claim to go beyond the character of a probe. All quantitative statements will need to be taken with a pinch of salt, given the fact that digital searches through each of the four media come with certain limitations. I suggest, nevertheless, that the patterns identifiable even in this limited material are substantial enough to warrant further and more extensive research into the occurrence and the functions of the 'scientific breakthrough narrative' in the context of public representations of science, whether employed by scientists, journalists, academics, or politicians or, indeed, in the context of literary discourse.

Approaches to the "Intra-Relationship Between Normal Science and Normal Science Reporting"

Joan Haran and Jenny Kitzinger's "Modest Witnessing and Managing the Boundaries Between Science and the Media" (2009) is particularly helpful in establishing a backdrop for the current analysis. The authors examine the ways in which the media, both general and scientific, were handling the claims of having achieved a breakthrough in the cloning of humans put forward by South Korean geneticist Hwang Woo Suk and his international team of collaborators. They trace the steps from the excitement of the initial announcements to the subsequent exposure of these claims as fraudulent through the work of South Korean investigative journalists, aided by whistleblowing members of Hwang's team. The paper does not explicitly engage with the concept of 'breakthrough,' but the incisive analysis of the interrelations between scientist researchers, policy makers, scientific journals, science journalism as well as general journalism, which the authors demonstrate in their analysis of both the initial enthusiastic coverage and the later debunking of Hwang's work, will be helpful in observing breakthrough discourse in coronavirus research reporting.

Haran and Kitzinger effectively demonstrate "how science journalism and news reporting routinely depends on official sources and how science correspondents often have an investment in narratives of scientific progress" (2009, 647). In discursive practice, these "mutually reinforcing connections" (2009, 646) extend across the range of scientists' specialized arenas of publication and exchange via the leading science journals and leading public media. In the latter, scientific developments of a particular significance will be reported not only in the 'science sections' but also in the main sections, resulting in "an investment [on the part of science journalists] in a story that will get their byline on the front page" (2009, 647).

Haran and Kitzinger's account highlights, at the same time, that this "intra-relationship between normal science and normal science reporting" (2009, 647) is routinely disavowed. In the public perception, the role of science journalism–in its different degrees of specialization and authority–for the validation and public positioning of scientific work tends to be overlooked. The public discourses thus appear to seek to establish a reductive picture of their own function, as mere observers and transparent media offering windows, as it were, on the work done by scientists in specialized seclusion. Arguably, this amounts to an implicit refusal to acknowledge the interrelationships between the spectrum of players from scientists and scientific institutions, funders, and policy makers, via major (peer-reviewed) science journals to the different types of science reporting in the wider media, and to critically examine the impact and effects of these discursive constellations both on the public perception of science and on the sciences themselves.

Although Haran and Kitzinger do not explicitly problematize the concept itself, it may be no coincidence that they choose the example of an ostensible 'scientific breakthrough' for their case study. The breakthrough appears as a central figuration drawing public attention to the work of scientists. It not only takes a prominent position in the public presentation and presswork of scientific institutions but no doubt contributes to shaping the practice of science itself, and perhaps to shaping the frameworks and conditions within which scientists' research continues to be devised, carried out, documented, and assessed.

Two inferences from Haran and Kitzinger's account of the "intra-relationship between normal science and normal science reporting" (2009, 647) appear especially relevant for the present context. The first of these concerns *the relationship between science and the public*: instead of conceptualizing science as divided into a more or less hermetical inner world of specialists on the one hand and a public arena of science reporting on the other, it is more realistic to envisage for each particular science report a spectrum of interrelated positions which includes

- a range of *scientists' voices*, including the main research scientists, team members and collaborators from other institutions (national or international), and scientists not involved in the research,
- *institutional voices*, such as speakers on behalf of research institutions, funding bodies, and science policy bodies,
- *science journals* (peer-reviewed) carrying scientific papers, but also press releases and news and opinion sections,
- *science journalism*, science sections of established media (newspapers, etc.),
- *political journalism*, with particularly salient science coverage in the context of general news, with exceptional achievements being reported on the 'frontpage,' and
- *popular journalism*, celebrating particular scientists and covering backstories and personal interest angles.

Not all of these positions will be visible in all cases, but the reporting and the establishing of the significance of scientific results is an effect of the interplay of these several agents, rather than a purely scientific process which is simply being relayed to a wider public by the media.

The second point to be drawn from Haran and Kitzinger's account concerns the specific status of breakthrough narratives in relation to 'normal science.' The idea that scientific breakthrough narratives are one of the elements in the connections between 'normal science and normal science reporting' adds a specific angle of interest to an examination of the incidence of breakthrough discourse under the conditions of the COVID-19 pandemic, since the pandemic creates a situation that in the eyes of some scientists no longer fulfils the conditions for the practice of 'normal

science.' On March 25, 2020, a group of nine scientists from research institutions across Europe and North America published a jointly authored blog post in which they claimed that the beginning pandemic should be classified as the latest instance of a situation to which the operations and procedures of 'normal science' were no longer applicable. Instead, they argued, the situation created by the COVID-19 pandemic should be conceptualized in terms of "Post-Normal Science (PNS)"–a term originally coined by two of the nine authors (Funtowicz and Ravetz, 1993), and defined by them as a "new understanding of science for situations 'when facts are uncertain, stakes high, values in dispute and decisions urgent'" (qtd. in Waltner-Toews et al. 2020).

Haran and Kitzinger's work thus helps sharpen the focus of the following analysis in two specific respects. First, it enables a clearer recognition of the constellations of science reporting and science journalism and of their role in mediating the yields of scientific research and in shaping the public perception of scientific innovation. Second, by extending their proposition of a correlation between 'normal science' and 'normal science reporting' to explicitly include the paradigm of the scientific breakthrough narrative, a question arises regarding the role of scientific breakthrough narratives under conditions of 'post-normal science,' or more specifically: about the role of scientific breakthrough narratives under post-normal social conditions that affect the frameworks under which, in other circumstances, 'normal science' is practiced.

It might then be that both aspects stand in a correlation. Being positioned at the interface between science and society, or more precisely between the specialist discourses of the sciences and the wider social discussion in public media, the study of scientific breakthrough narratives might shed light on the question not only of the mediation of science through public media but on the co-production of scientific breakthroughs through an interplay of specialist and public voices. How do the pressures, crises, and controversies in and among different sections of the public sphere connect to, and perhaps impact, the monitoring and critical assessment of scientific breakthrough potentials within the specialist arenas of scientific discourse? How do they affect the various dimensions of specialism–the interplay between the authority of knowledge and expertise on the one hand, and the principial openness of all scientific insight to further debate and revision or falsification, an interplay embodied in the peer review process, on the other? And how do they come into play in the complex public arena where controversy and the establishment of voices of authority in leading media intermingle, where multiple interfaces exist between the specialist discourses and the public arena listed above, the dimensions of public outreach–comprising a journalistic ethics of verification and responsible journalism–and at the same time an openness to political debate, positioning, and disagreement? Haran and Kitzinger have highlighted how the dimensions of specialism and of public remediation come together in the production of the

leading and validated science of the day. By focusing on the co-production of validated cases of scientific innovation under conditions of the pandemic, the material may also provide insights into the possible functioning of scientific breakthrough narratives in the contested discursive territory of 'normal science' vs. 'post-normal science,' of scientific practice and its multiple discursive remediations under the decidedly post-normal conditions of the COVID-19 pandemic.

