Citizen in Regulatory and Policy Science

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1. Introduction: The Lingering Problem of Extension

More than a decade ago, H.M. Collins and Roberts Evans in their seminal article titled *The Third Wave of Science Studies* cogently pointed out that the normative theory of how scientific or technical decision-making should be made cannot be derived directly from the descriptive studies of how interest, ideology and other extra-scientific factors indeed play a role in the closure of scientific and technical debates.[1] They suggested that scholarly attention of science studies be moved from empirically exposing the "Problem of Legitimacy" in technical decision-making to normatively tackling the "Problem of Extension" of how far the involvement of citizens in technical decision-making should extend. Their normative claim, admittedly based on their preference for the "form-of-life" of Western science, distinguished members of the public with experience-based expertise from those who merely have political rights.[2] Only the former, who've gained contributory expertise in the relevant science, should be considered legitimate decision-makers in addition to the certified core-scientists in respect of scientific knowledge. Contributions of citizens with only stakeholder rights on the other hand should be made to the political phase of the technical decision-making process.[3] Collins and Evans believed that admitting noncertified citizens with experience-based expertise instead of granting any member of the general public to the technical phase of the

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1 H.M. Collins & Robert Evans, *The Third Wave of Science Studies: Studies of Expertise and Experience*, 32/2 SOCIAL STUDIES OF SCIENCE 235, 239-40 (2002).

2 *Id.* at 244.

3 *Id.* at 249, 251, 261-62.

scientific knowledge production is the only plausible way to cure the problem of legitimacy without at the same time causing an unruly problem of extension.

It is against this theoretical backdrop that the concept of "citizen science" sometimes seems to be an oxymoron. Citizen science can be broadly seen as the involvement of non-scientist citizens in knowledge production of science. While enlisting local knowledge or labor of non-scientists for scientific knowledge-making has remained an important yet very often neglected side of knowledge production even after the professionalization of the modern science, "citizen science" as dubbed both by professional scientists and community actors is now gaining new momentum. Amateur bird watchers are engaged to report number and spices of migrant birds. Online volunteers are invited to participate in coordinated efforts to classify large volume of satellite images of tropical cyclones. Lay people are also asked to help professional astronomers to examine and interpret space telescope images of galaxy. Those are but a few examples of what indeed should be called *Crowd science*, in which large numbers of lay participants act as "sensors" or "basic interpreters" for natural scientific projects whose problem definition, study design and data analysis are primarily made and determined by professional scientists.[4] Equipped merely with what Collins and Evans called "beer-mat knowledge" or at best "primary source knowledge,"[5] citizens in crowd science simply contribute their time and labor rather than anything that can be candidly called "contributory expertise."[6] Without really taking part in the technical decision-making process of knowledge production, citizen scientists of this sort do not trigger the problem of

[4] *See* Muki Haklay, *Citizen Science and Volunteered Geographic Information – Overview and Typology of Participation*, *in* CROWDSOURCING GEOGRAPHIC KNOWLEDGE: VOLUNTEERED GEOGRAPHIC INFORMATION (VGI) IN THEORY AND PRACTICE 105-122 (Daniel Sui et al. eds., 2013).

[5] HARRY COLLINS & ROBERT EVANS, RETHINKING EXPERTISE 18-23 (2007).

[6] *But cf*. RICK BONNEY ET AL., PUBLIC PARTICIPATION IN SCIENTIFIC RESEARCH: DEFINING THE FIELD AND ASSESSING ITS POTENTIAL FOR INFORMAL SCIENCE EDUCATION 11 (2009)(classifying citizen science projects into three categories: contributory, collaborative and co-created.)

extension and do little to address the problem of legitimacy. They are more often the voluntary objects of new mode of knowledge reception that actually helps to reinforce the legitimacy of existing scientific knowledge.[7]

