GETTING THE BAD OUT:
REMEDIATION TECHNOLOGIES AND RESPECT FOR OTHERS

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ABSTRACT

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One of the great challenges of mitigating climate change involves determining not only which technologies can help alleviate pressures on energy consumption, but also what remediation technologies to employ in order to reduce greenhouse gas emissions in the atmosphere. The range of variants is intimidating. In this paper I argue that technologies like catalytic atmospheric scrubbing should be viewed as a morally justifiable approach to global emissions, so long as they are undertaken in direct proportion to the wrong-making emission on the part of individual actors, but only insofar as they are a direct response to wrong-making pollution. Far from an intuitive conclusion, if one takes a hard line against other forms of geoengineering—such as ocean seeding and stratospheric sulfur injection—as I have elsewhere, the conclusion that other variant forms of remediation are permissible is an open question. My conclusion is supported by a distinction between justified action and unjustified action, where the justification offered for an action is understood procedurally and deliberatively. Where in the earlier papers I have argued that individual or collective actors cannot, without globally expansive and multi-generational deliberative procedures, offer the justificatory support that would permit mammoth-scale geoengineering, in this paper I suggest that individual actors can act in such a way that remediation technologies are understood as aspects of their actions. The upshot of the argument is that human actors must take into consideration the interests and needs of all affected, human and non-human, which they can do by interrogating the reasons and norms that guide their behavior.

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INTRODUCTION

Arguments for and against environmental remediation have tended to stress mitigation of harms while turning a blind eye to other moral considerations that inform our views on environmental wrongdoing (Nelson 2008, Singer 2006). In this paper, I focus the discussion much more narrowly. I inquire into the conditions that make some very narrow set of mitigation projects permissible, and seek to outline what those conditions might be. Ultimately, I aim at the conclusion that what makes an engineering project permissible is whether all affected parties can accept not just the side effects of the project, but also the legitimacy of the project itself. The problem for this paper should be contextualized as part of a much larger project oriented around addressing concerns in climate change mitigation and environmental remediation.

The extent to which affected parties should have a say in the permissibility, legitimacy, or justification of a proposed project may not appear immediately relevant to the question of how to proceed in the face of anthropogenic environmental messes. That is, one might think that if one creates a mess, it's just natural that one should clean it up. Certainly, if it's true that anthropogenic climate change is the result of our careless emissions, then we should do what we can to reduce the effects of our actions on the climate. That seems to be just a straightforward fact about moral messes.

In earlier work, I've tried to demonstrate at least three related points. A first point that I've argued is that environmental problems go beyond simple characterization as damage done from harms. This is particularly true for ambient pollutants, of which greenhouse gasses fall into the paradigmatic category. Another point I've argued (with my colleague Bill Grundy) is that remediation technologies (RTs) don't offer a simple fix to non-harm related environmental problems (Hale and Grundy 2009). Having created a mess does not straightforwardly translate into a responsibility to clean that mess up. Nor does it even translate directly into permission to clean it up, nor to permission to clean up the messes of others. A third point that I've argued (with my colleague Lisa Dilling) is that very large scale geo-engineering projects, like ocean fertilization, are not permissible by virtue of the extent to which they are undertaken for the wrong reasons and the extent to which they are caught up in the lives of others (Hale and Dilling 2009). We argued that

actions like ocean fertilization cannot be understood independently of the antecedent events that have coalesced to bring about their consideration as viable options.

What I'll do in this paper, then, is to pick up where that work has left off, with the central objective of identifying a class of permissible RTs. This will require a relatively important preliminary observation: not all RTs are created equal. Some, like *in situ* bioremediation, involve modifying a specific site by introducing biological material to digest spills (Suthersan and Payne 2004, Warner 2007). Others, like carbon sequestration, involve planting acres of new flora, or simply managing forests, in order to absorb carbon from the atmosphere (Dilling 2007, Dilling, et al. 2003, Potter, et al. 2008, Thom, et al. 2002). Still others, like ocean fertilization, seek to capture carbon by encouraging phytoplankton growth in the ocean, thereby manufacturing a mid-ocean red tide and sequestering carbon to the ocean floor (Buessler, et al. 2008, Caldeira and Wickett 2005, Chisholm 2001, DoE 2008, Jamieson 1996, Kintisch 2007, Powell 2007, Scott 2005, St. Clair 1999). Yet a fourth technique, sometimes called "atmospheric scrubbing" or "air capture" involves capturing ambient air and scrubbing carbon or other pollutants from the captured air (Herzog 2003, Jones 2009, Keith, et al. 2006, Parson 2006, Spreng, et al. 2007, Stolaroff 2006). Many of these technologies can be demonstrated to work, and in some cases work very well. Nevertheless, each poses moderately to expansively thorny ethical challenges. Ethicists must be engaged in the project not just of assessing the various implications of such technologies, but also of establishing which RTs are appropriate and which are not. On this latter point, we should be careful to distinguish the problem of *whether* remediation is permissible from the problem of *which* RTs are permissible.