2020: A Year of Breakthrough Claims and Narratives

My review of the breakthrough coverage in leading media of science reporting shows not so much a clear-cut chronology of separate phases but rather a succession of distinct tendencies and prominent positions with certain chronological overlaps. Nevertheless, the dates as well as the sites of publication have a bearing on the trends I seek to highlight. For this reason, I have slightly adapted the author-date system of recording quotations to make both the dates and sites of publication instantly visible.[3] It will be seen that the narrative dimension linked to individual breakthrough claims may be very sketchy in some cases and quite elaborate in others. My account of the material will take note of this as appropriate.

End of the Year/End of the Decade Reviewing: Illustrating a 'General Breakthrough Appetency' in 'Normal Science Reporting' (December 2019–January 2020)

To set the background for the following case study, I will begin by looking at the situation just before the virus became a major focus of public attention. A glance at 'normal science reporting' around the end of 2019 provides a useful insight into breakthrough discourse under conditions of normal science and under 'normal' societal conditions. It can serve as a foil to the ensuing analysis of the evolving situation once the virus begins to dominate not merely science reporting but the general journalistic coverage. For these reasons I start by exploring the scientific breakthrough narrative in the context of customary reviews of the major events and developments of the year in these media.

End of the year reviews are a regular element in all fields of journalistic coverage. In late 2019, they were often extended into 'end of the decade' reviews. Science journalism is no exception to this practice, nor is this limited to the public segment, the

3 In addition to the last name of the author and the exact date of publication, I include a brief reference to the site of publication (*Guardian*, *NYT*, *Nature*, *Science* mag., *Lancet*). This will allow the reader to keep track of the temporal dynamic of the individual voices and contributions without having to turn to the bibliography in each case.

science sections of general media. Leading science journals featuring peer-reviewed original research participate in this kind of reporting as well. *Science* magazine has in fact offered an annual 'breakthrough prize' since the mid-1990s, and at the conclusion of each year crowns the winner of this prize, along with nine runners-up, which are also presented and lauded, though more briefly. *Nature* does not award a prize, but the final issue of 2019 provides its review of the "scientific events that shaped the decade." The pronouncements of both *Science* and *Nature* are invariably reported in the science sections of leading general media.

In its review, *Nature*'s editorial also looks ahead to the coming decade, declaring, "The 2010s saw breakthroughs in fields from gene editing to gravitational waves. The coming decade must focus on climate change." It goes on to detail, "Scientific and technological innovation has always created social and economic transformation. But the past decade showed, as few others have, the speed and scale at which such change can happen. If it continues at the present rate, the shape of the next ten years–from information technologies to applied bioscience, energy and environment–looks ever more contingent on the discoveries made in that time" (NN, *Nature*, 12/19–26/2019, 337).

I have quoted this passage for two reasons. First, it exemplifies the suggestion presented above about the functional dimension of the scientific breakthrough narrative: the proposition that scientific breakthrough narratives are fundamentally concerned with the transformative dynamics of scientific innovation is posited here as a truism. A second point is illustrated by this passage by implication: the public discussion of science–in which *Nature* is one of the most prominent voices and platforms–has the role of monitoring the work of scientists in order to single out those events in science to which can be attributed the potential of a transformative dynamics of this kind. Science reporting and science journalism need to be on the lookout for the scientific breakthroughs that are likely to 'change the world.' In this capacity, they will adopt all of the various points in the time scale we have identified as implied in the scientific breakthrough claim. They recapitulate the major breakthroughs of the (recent) past, from a point-of-view where their status as breakthrough is ascertained, even if not all of their implications may have become clear. They speculate about the areas where future or imminent breakthroughs will occur or are desirable, about the factors that may potentially bring them about, and about the effects (and possible benefits) that may ensue. And of course, as part of their day-to-day business, they will monitor, relay, and critically assess the breakthrough claims that come to their attention through the various relevant channels.

Early Pandemic Science Reporting: 'Breakthrough Hesitancy' (February–May 2020)

Breakthrough discourse is rare, albeit not completely absent during the initial months of the pandemic. However, it is accepted as a given that without a scientific breakthrough, there are no prospects for a swift return to pre-pandemic life. Remarkably, the dominant note in relation to breakthroughs is a decided skepticism. Writers express their reservations and express warnings against potential misguiding of public expectations both through the use of the label and the kinds of stories frequently associated with it. A writer in the *Lancet* warns very early on against the mistaken perceptions of scientific processes and against the misguided expectations created by certain versions of publicized breakthrough stories (Harmann, *Lancet*, 03/07/2020). A writer in *Science* magazine expresses his hesitation regarding breakthrough claims made in press releases of a particular scientific institution which are not backed up with relevant scientific detail: "The word 'breakthrough' was thrown around," writes Derek Lowe, arguing that such an announcement "is best met with a shrug until more details are released" and cautioning readers against unsubstantiated news flashes: "We can expect more announcements of this type in the near future, I would think" (Lowe, *Science*, 05/06/2020).

At the same time, writers articulate a fundamental conviction that any effective strategy to end the pandemic, or at least to end it quickly, would require a scientific breakthrough (e.g., Bokat-Lindell, *NYT*, 04/07/2020). This is accompanied by what might be described as a shift in the 'chronopolitics' of breakthrough coverage: a veritable 'breakthrough hesitancy.' Next to no mention is made of any past breakthroughs, while instead there is a combined attention to possible future breakthroughs—which currently are nowhere in sight—and a decided cautiousness regarding any breakthrough claims that might emerge from different sources. In addition, there is a general consensus on the areas in which such a breakthrough might be possible: the search is for different substances for treatment, possibly involving the use of antibodies (Lowe, *Science*, 05/06/2020), and, more remotely, the possibility of a vaccine (Bokat-Lindell, *NYT*, 04/07/2020). The emphasis, however, remains on stating that no breakthrough in any of these areas appears imminent to any qualified observers.