There are however other kinds of citizen science that are more ready to subvert the dominant position of professional scientists in knowledge production and thus inevitably induce the thorny problem of extension. It is so especially in the context of so-called public domain science. Air quality investigations initiated by local residents around a petrochemical plant may challenge current scientific presumptions and defy regulatory standards. The knowledge produced therefrom actually enhances the opportunity for those non-scientists to solve problems in the local communities. Citizen science of this sort has the potential to expose and re-negotiate the value judgments masked as technical necessities in current scientific practices and public policies. Therefore, whether the normative theory proposed by Collins and Evans is a desirable and justifiable way to prescriptively guide the extent of public participation in technical decision-making especially in the context of regulatory or policy science is again of great interests to people who take citizen science as a social movement means to realize the vision of social change through collective action.[8]

I will argue in this paper that because Collins and Evans fail to recognize the difference between research science and regulatory or policy science, in that the essence of the former is to produce extended knowledge while non-knowledge and nescience is also of great significance to the later, the qualification requirements unilaterally imposed on the public participation in the technical phase of knowledge production may inadvertently prevent the regulatory system that follows the

[7] *See*, *e.g.*, Sascha Dickel & Martina Franzen, *The "Problem of Extension" Revisited: New Modes of Digital Participation in Science*, 15(01) J. SCI. COMMUNICATION 1-15 (2016).
[8] *See* Ottinger.

normative plea from taking conflicting knowledge claims seriously. Alternatively, a normative theory that emphasizes instead on maintaining the *due process* of technical or scientific decision-making is of better outlook to make the best use of the empowering potential of citizen science without abandoning the value of scientific knowledge production.

2. Expertise in Producing Extended Knowledge versus Competency to Identify or Articulate Emergent Non-knowledge and Nescience

Science, in its broadest sense, can be seen as a systematic way to conquer the territory of unknown or ignorance. Knowledge then is the end product of such an endeavor. However, as knowledge grows, the realm of ignorance paradoxically increases. "Whenever new knowledge arises the perceived amount of non-knowledge increases at least proportionally since 'every state of knowledge opens up even more notions of what is not known.'"[9] Only then would it become conceivable for this *known unknown* to be the topic of further scientific investigations. This is primarily the way in which human gain knowledge although there are always *unknown unknowns* that may entirely eschew the grasp of human knowledge.

Drawing on the scholarships of ignorance studies, Matthias Gross proposes a simple categorization of different but very often overlapping notions of the unknown. Gross suggests that the term *ignorance* be used to generally point to the borders and the limits of knowing, while *non-knowledge* refers to "a type of knowledge where

[9] Matthias Gross, *The Unknown in Process: Dynamic Connections of Ignorance, Non-Knowledge and Related Concepts*, 55(5) CURRENT SOCIOLOGY 742, 743 (2007)(quoting Wolfgang Krohn, *Knowledge Societies*, *in* INTERNATIONAL ENCYCLOPEDIA OF THE SOCIAL AND BEHAVIORAL SCIENCES 8139, 8141 (Neil J. Smelser & Paul B. Baltes eds., Oxford: Blackwell, 2001).

the limits and the borders of knowing are taken into account for future planning and action."[10] Then, the intended goal of planning, tinkering and researching with non-knowledge is to develop *extended knowledge*, whereas *negative knowledge* is the knowledge of the limits of knowing with an active consideration that to think further into a certain direction is unimportant or of no interest. Belonging to a fundamentally different epistemic class, *nescience* is a complete unawareness of non-knowledge, a total lack of knowledge beyond any type of anticipation.[11]

The essence of research science is in the above sense based on investigating non-knowledge so as to produce *extended knowledge*. Scientists propose the hypothesis to explain the phenomenon within the realm of non-knowledge and develop sensible ways to test the null hypothesis. Until the hypothesis presumed false is positively proved otherwise can there be the claim of extended knowledge. Since only those who have relevant contributory expertise are able to determine if the evidence is sufficient to warrant the adoption of the hypothesis, only they are qualified to determine whether to declare that the previous limits and the borders of knowing have securely extended further to the once unknown territory. The institutional goal of research science to pursue extended knowledge reasonably limits the membership of decision-makers to those who have gained contributory expertise. Thus, even if it is admitted that politics is "intrinsic" to science as demonstrated convincingly by many studies of sociology of scientific knowledge,[12] members of general public without relevant contributory expertise are not only unqualified in theory but also unable in fact to take into consideration of all available evidences and put them in order according to their relative weight and value. To