My argument proceeds in four stages. In the first stage, I introduce a complicated scenario—I call it the "Town of Incenter"—involving three companies and their emissions. I use this scenario to challenge intuitions about what the wrong of pollution consists in. I then promptly move to the second stage of the argument, in which I suggest that all remediation actions must be evaluated not just in terms of their consequences, but also in terms of the reasons that most appropriately describe them. In the Town of Incenter case, this involves assessment not just of the motivation for the action, but also the antecedent conditions that have coalesced to bring about consideration of remediation in the first place. In the third stage of this argument, I introduce several situations related but similar to the Town of Incenter. I ply my position primarily along concerns about the direction and dissipation of agency, suggesting that actions for which we are responsible are actions over which we maintain some manner of moral jurisdiction. This position stands in contrast to a position that seeks to make a similar claim based on a false distinction between the natural and the non-natural, or the anthropogenic and the non-anthropogenic. For space reasons, I do not cover the question of moral jurisdiction between single agents and collective agents, between the 'I' and the 'We', though this concern is circulating in the background. In the final stage of this paper, I argue that the appropriate intervention comes only through technologies that shift the world back from State Y to State X, and not on to a third State Z. I also suggest that there is some mitigating factor—here framed as the intersection of interests—that suggests that it is not immediately permissible to bring the world all the way back to State X. As a result, I reason that technologies like, but not limited to, atmospheric carbon capture are easier to justify than many other proposed RTs.

One quick and final observation on methodology. I am employing the ever-maligned device of intuition pumping as my primary theoretical engine (Dennett 1995, Sencerz 1986). Naturally, some philosophers are skeptical of the usefulness of intuition pumps, as intuition pumps are effectively a string of hypothetical thought experiments aimed at priming the reader's intuitions about a given set of problems. In many philosophical circles, they are not employed at all. Even still, intuition pumps are employed to great effect by philosophers as diverse as Judith Jarvis Thomson and John Searle. I am well aware of the limitations of this device, but I think it particularly useful

for assessing these sorts of problems. The reason for this is primarily pragmatic: principle- or value-oriented methodologies, common in many branches of philosophy, inevitably raise many more questions than they answer. Climate issues are exceptionally broad-reaching, touching on science, policy, engineering, business, and so on. The intuition pump has the benefit of starting from a point of intuitive convergence and working out from there (McMahan 2000). While it may appear that this makes for a somewhat aimless stroll, I use the device only to inspire in the reader a reflective equilibrium, as have many others before me (for a nice example of this, see: Boonin 2003, 9-14, Rawls 1951). Rest assured, I have a destination. The intuition pumps serve to bring the reader most efficiently to the position that I advocate.

PART I: COLLECTIVE WRONGDOING

Suppose three widget companies: Acme, Beatme, and Capme. Acme emits additive A, Beatme additive B, and Capme additive C. Alone, each additive, A, B, or C, is completely undetectable and harmless to humans. When combined, however, the compound ABC is noxious and harmful to humans. Moreover, any non-ABC combination of two additives is undetectable and harmless to humans. AC, BC, AB—these are all innocuous compounds. If Acme and Beatme were to continue production of their widgets in the absence of Capme, there would be no noticeable outcomes. So too if only Acme and Capme were operating alone, and if Beatme and Capme were operating in the absence of Acme. It is the *confluence* of the additives, in other words, that creates the negative outcome. To foreshadow, I am expressly avoiding actual real-world chemical combinations on the assumption that A, B, or C are variables that may be quite distinct, or may, in fact, stand for the same pollutant. They could all be carbon, for instance.

To avoid responsibility-related complications about first priority rights, suppose that Acme, Beatme, and Capme become operative at exactly the same time, January 1, 2009, and that they are distributed geographically at the axes of an equilateral triangle. Depending on how the winds blow, the town of Incenter receives a greater or lesser degree of compound ABC. Sometimes the winds will blow just so that A mixes with B and C on the east side of town; and sometimes the winds will blow just so that B mixes with A and C on the south side of town. Sometimes the winds will keep A, B, and C from mixing at all.

The first most obvious question, of course, is which company, if any, is committing a wrong? Without clear harms from any single company, it might appear either that no company is doing anything wrong, or that all companies are equally complicit in creating a collective wrong. Certainly there are many directions from which one could weigh in on this issue. As I've said, I'm not interested in these responses. I'm talking about distributed responsibilities here—circumstances in which multiple parties can be said to be co-responsible for having brought about a given state of affairs—and I want to know what we are entitled to do in the face of bad states of affairs that are brought about through the distributed actions of several actors.