In parallel, a limited but promising potential for breakthroughs is identified outside these classical areas of scientific research. The *Lancet*, for instance, reports on the use of digital means for monitoring the emergence and spread of what at this stage was still referred to as an 'epidemic.' The article reports on work published on February 20, 2020 (Sun et al. 2020), whose aim was to "put together a line list of suspected, probable, and confirmed individuals on the basis of working criteria of the respective case definitions": "This line list would allow for quick preliminary assessment of epidemic growth and potential for spread, evidence-based determi-

nation of the period of quarantine and isolation, and monitoring of efficiency of detection of potential cases. Frequent refreshing of the line list would further enable real-time updates as more clinical, epidemiological, and virological (including genetic) knowledge become available as the outbreak progresses" (Leung and Leung, *Lancet*, 02/20/2020, e156).

The contribution analyses the currently existing difficulties and determines the conditions that would produce 'a breakthrough': "We surveyed different and varied sources of possible line lists for COVID-19 (appendix pp 1–4). A bottleneck remains in carefully collating as much relevant data as possible, sifting through and verifying these data, extracting intelligence to forecast and inform outbreak strategies, and thereafter repeating this process in iterative cycles to monitor and evaluate progress. A possible methodological breakthrough would be to develop and validate algorithms for automated bots to search through cyberspaces of all sorts, by text mining and natural language processing (in languages not limited to English) to expedite these processes" (Leung and Leung, *Lancet*, 02/20/2020, e156).

But even in this case, the point is to assert that a breakthrough has not yet happened. The work by Chinese scientists discussed in the article does not constitute a breakthrough in itself. It just enables speculation about what a "possible methodological breakthrough" might look like. Even here, the predominant note is one of caution and patience, since a decisive breakthrough does not appear to be in sight.

The sole instance where a certain development is actually characterized as a breakthrough concerns the question of how the scientific research into possible treatments or means of prevention is organized. The 'breakthrough' consists of a novel way of organizing additional funding for the WHO's urgent Covid response while ensuring the WHO's continued independence from the particular interests and agendas of any of the donors: a crowdfunding mechanism, running through "the UN Foundation, in the first instance," where "funding from all donor sources (individuals, companies, and philanthropies) is comingled when disbursed to WHO for WHO to put to urgent use" (Usher, *Lancet*, 03/28/2020).

To sum up, in these early days of the pandemic, it is remarkable that the term 'breakthrough' is very nearly absent from science reporting in relation to the coronavirus in the *Guardian* and the *New York Times*. The fact that the science journals (*Science*, *Nature*, *The Lancet*) predominantly express reservations or qualifications about most breakthrough claims reported elsewhere is not addressed in the leading general media. The few cases where breakthroughs are mentioned in relation to the pandemic underline a consensus that any effective strategy toward ending the pandemic would require the occurrence of a scientific breakthrough. At the same time, however, all writers assert that no chain of events appears to be discernible that might be confidently claimed to become part of a scientific breakthrough narrative.

Monitoring Therapeutic Breakthrough Claims (May–July 2020)

By May 2020, the term 'breakthrough' begins to pop up in discussions of possible treatments. There is a succession of reports, from different sources, about the possibility of effective treatments of COVID-19 in its different manifestations. Both science journalism and the leading science journals see their role not only in reporting these claims but also in contextualizing and critically assessing them. The treatments whose effectiveness is assessed in this context are hydroxychloroquine and coronavirus antibody therapy, then Dexamethasone in contradistinction to Remdesivir, and later an interferon booster. Gradually, the journals begin to display a readiness to engage in principle with the possibility that trials may reveal the effectiveness of new or existing medication for treating COVID-19 in one of its manifestations. At the same time, however, the pattern noted by Haran and Kitzinger, according to which the public reporting and the wider public echo wait for their cue, acting only after validation and endorsement of breakthrough claims by the leading science journals, appears to come into disarray in several ways.

The earliest candidate, hydroxychloroquine, is proposed and retracted in quick succession in the *Lancet*, with apparently no wider coverage in relation to breakthrough claims. On May 22, 2020, the *Lancet* carries a study on possible beneficial therapeutic effects from "Hydroxychloroquine or chloroquine with or without a macrolide." The study takes a very cautious stance and refrains from recommending the substances for treatment. It never comes close to categorizing the treatment as a breakthrough but quotes in passing an earlier article by Chinese scientists in which this treatment is described as a "breakthrough" (Gao et al. 2020). Within weeks, however, the *Lancet* publishes a retraction even of this cautious stance, in which three of the four original authors cast doubt on the reliability of the data source for their article, which had not been made accessible to them or to independent reviewers, and by implication on the reliability of their fourth co-author (Mehra et al., *Lancet*, 05/22/2020; Mehra et al., *Lancet*, 06/04/2020).

The retraction in the *Lancet* does not receive any immediate coverage as a case of an unsubstantiated breakthrough claim. In fact, it comes after, rather than before, lively and controversial public debates and controversies about the therapeutic values of the substance. In early April 2020, the *Guardian* already covers an extensive account of how political leaders including then-US president Donald Trump had endorsed the taking of Hydroxychloroquine on the strength of the possibility that it might have preventive or therapeutic effects in relation to COVID-19. While scientists warned that the study on which these claims were based were not reliable, the claims were promoted by US media outlets such as Fox News, conspiracy theorists, and influential personalities such as Elon Musk. Even without any scientific proof, the *Guardian* reports, "[a]n 85-year-old [malaria] medication was well on its way to becoming a Covid-19 meme": "The scientific debate over the drug was drowned out

by a decidedly partisan one" (Wong, *Guardian*, 04/07/2020). Without any prominent deployment of breakthrough discourse, the account which the *Guardian* gives of the spread of an unproven therapeutic claim speaks to the pressures which the pandemic appeared to be putting on the long-established patterns of what Haran and Kitzinger have termed the "intra-relationship between normal science and normal science reporting" (Haran and Kitzinger 2009, 647). The emergence of an 'alternative public sphere' based on a principle of distrust and suspicion against the liberal democratic public sphere represented by the leading media analyzed here, which had in many ways preceded the pandemic, clearly contributed to these pressures. It does not, however, appear to be the only factor responsible for the observable variations in breakthrough coverage.

It does not, for instance, appear to produce the next case, which is a report by the Press Association, relayed in the *Guardian*, announcing that a "[b]reakthrough [is] close on coronavirus antibody therapy" (06/07/2020). Whereas earlier claims relating to the effectiveness of antibody treatments had been greeted with skepticism in science journals (as indicated above, in this case, the *Guardian* relays the report without any caveats and without waiting for approval by the science journals. The reason must remain a matter of speculation, though one possible explanation could be the fact that in this case the claim originates with scientists working for the British Swedish company AstraZeneca, which may appear as a trustworthy source in a British context, as well as carrying particular interest to a British readership.