[10] Gross, *supra* note 9, at 749.
[11] *Id.* at 749-50.
[12] Cite second wave studies.

completely produce extended knowledge in research science, possessing contributory expertise seems at least to be a *necessary* condition as suggested by Collins and Evans. The only legitimate way to ever examine or challenge the intrinsic politics in producing extended knowledge is first to gain the required contributory expertise and to participate as a qualified member, and perhaps with the help of those with *interactional expertise* as suggested by Collins and Evans to actually earn sympathetic acceptance from the core-set scientists,[13] in the process of scientific knowledge production. No one without specialist contributory expertise should participate in the technical decision-making even in the name of questioning and changing its intrinsic politics.[14]

However, "no one can refer to their own current nescience because it is not part of their conscious."[15] Research science within its own epistemic realm cannot recognize *nescience* beforehand. Brian Wynne used Thalidomide as an example to illustrate how research science failed to foresee the existence of nescience.[16] When Thalidomide was tested to be used in the 1950s as a treatment for morning sickness, it did not occur to anyone to ask if the drug would have teratogenic effect on infants because scientists at that time had commonly held that placental barrier creates a safe place for fetal environment.[17] Relying upon the once widely accepted knowledge, medical scientists complacently claimed to extend their knowledge about the use of the drug only to realize later that it may cause server birth defects if

[13] Collins & Evans, *supra* note 1, at 244-46, 254-56.

[14] In the case of what Collins and Evans called *Golem sciences*, in which scientific controversy or debate over whether a hypothesis is sustainable has yet reached closure to the satisfaction of the core-set scientists and therefore scientific knowledge is in a state susceptible to doubt about its purpose and public use, decisions of public concern are of more weight. However, Collin and Evans still insist that they are the matters for *extrinsic* political sphere. Collins & Evans, *supra* note 1, at 268.

[15] Gross, *supra* note 9, at 746.

[16] While Wynne actually uses the term "ignorance" to describe such a state of total lack of knowledge, ignorance for him refers to nescience as used in this article. *See* Brian Wynne.

[17] *See* Dolores Ibarreta & Shanna H. Swan, *The DES Story: Long-term Consequences of Prenatal Exposure*, *in* THE PRECAUTIONARY PRINCIPLE IN THE 20TH CENTURY 90, 95 (Poul Harremoës et al. eds., 2002).

taken at early pregnancy. Since nescience belongs to a fundamentally different epistemic class from non-knowledge and extended knowledge, those who are able to identify and articulate its existence do not necessarily need to have the same expertise or qualifications as those who are eligible for making extended knowledge. Indeed, it may instead require "out of the box" thinking.

Except for those exposed by serendipity and hindsight, nescience is often revealed itself in a different "framing" of the problems, hypotheses or assumptions from the ones used in the existing scientific knowledge production.[18] Framing involves a *metascientific* process of selection and characterization of "what exists, what happens, and what matters."[19] Struggling over different framings thus entails conflicting knowledge claims that indeed reflect the metascientific beliefs and preferences operating in different societies or groups of people.[20] Such a struggle creates what Simon Shackley and Brian Wynne called *ambiguity*.[21] Unfortunately, challenges to the dominant framing are often easily dismissed as irrelevant. Their conflicting knowledge claims are then relegated to ravings uttered by someone without specialist contributory expertise, which should at most be managed as politics *extrinsic* to scientific knowledge production. But what is absolutely needed in engaging a constructive dialogue among different stakeholders to choose a better framing so as to prevent undesirable *negative knowledge* is not contributory