Backward-looking responsibility questions such as those above are important, of course. They may ultimately be relevant to a determination of what to do. If we can identify a culprit, we may be able to force that culprit to take action while keeping everything else running smoothly. On the other hand, there may not be enough time. Perhaps it is better to brush most of these concerns about culpability to the side and ask instead questions about how to move forward given the enormity of the problem. We can worry about culpability once the dust has settled. There will be ample time to point fingers later, as President Obama likes to say.

This forward-looking approach is also tempting. To mitigate harms, we should stop any one of the three companies from emitting either A, B, or C. Since the origins of ABC are known, it is also known that reducing one of the three emissions will result in overall benefits. Unfortunately,

there are many forward-looking policy approaches that can accomplish this, and each is beset with its own problems. We might simply shut one of the plants down; but to do so, we'd have to have a good method for determining which one to target. We might flip a coin and simply *destroy* one of the companies—just blow it up—a solution that might be effective, and perhaps even gratifying, but is arguably gratuitous and unnecessary. We might force a negotiation between the companies, so that two of the companies buy out the third company; an option that may be efficient, but is not necessarily optimal. We might regulate the pollutants A, B, and C, so that the townspeople of Incenter only receive smaller and less damaging amounts of ABC. We might control for discharges. And so on and so on. We could go on for a long time. Without some sense of the constraints under which we must operate, "everything is on the table."

What this points to, among other things, is a requirement to take a closer look at each of the three companies in order to determine what they're up to. I'll come back to this, because it is the question about the justification of the production project in the first place that, I think, will be driving the overall assessment of whether and how to proceed. But again, as with assigning blame, neither am I interested in the technical or policy solution to this problem. Rather, I'm interested in the morally appropriate remediation solution that brings harms back down to a tolerable level.[1] This is clearly the bigger and more pressing challenge. Not how to bring the harms down, but what is permissible. One can easily propose a range of solutions to the problem, any one of which may trample some set of rights or principles that are of moral significance.

What, then, are the conditions under which it would be permissible to reduce the problem generated by the distributed actions of Acme, Beatme, or Capme?

One important observation is that RTs ostensibly offer a middle moral ground: an opportunity to avoid assigning blame *and* an opportunity to avoid draconian policies of the sort I mention above. They are classic 'win-win' situations that entice policymakers with an incredibly appealing third way. It is therefore mighty difficult to argue against RTs. Nevertheless, this hasn't stopped people from trying. Objections to RTs generally function by demonstrating that they are not, in fact, win-win situations, but that there is a cost or a loss somewhere (see, for example: Enkvist, et al. 2007). In so doing, they tend to disregard concerns about the antecedent reasons and obligations to others, presupposing that the reasons describing an action take a back seat to other benefit and cost considerations. The most forceful objection that foes of RTs seem to muster is that RTs change our motivations (and ergo, our 'reasons'), thereby somehow encouraging bad behavior.

It is my view that the bigger danger is not that they change our motivations (and thus our behavior), but that they potentially mask what is morally suspect about our actions in nature in the first place: that our current practices are unjustified. The important question that the culpability responses I raised earlier elide, but that these policy responses underscore, is the question about who is doing what for which reasons. And it is that direction that I shall now pursue. I want to look closely at the reasons we have for undertaking action.

PART II: THE DIRECTION OF AGENCY

One common reasons-related objection to RT is the objection that RTs encourage bad behavior. As I mentioned earlier, there are many arguments for and against RTs, but here I am

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[1] One may question this as an objective, particularly given my earlier insistence that pollution involves a form of moral trespass that is not adequately characterized in the language of harms. Nevertheless, acknowledging that remediation technologies only ever remediate harms and cannot turn back the clock on wrongs, it is a short jump to understand that the determination of what is a tolerable level of pollution must be arrived at through some alternative calculus or mutually respectful methodology.

distilling out only *reasons-related* objections, by which I mean those that object to such technologies on grounds that they entail acting for the wrong reasons. The argument that RTs encourage bad behavior (or install a 'moral hazard') is, to my knowledge, one of the few publicly-articulated reasons-related objections, as almost all other objections suggest that some particular method of remediation is too risky (Schneider 2006), or at best that that method of remediation may unjustly affect the lives of others (Jamieson 1996). I think the moral hazard is a wrong-headed concern, and I have argued against it elsewhere (Hale 2009). Nevertheless, it is worth exploring these cases, if only because it is a speedy route to the governing observation that harms from actions do not necessarily establish those actions as wrong; and that harms from wrong actions do not immediately authorize the source of that harm (or their proxy) to redress that harm.