Dexamethasone is the treatment option that creates the widest echo and whose breakthrough claim is reported widely and without reservations. The 'breakthrough' is covered simultaneously by *Nature* and *Science* on June 16, 2020 (Ledford 2020a; Kupferschmidt 2020), and in an article in the *Guardian* the following day (Boseley, *Guardian*, 06/17/2020). The discovery of the treatment is immediately claimed as a success of British science in press conferences by the British government (specifically Prime Minister Boris Johnson and Health Secretary Matt Hancock, quoted in *The Guardian*'s live blog, Sparrow and Perraudin, 06/16/2020).

The report in *Nature*, echoed in the *Guardian* on the following day, details the findings and specifies the beneficiaries. The effectiveness is greatest among "critically ill patients on ventilators" among which group the drug is reported to have lowered mortality by 33 %, reducing the percentage of deaths from just above 40 % to just under 30 %. The article goes on to identify a second group of beneficiaries: "Those who were receiving oxygen therapy but were not on ventilators also saw improvement: their risk of dying was reduced by 20 %." It also points out that the treatment makes no difference to all other patients: "The steroid had no effect on people with less severe cases of COVID-19–those not receiving oxygen or ventilation." The report goes on to quote "a chief investigator on the trial," "Peter Horby, an infectious-disease specialist at the University of Oxford, UK," who described the findings as "a major breakthrough," and then contrasts the results with those relating

"the only other drug shown to benefit people with COVID-19 in a large, randomized, controlled clinical trial," "the antiviral drug remdesivir": "Remdesivir was shown to shorten the amount of time that patients might need to spend in hospital, but it did not have a statistically significant effect on deaths" (Ledford, *Nature*, 06/16/2020).

The attitude taken in *Science* magazine with regard to the Dexamethasone trial is somewhat more reserved. Science holds back its own assessment: "Although full trial data have not yet been released, several outside commentators hailed the result as a 'breakthrough'" (Kupferschmidt, *Science*, 06/16/2020). The article then details the mode of operation and the statistical effects of dexamethasone treatments on the different groups of patients, and it also includes a plea of urgency to account for the fact that the recommendation was publicized before the trial data backing up the recommendation had been consolidated and finalized for publication. Once these results are made available in preprint (Horby et al. 2020), *Nature* publishes a revised version of its earlier article (Ledford 2020b), which includes more detailed information but does not use the term 'breakthrough' any longer.

In July, again without any precedent in the leading science journals, the Guardian reports on a further "'major breakthrough' in the treatment of coronavirus patients" achieved by "[t]hree professors at the University of Southampton school of medicine" who had established a company to produce an "interferon beta booster" whose share price had now suddenly risen significantly. A study of "101 people" given "a special formulation of the professors' interferon beta drug, called SNG001, delivered directly to their airways via a nebuliser" show significant positive effects compared to a placebo group: "the odds of patients developing a severe version of the disease were reduced by 79 %, and their breathlessness was also 'markedly reduced', the company said" (Neate, *Guardian*, 07/24/2020). This breakthrough claim finds no wider echo, however, and the 'special formulation' of the drug appears not to be ready for general use.

The public coverage of these several 'major breakthrough' claims displays some notable variations to the pattern of 'normal science reporting' described by Haran and Kitzinger, where the general science journalism follows the cue of validation by reports in science journals. While the leading media of science reporting clearly embrace their role of 'breakthrough monitoring,' the pattern according to which they do so appears to be susceptible to variation on account of a range of factors. A successive 'breakthrough appetency' may most clearly be discerned in relation to Dexamethasone. But even here, there are indications that initial responses are calibrated not simply in accordance with, and in consequence of, the positions emerging from the leading science journals. British media of science reporting appear to display a greater readiness to credit and relay breakthrough claims made by British scientists and institutions, as the respective responses by *Science* and *Nature* demonstrate, and evidenced by the relative prominence of breakthrough coverage in the *Guardian* as compared to the *New York Times*. National proximity is also in evidence in the case

of the AstraZeneca antibody treatment. The 'major breakthrough' claim relating to Synairgen's interferon beta booster is reported by the *Guardian* on the strength of the scientists' company's press announcement, and without the precedent of a report to that effect in a science journal. National proximity may be a factor here, too, as the *Guardian* reports on a breakthrough claim mounted by scientists from the University of Southampton. And it may even become a factor in reporting on the 'major breakthrough' claim relating to Dexamethasone, which is widely relayed. Still, it appears that British science media show a greater readiness to embrace a claim proposed by British scientists, even if the intensity of the initial breakthrough claims is not sustained and in fact retroactively toned down in *Nature*.

The controversies concerning the effectiveness of hydroxychloroquine do not appear to provide the pattern for all the variations which have just been listed. In fact, it appears that they are barely touched by breakthrough discourse. Instead, the tentative (and as it turns out sometimes premature or inconsequential) reporting on different therapeutic breakthrough claims appears to produce variations that speak for a growing if still cautious 'breakthrough appetency,' and a readiness to attribute greater credit to as yet unsubstantiated breakthrough claims calibrated by national proximity and the previous reputation of the claimants.

The leading media's own readiness to deviate from the sequential pattern of science reporting will be toned down again in the face of a growing tendency toward the strategic adoption of breakthrough discourse by political actors in a constellation of 'conflicting public spheres.'

'Race for the Vaccine' and Politicized Breakthrough Claims (July–October 2020)

While scientists across the world are working on the development of vaccines and beginning to report the results of their preliminary tests, breakthrough discourse in the public coverage of science takes on a new quality. This is in consequence of a growing tendency among politicians, notably among governments and their representatives, to mount their own breakthrough claims. Science journalists and science journals see a need to respond to these. The discussions around the scientifically unsupported claims about hydroxychloroquine as a 'miracle cure' were an early instance of the resulting controversial constellation, but that debate did not involve any significant dimension of 'breakthrough discourse' on either side. This changes in the course of the summer of 2020, as governments, and especially political actors with leanings that can be described as populist, begin to display a particular propensity towards presenting breakthrough claims, with science journalists and leading news media seeing the need for resistance.

Back in June, responding to the announcements of the results of the Dexamethasone trial, the British government, and prime minster Boris Johnson himself, had been quick to classify the results both as a breakthrough and a success for British

science. Another such claim is made in July with respect to results of early stages of vaccine trials. On July 20, 2020, the *Lancet* features a news release announcing that "British, Chinese COVID-19 Vaccine Trials Show Promise." The article points out that "[o]ver 250 candidate vaccines are currently under investigation worldwide, with billions of dollars poured into this research," and goes on to detail the promising results of two of these (University of Rochester Medical Centre 2020). It does not use the term 'breakthrough' in relation to the results reported by either the British and Chinese trials, however. On the same day, the *Guardian* reports that the British prime minister and health secretary have spoken of the British results as "a major breakthrough" (*Guardian*, 07/20/2020), but avoids endorsing it. The fact that the breakthrough claim is mentioned only in quotation marks suggests quite clearly that the *Guardian* takes its cues from science journalism while remaining skeptical of other sources. A few days later, indeed, an opinion piece in the *Lancet* will describe both the Chinese and British results as "unquestionable breakthroughs in the global response to the COVID-19 pandemic" (Horton, *Lancet*, 07/25/2020), but this assessment has not been made at the time when the *Guardian* breaks the news. As the *Guardian* reports, the UK government seeks ways for a speedier approval of a potential British-developed vaccine than would be possible in the UK under EU membership, hence the ability to bring the benefits of the vaccine breakthrough to the British people is pitched as a benefit of Brexit (see Boseley, *Guardian*, 08/28/2020).