[18] *See* Sheila Jasanoff, *Technologies of Humility: Citizen Participation in Governing Science*, 41 MINERVA 223, 240-41 (2003); Brian Wynne, *Frameworks of Rationality in Risk Management: Towards the Testing of Naïve Sociology*, *in* ENVIRONMENTAL THREATS: PERCEPTION, ANALYSIS, AND MANAGEMENT 33, 33 (Jennifer Brown ed., 1989). Also, it is in this sense that "nescience can very well be a basis for understanding ignorance, negative knowledge, non-knowledge, as well as new, extended knowledge." Gross, *supra* note 9, at 750.

[19] TODD GITLIN, THE WHOLE WORLD IS WATCHING: MASS MEDIA IN THE MAKING AND UNMAKING OF THE NEW LEFT 6 (1980).

[20] *See* Deborah G. Mayo, *Sociological versus Metascientific Views of Risk Assessment*, *in* ACCEPTABLE EVIDENCE: SCIENCE AND VALUE IN RISK ASSESSMENT 249, 256-260 (Deborah G. Mayo & Rachelle D. Hollander eds., New York: Oxford Univ. Press, 1991).

[21] Simon Shackley & Brian Wynne, *Global Warming Potentials: Ambiguity or Precision as An Aid to Policy?*, 8(2) CLIMATE RESEARCH 89, 96-97 (1997).

expertise under any specific framing but the competency to offer propositions regarding "what exists, what happens, and what matters" to be taken into consideration in scientific decision-making. Such competency is certainly not *sufficient* because the weight and value of each proposition remain to be properly ranked in order. The latter task will not only benefit from the expertise used to judge other expertise, that is, *meta-expertise* as Collins and Evans called it.[22] It also relies upon the sensibility and the willingness to extend the acceptance of new propositions to the greatest extent compatible with what form our currently defined common world.[23] Rejecting the participation of the general public in knowledge production simply because their conflicting knowledge claims were made without specialist contributory expertise is to refuse to engage oneself in the deliberation on the framing of the scientific issues to be addressed and unduly short circuit the scientific knowledge production process.

3. Problems of Framing in Regulatory and Policy Science

Although the struggle over different framings may have great influence on how scientific knowledge is produced, research science or esoteric science is admittedly less susceptible to the problem of *ambiguity*. Because each research science or esoteric science is of concerns only to a small group of specialists, their "common world" is relatively secluded and limited. Not many outsiders would have real interests or stakes in requesting entry into it. The scope of non-knowledge or the

[22] Collins and Evans further distinguish between two types of meta-expertise: *external* meta-expertise does not turn on acquisition of the expertise at issue, and *internal* meta-expertise does involve an acquisition with the substance of the expertise being judged. COLLINS & EVANS, *supra* note 5, at 45-67.

[23] *Cf.* BRUNO LATOUR, POLITICS OF NATURE: HOW TO BRING THE SCIENCES INTO DEMOCRACY 105-116 (Catherine Porter trans., Cambridge: Harvard Univ. Press, 2004).

existence of nescience in research or esoteric science is therefore of only indirect importance to the general public. It is normatively acceptable to leave the decision of framing to its specialist members.

On the other hand, once the science enters into the public domain, things become different. Once the issues with respect to scientific decision-making are of visible relevance to the public, focus only on the development of extended knowledge under a given framing without acknowledging the possible existence of nescience in a different epistemic realm is to ignore that the choice of framing within which public domain science is operated is always contingent on cultural, social, political and regulatory contexts.