What would it mean for me to act under the supposition that the world would be cleaned up immediately following my act? In other words, it is conceivable that the introduction of a clean-up technology makes it possible to reorder my priorities. In the face of RTs, I now have a method of acting without facing any repercussions from my actions. As a 2002 press release from Los Alamos National Laboratory notably put it: "Imagine no restrictions on fossil-fuel usage and no global warming!" (Rickman 2002). Perhaps there is something wrong with thinking this way. Consider:

Airlines pay cleaning crews to remove garbage after patrons have disembarked from their flights. So too for stadiums: they pay janitors to clean up after games. As a patron with knowledge of this, am I permitted to leave my garbage behind on my seat? In one sense, yes, because the clean-up person is there to clean. There may even be a reasonable expectation from all parties that this is the way things are done. The airline has an interest in seeing its patrons disembark as quickly as possible, for instance, and so may not want them to bother tidying their waste. In another sense, it is clearly not permissible for me to leave my garbage on my seat. It's plainly inconsiderate of others to leave a mess behind. It's inconsiderate of those who will later sit in the seat, but more than this, it makes extra work for the clean-up staff. One could base arguments on a good number of external considerations about what would make the act permissible or impermissible here. Perhaps the patron and the janitor are bound by a tacit contract, or by conventions, to abide by general rules of airline decorum. Or perhaps the contract is more explicit: perhaps the janitor has been hired expressly to serve the patrons. We can go quite a distance by exploring the branches of this axis.

Putting such arguments aside, there is a point at which most agree that some actions overstep clean-up capacity and become clearly impermissible. It is not permissible for me to smear mustard on the seats, for instance. Despite the presence of the cleanup crew, I may be doing permanent damage to the seats if I smear mustard on them. Smearing mustard goes beyond any reasonable expectation of what the crew might be in place to do. It would obviously be wrong of me to deliberately smear mustard on the seat; and if I were *accidentally* to smear mustard on the seat, I may not have done wrong, but I may be liable for having ruined the seats. The situation varies, of course, but it varies according to degree and scope. One very natural inclination when talking about RTs is to speak in terms of intentional or deliberate actions versus accidental actions. This view is handily covered in the doing and allowing literature (for a particularly poignant exploration of the role of intention regarding climate change and geoengineering, cf. Jamieson 1996). I cannot cover it here.

It is also natural to assume that what really should regulate one's behavior is whether harm is done. But again, sometimes we put these cleanup crews in place specifically because we want to encourage harmful behaviors. We tear holes in the walls of our home in order to get at the plumbing, knowing that we can repair the damage later. We conduct surgery on willing patients knowing that we can sew them back up. We assign orderlies to hospital cleanup crews so that doctors focus on the patients and don't worry as much about their messes, sometimes even with the expectation that sheets and linens will be damaged. We pay landowners large sums to permanently

sully their land so that we can generate garbage without having to live in squalor. Harms are part of the figuration in such cases. And yet we very often say, in all of these cases, that some actions are permissible, some are impermissible, and that there are still wrongs to be done.

What this points to, I think, is the importance of looking at the breadth of the act—of finding the most accurate act description and assessing the obligations and permissions according to that description. We should ask: what's really going on? How did such a state of affairs come to be? What reasons could be motivating one actor to take action? What reasons might be festering under the surface? Who will be affected or has been affected, and what stake can they claim in the consequent re-action? In order to determine what actions are permissible, we need to ask what reasons are justified, which involves taking into consideration all of these commingled reasons. All such related considerations—about the initiating wrong, about the intent of the actor, about the parties affected, and so on—are extremely important to a determination of the permissibility, or justifiability, of an action.

This discussion is revealing. In identifying permissibility as functioning according to the justifiability of an action, some basic principles begin to emerge about the constraints to which remediating actions should be subject. Namely, the more narrowly an action impacts the world, the fewer interests are involved, and the more latitude an actor has to alter the outcomes of the action.

In the case of emissions into ambient air, the permissibility of an action is immediately complicated by the extent to which the outcomes of the preliminary action pervade the lives and interests of others. Allow me a few more examples. Here are two intuitions I think we probably share, all related to somewhat more containable messes.

1) It is permissible for me to camp in a campsite, so long as I can return the campsite to its original state upon my departure.
2) Everything else being equal, it is not permissible for me to camp at a campsite with the intention of returning the campsite to its original state at a later time. I cannot leave the area for a few days and then come back to clean up my mess.