Apart from this instance, however, the several processes of vaccine development and testing worldwide do not attract any large amount of breakthrough discourse in the leading media. In close proximity to the aforementioned report, the *Observer* (the Sunday edition of the *Guardian*) informs its readers that "the race for a Covid-19 vaccine is getting dirty" (Spinney, 08/30/2020). The article, which surveys the efforts toward developing vaccines that are underway around the world and addresses the political dimensions as well as the scientific debates around the handling of these efforts, does not employ or discuss the term 'breakthrough'; it was only returned in the search on account of 'breakthrough reports' referenced in it as potentially of further interest to readers. The article details the undertones of Cold War rhetoric and imperial ambitions in the contexts of the Russian, Chinese, and North American efforts. In addition, it reports scientific disagreement concerning the proper speed in vaccine development, pointing out that considerations of urgency should be balanced against the risks contingent on the mass deployment of an insufficiently tested vaccine, and specifically reporting skepticism and debate among scientists concerning the risk of "antibody-dependent enhancement," where the antibodies produced after a vaccine "can cause the recipient to experience a worse bout of the disease if that person becomes infected naturally later on." It may be noted in passing that the reporting of disagreement among scientists, and coverage of the points that are here listed as controversial, will no longer play a role in the coverage of the vaccine breakthroughs at the end of 2020. The article then goes on to point out that British science

sides with those in favor of speedy processes, as the "front-running Oxford University/AstraZeneca vaccine […] is one of a number of projects running phase 2 and 3 trials simultaneously" (Spinney, 08/30/2020).

By this time, there is a new challenge in breakthrough reporting: politically motivated but insufficiently substantiated therapeutic breakthrough claims. Most prominent among these is the announcement of "a very historic breakthrough" by US President Donald Trump, referenced already in the opening section of this chapter. The leading media see the need to resist this characterization, deploring the politicizing of scientific breakthrough claims and evidence-based decision making, while pointing out the risks that attend the "emergency use authorization (EUA) for convalescent plasma to treat people with severe COVID-19" issued by the U.S. Food and Drug Administration (Kupferschmidt and Cohen, *Science*, 08/24/2020). The *New York Times* editorial board takes a similar view, headlining "Politicizing Medical Science Will Cost American Lives" (08/24/2020), and returns to the question to further substantiate its resistance in early September (Lamas, *New York Times*, 09/02/2020).

A subsequent therapeutic breakthrough claim, mounted by the Brazilian government, is met with a summary dismissal. *Science* magazine reports, "On 19 October, the Brazilian government organized a high-profile ceremony to announce what it billed as a new breakthrough in the fight against the COVID-19 pandemic: the antiparasitic drug nitazoxanide. President Jair Bolsonaro was present, as were several other Cabinet members. 'We are announcing something that will begin to change the history of the pandemic,' science minister Marcos Pontes said" (Escobar, *Science*, 10/28/2020). The report is framed with a simple, decided and ironic dismissal: "Only one thing was missing from the presentation: the evidence. And when it emerged four days later, scientists were decidedly underwhelmed" (Escobar, *Science*, 10/28/2020).

Meanwhile, in reporting on the FDA's approval of Remdesivir in October 2020, science journalism merely sees a need to return to the position of monitoring breakthrough claims. The step does not call for resistance to political interference in evidence-based scientific decisions but simply for clear statements concerning the limited benefits to be expected of the treatment. The *New York Times* quotes a medical expert who declares, "This is not a blockbuster drug. This is not some massive breakthrough. It's a drug that appears convincingly to benefit patients, but it's not some kind of miracle cure" (Levenson, *NYT*, 10/22/2020, updated 10/29/2020).

Validated Vaccine Breakthroughs (November–December 2020)

Starting in November 2020, news of the results of vaccine Phase 3 trials move to the center of reporting. There is never any question that the results reported constitute anything but breakthroughs, and the coverage is extensive. Beginning with widely relayed reports on the mRNA vaccine breakthroughs by Pfizer/BioNTech and

Moderna on November 9 and 10, there is constant and insistent breakthrough coverage for much of November. The *Guardian* alone has four substantial pieces in these first two days, and follows it up with another three within the next ten days. The focus is first on BioNTech, then on Moderna, and then on the science behind both of these vaccines. A piece on the future Nobel Prize winner Katalin Karikó (Kollewe, *Guardian*, 11/21/2020) demonstrates that what has now come to be recognized as a breakthrough was already achieved in 2005 and consisted in the ability to produce mRNA that did not trigger inflammatory reactions and could therefore be safely injected into humans. Two weeks after BioNTech and Moderna, the Phase 3 results reported by Oxford scientists on the AstraZeneca vaccine are also positive and are reported as "the latest breakthrough." There is additional praise for the AstraZeneca vaccine on account of its being far less expensive (US-$3 as opposed to US-$70 per dose) and far easier in the logistics of distribution and storage than its competitors (Boseley, *Guardian*, 11/23/2020).

The assured status of these scientific results as breakthroughs prompts far more developed 'breakthrough narratives' than had been offered with the breakthrough claims in the course of the year. There are now extensive accounts of the frequently difficult paths that led to the results. By December 6, in an article titled "The Vaccine Miracle: How Scientists Waged the Battle Against Covid-19," the *Observer* looks back over a succession of breakthroughs in 2020. The narrative begins with the "sequencing breakthrough" by virologist Zhang Yongzhen at the Shanghai Public Health Clinical Centre, who published "the genome of the Sars-CoV-2 virus in January" 2020, and moves straight on to the "international effort" in the development of vaccines, of which around 200 had been or were still in the process of undergoing clinical trials before singling out the three vaccines that had announced the successful passing of Phase 3 clinical trials in the course of November.

The type of scientific breakthrough narrative offered here is quite selective in comparison with the story of breakthrough discourse that has emerged in the course of this chapter. The article does not record the several trajectories, shifts of direction, and various players in the breakthrough debates through the course of the year, and it has little place for the controversial claims, requiring a careful monitoring, insistent warning, and even determined resistance against misleading breakthrough bids. In a field marked by contested and disputed claims, these narratives offer orientation and authority.