When individual regulatory decisions or more general policymaking are turned on *existing* extended knowledge, the problem to be solved is often structured in a way that leaves the actual decision-making to specialist experts. Food safety regulation of *known* "poisonous or deleterious substances" relies on the certified labs to determine if the food at issue is adulterated. The policy advocacy for banning electronic cigarettes resorts to the generally accepted knowledge about the harm and the addictive effect of nicotine. The regulatory and policymaking frameworks of this sort take regulatory or policy science as ruling and leave no room for conflicting knowledge claims.[24] However, people may not have doubts about the technical qualifications of a certified lab while arguing if the TDI (tolerable daily intake) is set at a level that properly takes into account of the most vulnerable groups. No one questions the injurious nature of nicotine while many may have disagreement over if the potential use for smoking cessation outweighs the likelihood of developing an

[24] *See* Matthijs Hisschemöller, *Participation as Knowledge Production and the Limits of Democracy*, *in* DEMOCRATIZATION OF EXPERTISE?: EXPLORING NOVEL FORMS OF SCIENTIFIC ADVICE IN POLITICAL DECISION-MAKING 189, 193-94 (Sabine Maasen & Peter Weingart eds., Dordrecht: Springer, 2005).

alternative nicotine addiction. Both conflicting knowledge claims point to the emergent non-knowledge that once was unwittingly placed under the territory of extended knowledge and instead demand more research to be done to address the scientific issues defined under the new framing. People who made the above claims may not necessarily possess the specialist contributory expertise, either certified or experience-based, at a level that is needed to be able to judge whether the development of extended knowledge succeeds. Their claims are however not to be treated merely as *extrinsic* political or value preferences whose playing field belongs only to the political sphere.

When science is commissioned by the regulatory agencies or policy makers to explore the territory of non-knowledge, the questions of how to frame the scientific issues to be addressed, methods to be employed, and variables to be used are even more likely to be open-ended. The regulatory or policy frameworks of this sort usually use tools such as risk analysis, technology assessment, and impact assessment to provide the empirical bases for regulatory decisions or policymaking. While most of such decision-making tools distinguish, either conceptually or institutionally, between the stage of scientific assessment and the stage of policy management,[25] the struggle over different framings persists. Science and values interact dynamically throughout the very process when non-knowledge at issue is supposed to be explored scientifically. As David Winickoff and his colleagues have pointed out, even the seemingly the purest descriptive work of risk identification is not simply a matter of recognizing a problem.[26] "Limiting the probabilistic measure

[25] For example, the stage of risk assessment and the stage of risk management. *See* NATIONAL RESEARCH COUNCIL, SCIENCE AND DECISIONS: ADVANCING RISK ASSESSMENT 31 (2009). *Cf.* Red Book (1983) and Orange Book (1996).

[26] David Winickoff et al., *Adjudicating the GM Food Wars: Science, Risk, and Democracy in World Trade Law*, 30 YALE J. INT'L L. 81, 94-98 (2005).

for risk assessment to human mortality tacitly places zero value on protecting non-humans; it also places little value on protecting humans from non-fatal forms of harm."[27]

Moreover, the allocation of the burden of proof in the state of scientific uncertainty under a regulatory or policy framework is also going to affect not only how the problem will be managed but also how the problem is perceived. The controversy over Ractopamine attests to the decisive effect of the presumption when neither side has enough evidence to prove the safety nor the harm of the beta agonist commonly used in the United States and Canada as a feed additive to promote leanness in food animals. If a legal system takes the position that no animal feed additive should be permitted unless it has been proved to be safe, the state of uncertainty would have prevented the knowledge producer from declaring the development of extended knowledge of safety.[28] If, on the other hand, a legal system requires that the regulatory measure of prohibition needs to be based on scientific principle and scientific evidence, as in the case of the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), failure to obtain enough evidence to demonstrate that the additive is unsafe would prevent the knowledge producer from drawing a conclusion that the extended knowledge of danger has been developed.[29]

Framing literally determines the outcome of regulatory or policy science. It reflects metascientific beliefs and preferences of different groups of people and is a

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[27] *Id.* at 94.

[28] *See*, *e.g.*, European Food Safety Authority, *Safety Evaluation of Ractopamine: Scientific Opinion of the Panel on Additives and Products or Substances Used in Animal Feed*, 1041 THE EFSA JOURNAL 18 (2009) [hereinafter EFSA Report].