The reason for this is that others probably will, or simply just may, be affected by my actions in the interim. Hikers may stumble on my abandoned site and have their experience in nature ruined. Bears may find my site and develop a taste for peanut butter, thereby jeopardizing their taste for natural foods like berries and salmon. Rodents may find temporary refuge in my abandoned cook tins. And so on. As the days tick by, the wrongness of my refusal to clean up the site becomes cemented. As my earlier action (the sullying of the campground) begins to overlap with the interests and concerns of others, it takes on the character of having disrespected them. My culpability for having done wrong becomes ossified in the moral fabric of interaction. Here's a further thought.

3) It is not permissible for me to leave a site unattended for fifty years and then come back and remove something that has been a part of that site with the same moral authority as I might under conditions in which I clean up the site on the day I leave, or even a few days later.

It is not clear that I am permitted to disturb mining equipment from the 1940s, for instance, even if it was I or my company who left it there. In the intervening years, the abandoned equipment may have taken on a different importance or meaning. (It's not that it definitely *has* taken on a different meaning, only that it may have.) Hikers walking through the woods fifty years from now may stumble upon an archeological wonder. Future bears may have colonized the site to make it their own. Rodents may depend on the area for shelter. Trees and plants may have found the area particularly hospitable.

Just as agency emanates from an individual actor and offers up actions that can be deemed permissible or impermissible according to how they interweave with the interests of others, agency dissipates as time passes, as the outcomes of one past action intermingle with the lives and interests

of others. This is no spooky metaphysical claim about agency, but rather a pragmatic reality. Singular agency dissipates: new considerations are born as lives and activities interact. From this, new reasons emerge. Minimally, time and historical considerations are introduced. The abandoned mining site becomes a place of historical significance.

PART III: INTUITION PUMPS

Consider the following cases.

Volcano
Suppose that there is some natural point-source—a volcano, say—that in a steady-state is emitting B into the atmosphere. Imagine that Beatme is taken out of production, but that this Volcano serves the purpose of emitting equivalent quantities of B into the atmosphere. For clarity's sake, distinguish between B_V (emitted from the volcano) and B_B (emitted from Beatme). Now our scenario involves two online factories, Acme and Capme, as well as one volcano.

Is it permissible to remove B_V from the atmosphere in order to avoid its mixture into the harmful compound ABC? I think the answer is no. We ought not to remove B_V out of the atmosphere, even though it is generating effectively the same emissions as the Beatme factory was emitting, and even though its emissions are commingling with A and C to create the toxic pollutant ABC, thereby creating the same harms on the population of Incenter. For reasons that I cannot cover here, I suspect my intuition would not waver in the face of reasonably inexpensive capture technologies that could be affixed to the mouth of the volcano. Despite my intuitions about atmospheric emissions of B_V, I also have intuitions that it may nevertheless be permissible to stop the volcano from erupting and covering the town of Incenter in magma, should such a technology be available. What I suspect is that the distinction between such cases hinges not on harms to individuals, nor on justice between individuals, but rather on *what could or would be accepted by all affected parties*. Being covered in magma is an unacceptable outcome to all. Filtering the atmospheric emissions of the volcano is a considerably hazier proposition, speaking in terms of what could be accepted by all. We are thus left to find a different solution. In lieu of capping the Volcano, we must seek to modify some output of Acme's or Capme's in order to alleviate the threat. As we interrogate this case, we should bear in mind the somewhat more realistic case:

Suffusion
B is a manmade pollutant emitted from Beatme (in the form of B_B), but it is also occurs naturally, as from a nearby volcano (B_V), thus creating problems for Acme and Capme.

Would we be authorized in removing *more* B from the atmosphere than Beatme has emitted (B_B) to reduce the effects of ABC? I think the answer is no, that we wouldn't be permitted to remove more B from the atmosphere. We cannot remove B_V, I believe, but only as much and up to B_B, the amount that Beatme has contributed. Here, then, is a further intuition. My intuition is that we are permitted to remove B_B from the atmosphere, but not B_V out of the atmosphere. My suspicion is that this has little to do with the otherwise commonplace distinction between the natural versus the non-natural (B_V versus B_B), but more to do with the direction of agency.

Nevertheless, this is our puzzle. Why is this so? Why is this the appropriate solution? If it is appropriate to remove some B_B out of the atmosphere, why not remove B out of the atmosphere

to our heart's content? Why must we be more restrained? Or, put differently, if we can steer atmospheric concentrations in one direction, oughtn't we to steer them in the direction of an ideal state, supposing that we can identify what that ideal state might be? I think it is impermissible to steer atmospheric concentrations of A, B, and C toward an ideal state; and I think it has little to do with the question of whether we can identify an ideal state.

Consider this conflating observation. Suppose it is discovered that A and C are both more reactive with another element, β, than with B. We know that this element β is harmless, and that the combination of AβC is equally harmless. Suppose we introduce some harmless element β, a replacement for B. We'll then have the inert compound AβC. This would have the effect of rendering ABC inert, effectively removing the impacts on other populations. Now consider:

> **Smokestack**
> Suppose we could construct a giant smokestack to emit β over the town of Incenter. Would it be permissible to shoot β into the atmosphere in order to pre-empt the bonding of B with A and C?