The vaccine results thus provide a vindication of 'normal science' and its ability to produce socially desirable outcomes, the means of shaping and transforming the shared social world in desirable ways. This perspective is prominent in the *Guardian* and *Observer* (see Kollewe, 12/06/2020; Vallance, 12/13/2020) and in *Science* magazine (see Thorp, 12/18/2020). It is true that there is close temporal proximity in the reports, resulting no doubt from the extraordinary news value attached to them. Nevertheless, and in spite of the acceleration of regular testing procedures used in some

cases, the coverage of the vaccine results as breakthroughs also somewhat restores the sequential patterns of science reporting, where the results of tests are published after peer review, and where the leading media in science reporting, beginning with science journals (*Nature*, *Science*, *The Lancet*) and continuing with the leading general media such as the *Guardian* and *New York Times*, then go on to announce the significance of the results, and endorse their character as a scientific breakthrough, reflecting on the paths by which it became possible and discussing the magnitude and quality of the transformative effects to be expected from them.

Journals can now extend a similar perspective—the idea that success is the product of patient and thorough scientific research, and this in turn will provide reliable distinctions between valid and invalidated breakthrough candidates—to the range of the successive therapeutic breakthrough claims. In the reporting of the *Guardian*, the breakthrough claims made by British scientists are given precedence. First comes a report of a further breakthrough achieved in this way by UK scientists in Edinburgh, devising ways of preserving the lives of the critically ill (Sample, *Guardian*, 12/11/2020). The news is based on a paper published in *Nature*, though the breakthrough claim relayed does not feature in that paper but is made in the investigators' press statement. Two weeks later, the *Observer* recounts the story of the identification of "breakthrough medicines that could change the course of Covid" through the means of "the world's largest randomised Covid-19 drug trial," again instituted by two Oxford scientists (McKie, 12/17/2020). The many controversial therapeutic breakthrough claims which presented cause for concern in the course of the year now reappear in their proper place, having been evaluated in large-scale randomized trials. The confirmation of the effectiveness of Dexamethasone "remains one of the most dramatically successful outcomes in the battle against Covid-19. A cheap treatment for inflammation was found to save lives of seriously ill patients while a trio of much-touted therapies were shown to have no effect" (McKie, 12/17/2020). What is vindicated with the confirmation of the breakthrough claims founded on the procedures required by 'normal science' is the confidence in the procedures of normal science, even in situations that display characteristics of 'post-normal science.'

Science magazine awards the distinction of the '2020 Breakthrough of the Year' to the new vaccines (Cohen, 12/17/2020). The accompanying article offers an extensive and differentiated breakthrough narrative that comes with a message: the vindication of the processes of normal science, even under the exceptional conditions created by the pandemic. The development of the vaccines is placed in the context of a global race, indeed a veritable imperial scramble for the vaccine that prominently includes Russian and, above all, Chinese efforts. The article is also careful to qualify the breakthrough label, emphasizing that it would be misleading to expect a swift and immediate effect and to attribute an instant transformative power to the breakthrough: "To be sure, the clinical trial results reported to date have mainly come from

glowing company press releases, not the full presentations of data that could reveal caveats. Vaccine doses will be scarce for even the wealthiest countries until at least spring, and the world's poor will surely wait longer, despite the creation of a global alliance, the COVID-19 Vaccines Global Access Facility, to increase access." In spite of these qualifications, the assurance of a validated breakthrough presents a vantage point from which the situation can be put into perspective. The difficulties have not vanished, but a position has emerged from which it will become possible to identify challenges and devise strategies to meet them: "[T]he pandemic-battered world has a long trip ahead on a steep mountain road with no guardrails. Vaccine hesitancy, manufacturing problems, and breakdowns in supply chains could botch ambitious rollouts. SARS-CoV-2 might mutate to evade protective immune responses. Vaccines might prevent disease, but not transmission, delaying the end of the pandemic. Worst of all, rare, serious side effects could surface when vaccines move from efficacy trials to entire populations" (Kupferschmidt, *Science*, 12/18/2020).

The situation in late 2020 thus seems to warrant a vantage point of interpretive authority over the state of scientific research and its implications for the urgent societal issues linked to the coronavirus crisis. It creates the opportunity to move from a situation of open controversy largely dominated by the fault lines of the political situation to a situation dominated by a clear message. A pivotal point has been found around which the details of an authoritative breakthrough narrative will continue to unfold. At the same time, the narrative recapitulation of the paths by which the breakthrough has been reached serves to validate and vindicate the effectiveness of the established modes of operation of 'normal science.'

The fact that breakthrough discourse appears to become less frequent in 2021 may well have to do with the fact that the difficulties listed here have come to occupy the practical management of the pandemic. Consequently, the '2021 Breakthrough of the Year' in *Science* magazine has no direct COVID-19 connection, but two of the 'runners-up' relate to effective medication and to antibody treatments (see Cohen 2021 and Couzin-Frankel 2021).

Conclusion

Breakthrough reporting has a complex relation to the exceptional, as the review of materials on breakthrough claims in COVID-19 research illustrates. On the one hand, the very designation marks and highlights an exceptional moment, a moment that will bring a change of perspective whose nature and effects cannot be predicted in their entirety, and which therefore require discursive evaluation. On the other hand, the occurrence of these exceptional moments is to be expected within the regular operations of 'normal science.' The fact that *Science* magazine can count on finding at least ten candidates (one winner and nine runners-up) for the award of

'Breakthrough of the Year' speaks to the fact that it may be confidently expected that there will not be a shortage of such exceptional events within the regular operation of 'normal science.'

It must be noted, however, that the question of the degree to which the steps and procedures taken in reaching the vaccine breakthroughs answer to the description of 'normal science' or 'post-normal science' is not explicitly raised in science journalism at the time. It is also far beyond the expertise of this chapter. What an examination of breakthrough discourse in 2020 does show, however, is that breakthrough discourse under conditions of the pandemic occurred in a 'post-normal' societal environment. The celebration of the vaccine breakthroughs allows the embattled public spheres, which have long been the hallmark of pluralistic Western societies, to reassert pre-eminence against the challenges mounted by populist politicians and right-wing media, and to maintain an idea of global leadership in science in the face of competition in research from other, non-Western world powers. The confident identification of the breakthrough of the year does occur in a 'post-normal' social and political setting where *stakes* remain *high*, *values in dispute and decisions urgent*, even though it looks as though facts have become somewhat less uncertain.

Scientific breakthrough narratives in this context appear to have specific functions. They maintain and confirm the generally held assumption in modern societies concerning the transformative power of scientific innovations–the assumption that societies are shaped by the ways in which they implement their advances in technology (and not, for instance, by the agency of supernatural entities, or for that matter by means of 'conspiracies'). At the same time, they provide a pluralistic space for negotiating the assessments and expectations concerning the ways in which such a transformation will take place or has taken place.

In many cases, it appears, the scientific breakthrough narrative will be consolidated in retrospect, once the event marked as 'the scientific breakthrough' has been identified and more or less agreed on, and the intermediate potential trajectories have at least started to unfold. However, the narrative itself potentially emerges already with the breakthrough claim–which may be made simultaneously with the first presentation of the results of research, in some cases even before their publication. The familiar genre features of the narrative may even be invoked before results have been achieved, or research has been undertaken, for instance in order to mobilize support for undertaking certain kinds of research.

Clearly, the pandemic has created intense public interest and intense pressures on the processes that belong to these early stages of scientific research. The evident need felt by the leading media in science reporting to monitor and manage the breakthrough discourse around COVID-19 research, their determination to resist 'hostile takeovers' but also their occasional tendency to indulge in the circulation of unconfirmed and anticipatory breakthrough claims, especially in cases of national proximity, testify to the exceptional exposure which research processes experience

under the conditions of a pandemic situation in which diffuse societal expectations are centered on science.

The decrease in ongoing breakthrough discourse in relation to COVID-19 research in 2021 appears to be contingent on the fact that the question of what constitutes the scientific breakthrough in relation to COVID-19 has been largely settled. While this question is still open, this unsettledness creates the potential for a great deal of contentiousness in breakthrough reporting, which can be exploited from many directions. This, in turn, creates the need to resist the propagation of what must be categorized as unsubstantiated and misguided scientific breakthrough narratives—as well as the danger of succumbing to the invitation to relay premature and ephemeral breakthrough claims. Once the breakthrough question has been settled, science reporting can return to its established sequential patterns and to the position of 'modest witness' (see Haran and Kitzinger 2009 above).

This return to normal science validated by the modest witnessing of science journalism in the leading media also implies a reaffirmation of that fundamental tenet, specific and perhaps exclusive to modern societies, that scientific innovation has the capacity to shape and transform society. The wider scope of projected research on the scientific breakthrough narrative will no doubt need to observe the operations and functions of that narrative in very different historical and societal settings, quite different from the very distinctive context of the COVID-19 pandemic. Similarly, the literary dimensions of this wider project on scientific breakthrough narratives would need to widen its scope beyond science in novels with contemporary settings, and will need to involve research both on historical science novels and on speculative fiction. Speculative fiction, indeed, has been considered in some of its genre definitions as precisely a type of narrative that imaginatively spells out the societal and above all the human consequences which the transformative dynamics of scientific innovation may entail. Given its pervasive spread across public and specialist discourses in and around the sciences, the scientific breakthrough narrative stands to be examined as one of the core elements in the narrative meaning-making of modernity.

Works Cited

Bokat-Lindell, Spencer. 2020. "When Will There Be a Treatment for the Coronavirus?" *New York Times*. April 7. https://www.nytimes.com/2020/04/07/opinion/coronavirus-treatment.html.

Boseley, Sarah. 2020a. "Dexamethasone: Low-Cost Drug Helps Prevent Deaths of Sickest Coronavirus Patients." *Guardian*. June 17. https://www.theguardian.com/world/2020/jun/16/steroid-found-to-help-prevent-deaths-of-sickest-coronavirus-patients.

Boseley, Sarah. 2020b. "UK to Give Emergency Approval to any Covid Vaccine Breakthrough." *Guardian*. August 28. https://www.theguardian.com/world/2020/aug/28/uk-emergency-approval-covid-vaccine-breakthrough.

Boseley, Sarah. 2020c. "Vaccine Results Bring Us a Step Closer to Ending Covid, Says Oxford Scientist." *Guardian*. November 23. https://www.theguardian.com/world/2020/nov/23/vaccine-brings-us-a-step-closer-to-ending-covid-says-oxford-scientist.

"Breakthrough Close on Coronavirus Antibody Therapy: Reports." *Guardian*. June 7. https://www.theguardian.com/world/2020/jun/07/breakthrough-close-on-coronavirus-antibody-therapy-reports.

Brown, Nik. (2000) 2016. "Organising/Disorganising the Breakthrough Motif: Dolly the Cloned Ewe Meets Astrid the Hybrid Pig." In *Contested Futures: A Sociology of Prospective Techno-Science*, edited by Nik Brown, Brian Rappert, and Andrew Webster, 87–110. Abingdon: Routledge.

Cohen, Jon. 2020. "2020 Breakthrough of the Year." *Science*. December 17. https://vis.sciencemag.org/breakthrough2020.

Cohen, Jon. 2021. "Artificial Antibodies Tame Infectious Diseases." *Science*. December 16. https://www.science.org/content/article/breakthrough-2021#section_antibodies.

Couzin-Frankel, Jennifer. 2021. "Potent Pills Boost COVID-19 Arsenal." *Science*. December 16. https://www.science.org/content/article/breakthrough-2021#section_covidpills.

Escobar, Herton. 2020. "'Another piece of populist propaganda': Critics Slam the Brazilian Government's New COVID-19 Drug." *Science*. October 28. https://www.science.org/content/article/another-piece-populist-propaganda-critics-slam-brazilian-government-s-new-covid-19-drug.

Funtowicz, Silvio O., and Jerome R. Ravetz. 1993. "Science for the Post-Normal Age." *Futures* 25(7): 739–55. doi: 10.1016/0016-3287(93)90022-L.

Gao, Jianjun, Zhenxue Tian, and Xu Yang Gao. 2020. "Breakthrough: Chloroquine Phosphate Has Shown Apparent Efficacy in Treatment of COVID-19 Associated Pneumonia in Clinical Studies." *BioScience Trends* 14(1): 72–73. doi: 10.5582/bst.2020.01047.

Haran, Joan, and Jenny Kitzinger. 2009. "Modest Witnessing and Managing the Boundaries Between Science and the Media: A Case Study of Breakthrough and Scandal." *Public Understanding of Science* 18(6): 634–52. doi: 10.1177/0963662509338324.

Horby, Peter, Wei Shen Lim, Jonathan Emberson, Marion Mafham, Jennifer Bell, et al. 2020. "Effect of Dexamethasone in Hospitalized Patients with COVID-19: Preliminary Report." *medRxiv*. June 22. doi: 10.1101/2020.06.22.20137273.

Horton, Richard. 2020. "Offline: Preparing for a Vaccine against COVID-19." *Lancet* 396(10246): 226. doi: 10.1016/S0140-6736(20)31636-6.

Horvitz, Leslie Alan. 2002. *Eureka! Scientific Breakthroughs That Changed the World*. New York: John Wiley & Sons.