I suspect many would find such a resolution to be impermissible, mostly because it operates on the presupposition that one can alter the atmosphere (an environment with wide distributional influence and impact) in order to satisfy the concerns of the relative minority, the human population of Incenter. Moreover, it is not in any respect a true remediation solution. Rather, it involves moving the universe not from one state to a previous state (from State Y back to State X, say), but from one undesirable state to another, presumably more desirable, state (from State Y to state Z). It does so by way of intermingling β emissions with the lives of others, human and non-human. What should be clear is that the two cases differ primarily in that one is more-or-less of natural etiology while the other is more-or-less non-natural.[2] Consider, by contrast:

> **Counteraction**
> Acme and Capme set up some device to combine β with A and C, respectively, on site, in the factory, before A or C is emitted into the atmosphere. They then plan to emit compounds of Aβ and Cβ into the atmosphere, knowing that they will eventually combine to form AβC. Provided that β is harmless, as well as the combination AβC, intuition suggests that such activities would be harmless.

I suspect that Counteraction is nowhere near as problematic as Smokestack, even though, again, β emissions are equivalent. The reason for this rests with the suggestion that emissions constitute a sort of 'moral trespass', a term that I borrow unapologetically from Mark Sagoff (2004). Altering an emission prior to its release and, say, mitigating harms from that emission does weigh on the overall assessment of its permissibility (but does not authorize its release, even when harms are completely eradicated), until the emission has been released, at which time there is more to consider. This is neither a factor of time, nor a question about where the emission is in the pipeline, but rather about who is affected and what they could or would accept. Consider, instead, this case:

> **Beta Jets**
> Suppose β is a naturally-occurring molecule. It is prevalent and abundant near the town of Incenter, thanks to a nearby lava field from which jets of β shoot up out of the hot magma.

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[2] I would like to avoid a lengthy discussion of what is natural versus what is non-natural. Instead, I prefer to understand the distinction between the two cases in terms of whether there is some agential involvement.

Lucky for Incenter, β has always been around in elevated concentrations, latching on to atoms of A and C, thereby thwarting a potential catastrophe.

Here we have a case in which the natural state of affairs is beneficial to the residents of Incenter, perhaps without their knowledge. Such a case is likely not far from reality. Who knows what untold horrors could have befallen us had it not been for the preemptive remediation technologies of Mother Nature? Ecosystem services have provided innumerable benefits and a comfortable sanctuary from our inconsiderate tendency to degrade and sully the earth. Are we permitted continue emitting A and C into the atmosphere in the face of such knowledge? One might think we are, since the Beta Jets have been around in abundance. I'm not clear on that. As I've tried to argue before, and as I believe I am justified in arguing, even emitting harmless (or perhaps beneficial!) compounds into the atmosphere amounts to moral trespass. In order to authorize such actions, we need to solicit input from all who would be touched (not necessarily harmed) by our action. To see this, consider:

Beta Spritzers
Suppose that the lava field is discovered to be a natural source of β emissions, but that it is only emitting half as much as would be needed to offset the confluence of B emissions in the atmosphere. It is only "spritzing" β into the air. We could easily allow the lava field to release more β by drilling holes in the lava.

Are we permitted to drill holes in the lava? I don't think we are. I don't think we are for the same reason that I don't think we're permitted to build a smokestack that spews β into the atmosphere. Doing so involves asserting our control over the situation, injecting our culpability into nature's air passages, enforcing our will on the lives, activities, projects, and interests of others. If something unforeseen were to eventuate from our action—suppose β exhibits grue- or bleen-like properties (Goodman 1955), that it is harmless before December 31, 2049 but deadly after January 1, 2050—we can be said to have done wrong.

PART IV: PERMISSIBLE INTERVENTIONS

Return, then, to Acme, Beatme, and Capme. If Acme emits A knowing that it will intermix with B and C and does nothing to stop the mixing of B and C, it is reasonable to suggest that Acme will have done something quite wrong. Most agree to this. But I have been suggesting that even if Acme takes steps to ensure, if and when B and C intermix, that the impacts are minimized, it is not clear if it has yet done what is required of it. What is required is that it consider whether emitting A is justified, by which I mean something other than whether, on balance, benefits outweigh costs. Acme must understand the full breadth of its action in determining how to evaluate whether and what sort of RT to employ.