Kollewe, Julia. 2020. "Covid Vaccine Technology Pioneer: 'I never doubted it would work.'" *Guardian*. November 21. https://www.theguardian.com/science/2020/nov/21/covid-vaccine-technology-pioneer-i-never-doubted-it-would-work.

Kuhn, Thomas. 1962. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.

Kupferschmidt, Kai. 2020a. "A Cheap Steroid Is the First Drug Shown to Reduce Death in COVID-19 Patients." *Science*. June 16. doi: 10.1126/science.abd3683.

Kupferschmidt, Kai. 2020b. "Shots of Hope." *Science*. December 18. https://vis.sciencemag.org/breakthrough2020/#/finalists/2020-breakthrough-of-the-year.

Kupferschmidt, Kai, and Jon Cohen. 2020. "In FDA's Green Light for Treating COVID-19 with Plasma, Critics See Thin Evidence–and Politics." *Science*. August 24. doi: 10.1126/science.abe4806.

Lamas, Daniela J. 2020. "More Than 70,000 Covid-19 Patients Have Received Plasma. Does It Help?" *New York Times*. September 2. https://www.nytimes.com/2020/09/02/opinion/coronavirus-convalescent-plasma.html.

Ledford, Heidi. 2020a. "Coronavirus Breakthrough: Dexamethasone Is First Drug Shown to Save Lives." *Nature*. June 16. doi: 10.1038/d41586-020-01824-5.

Ledford, Heidi. 2020b. "Steroid Is First Drug Shown to Prevent Deaths from Covid-19." *Nature* 582: 469.

Leung, Gabriel M., and Kathy Leung. 2020. "Crowdsourcing Data to Mitigate Epidemics." *Lancet Digital Health* 2: e156–57. doi: 10.1016/S2589-7500(20)30055-8.

Levenson, Michael. 2020. "F.D.A. Approves Remdesivir as First Drug to Treat Covid-19." *New York Times*. October 29. https://www.nytimes.com/2020/10/22/us/remdesivir-fda-approved.html.

Lowe, Derek. 2020. "Details of a New Anti-Coronovirus Neutralizing Antibody." *Science*. May 6. https://www.science.org/content/blog-post/details-new-anti-coronovirus-neutralizing-antibody.

McKie, Robin. 2020a. "The Vaccine Miracle: How Scientists Waged the Battle Against Covid-19." *Guardian*. December 6. https://www.theguardian.com/world/2020/dec/06/the-vaccine-miracle-how-scientists-waged-the-battle-against-covid-19.

McKie, Robin. 2020b. "The Breakthrough Medicines that Could Change the Course of Covid." *Guardian*. December 27. https://www.theguardian.com/world/2020/dec/27/the-breakthough-medicines-that-could-change-the-course-of-covid.

Mehra, Mandeep R., Sapan S. Desai, Frank Ruschitzka, and Amit N. Patel. 2020. "Hydroxychloroquine or Chloroquine With or Without a Macrolide for Treatment of COVID-19: A Multinational Registry Analysis." *Lancet*. May 22. doi: 10.1016/S0140-6736(20)31180-6.

Mehra, Mandeep R., Frank Ruschitzka, and Amit N. Patel. 2020. "Retraction–Hydroxychloroquine or Chloroquine With or Without a Macrolide for Treatment of

COVID-19: A Multinational Registry Analysis." *Lancet*. June 4. doi: 10.1016/S0140-6736(20)31324-6.

Neate, Robert. 2020. "'Major' Breakthrough in Covid-19 Drug Makes UK Professors Millionaires." *Guardian*. July 24. https://www.theguardian.com/world/2020/jul/24/major-breakthrough-in-covid-19-drug-makes-uk-professors-millionaires.

"Politicizing Medical Science Will Cost American Lives." *New York Times*. August 24. https://www.nytimes.com/2020/08/24/opinion/trump-fda-coronavirus.html.

Sample, Ian. 2020. "Coronavirus: UK Scientists Identify Drugs That May Help Severe Cases." *Guardian*. December 11. https://www.theguardian.com/science/2020/dec/11/coronavirus-uk-scientists-identify-drugs-that-may-help-severe-cases.

"Scientific Events that Shaped the Decade, The." 2019. *Nature* 576: 337–38. doi: 10.1038/d41586-019-03857-x.

Sparrow, Andrew, and Frances Perraudin. 2020. "UK Coronavirus: Johnson Hails 'Breakthrough' of Cheap Steroid That Helps Prevent Covid-19 Deaths–As It Happened." *Guardian*. June 16. https://www.theguardian.com/world/live/2020/jun/16/uk-coronavirus-live-lockdown-has-been-disaster-for-society-says-william-hague.

Spinney, Laura. 2020. "How the Race for a Covid-19 Vaccine Is Getting Dirty." *Guardian*. August 30. 2020/08/30. https://www.theguardian.com/society/2020/aug/30/how-the-race-for-a-covid-19-vaccine-got-dirty.

Sun, Kaiyuan, Jenny Chen, and Cécile Viboud. 2020. "Early Epidemiological Analysis of the Coronavirus Disease 2019 Outbreak Based on Crowdsourced Data: A Population-Level Observational Study." *Lancet Digital Health* 2: e201–208. doi: 10.1016/S2589-7500(20)30026-1.

Thorp, H. Holden. 2020. "A Breakthrough for Us All." *Science* 370(6523): 1381. doi: 10.1126/science.abg1254.

University of Rochester Medical Centre. 2020. "British, Chinese COVID-19 Vaccine Trials Show Promise." Press release. July 20. https://www.urmc.rochester.edu/encyclopedia/content.aspx?contenttypeid=6&contentid=759653.

Usher, Ann Danaiya. 2020. "WHO Launches Crowdfund for COVID-19 Response." *Lancet* 395: 1024. doi: 10.1016/S0140-6736(20)30719-4.

Vallance, Patrick. 2020. "Science Has Led Us to the Brink of Beating Covid-19. Let's Not Jeopardise It." *Guardian*. December 13. https://www.theguardian.com/commentisfree/2020/dec/13/science-has-led-us-to-brink-of-beating-covid-19-lets-not-jeopardise-it.

Waltner-Toews, David, Annibale Biggeri, Bruna De Marchi, Silvio Funtowicz, Mario Giampietro, et al. 2020. "Post-Normal Pandemics: Why Covid-19 Requires a New Approach to Science." *STEPS Centre*. March 25. https://steps-centre.org/blog/postnormal-pandemics-why-covid-19-requires-a-new-approach-to-science/.

Wong, Julia Carrie. 2020. "Hydroxychloroquine: How an Unproven Drug Became Trump's Coronavirus 'Miracle Cure'." *Guardian*. April 7. https://www.theguardian.com/world/2020/apr/06/hydroxychloroquine-trump-coronavirus-drug.