Moreover, I have argued that actions by any of the three companies must attend to concerns about the direction and dissipation of agency, about the intermingling of agency with the interests of others. Acme is responsible for emitting A_A, whatever its effects. Beatme is responsible for emitting B_B, whatever its effects. So too for Capme. Their responsibility lies with their action—particularly with the reasons for their action—and not solely with the effects of their action. As their emissions dissipate into the atmosphere, their responsibility becomes entangled with the lives, actions, and decisions of others, including the other companies around them. Their responsibility then dissipates as it intertwines with the interests of others, such that there is no longer a simple question of turning

back the clock, but only a question about how far back the clock is permitted to be turned. This question about what is a permissible intervention, I think, can only be answered through deliberative engagement with all affected parties. There are, however, a few signals about the direction in which we should seek an answer.

An accurate description of any RT must understand the technology not just in terms of whether a resultant state is better than the one that precedes it, but also about the direction of agency, the intermingling of interests, and the reasons that have motivated the initiating action. It is wrong, for instance, to assume that because some damage has been done somewhere, that therefore the entire site is open for transformation. This is particularly true of the initiating action was unjustified, but it holds for justified actions as well. What emerges from this observation is that justificatory burdens are lighter for actions that seek to reverse a harm done than for actions that seek to patch over a harm by introducing a new state of the world. Consider the scenario:

Creation of Harm: moves universe from State X → State Y

In the creation of a harm, an actor moves the universe from State X to State Y. That much is clear. The question for this paper is which direction we are permitted to move from there. My suspicion is the following:

Permissible:
Undoing of a Harm: RT Action Φ_1 moves State Y → State X.

Impermissible:
Patching over a Harm: RT Action Φ_2 moves State Y → State Z.

Here's why. To determine whether the widget production is permissible, which is the first and more primary question for an actor, the entire configuration must be assessed and evaluated, including antecedent and consequent conditions, preliminary and postliminary justifications, as well as the validity claims of all affected parties. It must be looked at in the context of all three companies, as well as the residents of Incenter, and it must be understood from the perspective of A, B, and C emissions. This is just the nature of almost all ethical evaluations: they are tied tightly to our actions, to our agency. As our actions slip from our control, they impact and intermingle more and more with others.

Given the balance of justificatory burdens, it is likely more justified to say that harms should only ever be undone, lest one risk further wrongdoing, adding the caveat that harms are not permitted to be unilaterally undone—taken all the way back to the original State X—as they are not always unwelcome harms. Depending on one's perspective, in fact, they are not always harms. In the case of many RTs, we must take extra precautions to ensure that we are only undoing what has been done, and not adding insult to injury. To see this, consider cases in which a *benefit* is introduced. In such cases, one is permitted to remove external benefits only if the benefits have not yet intermingled with the interests of those affected. One can spray nitrogen fertilizer in the air over another's farm, for instance, and remove the fertilizer before it hits the ground, thereby depriving a farmer of potential external benefits; but one cannot remove nitrogen from the farmer's soil without consulting with the farmer, even if one is responsible for having put the nitrogen there. The reason for this is the same in both harms and benefits cases: as the impact of one's actions intermingle with the interests of others, the justificatory burden grows greater.

One technology that seems to meet the standard of a weaker justificatory burden is the technology known as air capture or atmospheric scrubbing. As my colleague Roger Pielke points

out, by way of advocating for the technology, the "IPCC, both in its 2005 report and capturing and sequestering carbon dioxide and its 2007 Fourth Assessment Report mentioned air capture only in passing" (IPCC 2005, IPCC 2007, Pielke Jr. 2009). Air capture is a selective remediation technology. If employed cautiously, it makes it possible that a single actor can take away the harm-causing dimension of his wrongdoing.

Given the strong justificatory hurdles that must be leapt to ensure justification of movement in one or the other direction, it is much more difficult to justify a move from State Y to State Z than it is to justify a move from State Y to State X. It is much easier, that is, to justify undoing a harm backwards than it is to justify patching over a harm forwards. For practical purposes, RTs that move in the direction of undoing are those that should be pursued.

To arrive at this conclusion, I have presupposed that the permissibility or impermissibility of an emission hangs on its justification. One cannot indiscriminately make a mess of things for the sake of making a mess, or for reasons that have not met and passed tests of wide deliberative scrutiny. It is very often the case, particularly with carbon emissions, but also with other sorts of negative externality emissions, that emitting actions were not themselves justified (or were justified according only across a very narrow justificatory horizon). On this view, RTs may make some actions permissible that were otherwise impermissible. If the justificatory procedure is left open enough to allow affected parties input into the determination of whether to move forward with the RT, then it may be permissible.

CONCLUSION

In order to determine which courses of environmental remediation are permissible, we need to adopt a position of respect for the rest of the world. This means ensuring that our actions are justified, that our action could meet with the wide reflective scrutiny of all affected parties, human and non-human, living and non-living. More than anything, we must ensure that the actions we seek to counteract are "our actions." When commission of an action falls most directly on the shoulders of an agent, then that agent can claim direct jurisdictional control over that action. The tired and problematic distinction between natural and non-natural is, from the above analysis, largely irrelevant, as the permissibility of remediation actions is contingent more upon the direction of agency than upon some particular status of the world. Nevertheless, such a distinction may be a helpful folk-psychological device for categorizing actions, at least in lay discourse, and therefore, perhaps even for this summary conclusion. As with all cases, the antecedent conditions and the reasons we offer for our action may make all the difference regarding permissibility.

So far as some natural-ish events are concerned: We are many times not *obligated* to undo what has happened, though in many cases, we are *permitted* to undo what has happened. As a rule of thumb, we ought not to try to remedy our actions by way of introducing new states of affairs that *appear to be natural* or that appeal to particular past or future states of the world. It is one thing to plant a new forest for the purpose of sequestering carbon, and yet quite another to replace a downed forest with the objective of restoring the world to its original forested state. In instances in which planting more forest in order to return the atmosphere to its original state may be justifiable, what authorizes a community to do so is (a) the forestry practices that have preceded the decision to plant that forest and (b) the harm done to the atmosphere by other practices. If a community decides that it would like to alter the state of the atmosphere by planting a forest, it is far from a foregone conclusion that it is permitted to do so; at least, it is not clear that it would be permissible in a hypothetical universe where there has been no forestry. On the other hand, if the community decides to plant a forest for the sake of having a forest, it *may* do so, but only on condition that it

considers the impact of its actions on all affected parties. This is no different than building a factory that emits β, except insofar as one solution offers up trees and the other offers up widgets. The justification of the planting of that forest will depend on the extent to which the project is acceptable to those affected.

So far as some non-natural-ish actions are concerned: We can undo what we have done, but we cannot undo the wrong associated with what we have done. If we have wronged another, we are obligated to undo what harms we have done; and to seek reconciliation with the other for the wrong. In some cases, this is impossible, just as in some cases it is impossible to gain credit for a good deed done. If another has been wronged by others, it is an open question as to whether outsiders can or should intervene. This open question can only be answered by appeal to all affected. In other words, once an act is committed by an actor, it is permissible to return the world back from State Y to State X, or anywhere along a continuum between Y and X—where X is the baseline state and Y is the resultant state—given that once an actor has acted upon the world, he has injected the world with agential control and culpability. But an actor cannot then legitimately move the world from State Y to State Z—where Z is a new third state—without also injecting further control into the world. Movement from State Y to Z is permissible only in consult with those affected, just as planting a forest or building a factory is permissible only in consult with those affected. Movement from state Y back to X is permissible only insofar as others will not be further affected by that movement.

Early in the paper I mentioned that all RTs are not created equal. At that point, I mentioned several proposed RTs. Employing what we have concluded, we must ask ourselves what are appropriate technologies. On the reasoning that I have offered, any geoengineering project that purports to move the world from Y to Z, like ocean fertilization or stratospheric sulfur injections (Brovkin, et al. 2009), and not from Y back to X is impermissible. These projects are far too comprehensive to be considered permissible, except in the most dire circumstances. In extraordinary and dire circumstances, the permissibility of shifting the world to State Z may be left on the table, but such justification will be difficult, if not impossible, to establish. The justificatory hurdles are enormous. Should we need to clean up the world, as we do now, in the face of anthropogenic climate change, we should take special precaution to ensure that we do not accidentally shift to State Z. Technologies such as atmospheric scrubbing—a technology that removes carbon dioxide, and only carbon dioxide from the atmosphere—if employed expressly for the purpose of shifting the world back from State Y to State X, may be the only permissible direction to pursue.

On the reasoning that I have offered, it is most transparently permissible to clean up an emission prior to its release, though it is not always required. Some emissions are unproblematic, and may even be desired by some parties, but their permissibility will be determined by the extent to which the affected community could or would assent to their release. The release of oxygen and carbon in a non-saturated environment may be these sorts of pollutants. In cases in which there is post-facto knowledge of the devastating effects of our emissions, it is permissible to remove that which we have put into the atmosphere, but it does not remove the wrongdoing.

I have argued, effectively, that we can remove some pollutants that we have ourselves directly contributed, or we can remove pollutants on behalf of those that others have contributed, but we are not permitted to remediate pollutants if a RT involves transforming or adding something new to the pollutant to reduce its harmful nature, unless it can be demonstrated that all affected parties could or would assent to the remediating action. For this paper, I have ignored questions of political jurisdiction—questions about whether I am permitted or obligated to remediate emissions from Smith or Jones—and instead chosen to focus on related questions about justifiability.

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