[29] *See*, *e.g.*, WORLD HEALTH ORGANIZATION, EVALUATION OF CERTAIN VETERINARY DRUG RESIDUE IN FOOD 44 (WHO Technical Report Series 925, 62nd report of the Joint FAO/WHO Expert Committee on Food Additives, 2004).

matter of *intrinsic* politics in the process of knowledge production according to the standard of Collins and Evans. Participation in the deliberation on framing, like identification of the emergent non-knowledge or even nescience, however, does not require the same contributory expertise as necessary to make judgments on the acceptance of extended knowledge for regulatory or policy science. Prohibiting people from contributing their conflicting knowledge claims derived from different framings simply because they lack specialist contributory expertise is to illegitimately monopolize the process of knowledge production in the name of not licensing the importation of *extrinsic* politics into science.

4. Due Process as an Alternative Normative Guidance

If the imposition of high eligibility criteria to participate in scientific or technical decision-making is not a justifiable normative move as thought by Collins and Evans, are we then short of any normative guidance and lost in the vale of relativism? How do we arrange citizen's participation in the knowledge production of regulatory or policy science in a way that is compatible with both the forms-of-life of democracy and Western science so as to be away from the invasion by the mob?

Proposing also a normative theory, Bruno Latour's approach replaces Collins and Evans' "problem of extension" with the "problem of due process." For Latour, what is important is not *who* gets to participate in scientific or technical decision-making but *what procedural rules* should the scientific or technical decision-making follow. Latour argues that a normatively better way to make scientific or technical decisions is not to maintain the separation between nature and society but to bring nature and society together in a way that *takes* all relevant

propositions *into account* and *arranges* those propositions *in rank order* according to their compatibility with those which are already instituted.[30] Latour's normative theory is evidently based on his preference for making a Collective that accommodates as many propositions as they can be all compatible in the same common world. It shows more concerns for the value of democracy than others. Would he then sacrifice the form-of-life of Western science and fall prey to the mob rule?

To illustrate the danger of allowing people without specialist contributory expertise to participate in scientific or technical decision-making, Collins and Evans used the cases of "crashing fuel flasks and aircraft" in 1984 as examples to explain why they think *extrinsic* politics needs to be kept at bay.[31] In both cases, the decision-makers resorted directly to the public audience as witnesses for their endorsement of the ostensible results of publicly conducted tests. Collins and Evans faulted such participation by the public for serving only political ends rather than pursuing scientific soundness because the public did not have the necessary expertise and were in no position to make judgements about the meaning of the tests. They argued that because the general public was too naïve to tell "certain special features of the test whose significance was evident only to the expert eye," "[i]ncluding inexpert members of the public within the groups judging the meaning of these two [tests] meant that debate was cut off prematurely before the appropriate expert analysis…had time to make a mark."[32]

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[30] LATOUR, *supra* 23, at 91-127.

[31] The first involved crashing a train travelling at high speed into a nuclear fuel flask to demonstrate the safety of the method of train transporting spent nuclear fuel. The second involved crashing into the ground a remotely controlled airplane and a full load of a special jet-fuel supposed to reduce the likelihood of the catastrophic life-taking fires. The tests apparently showed that the flask did survive the spectacular crash with its integrity unscathed, whereas the aircraft was almost completely destroyed by fire. Collins and Evans, *supra* note 1, at 263.

[32] *Id.* at 264.

However, Collins and Evans' cases demonstrate exactly that the problem lies not in general public's lack of contributory *expertise* but in the undue *process* through which technical decisions were being made. What the public were asked to do in the above two cases was not to exercise their political rights, as defined by Collin and Evans, to determine the questions of value and preference, but simply to attest to the test results. These were not the cases of disorderly bringing the answers to *extrinsic* politics into the questions of knowledge production. What was actually wrong with the public participation in these two cases is that decision-makers did not *take* all the relevant evidences and propositions *into consideration* and bluntly did injustice to the general public who were invited to serve as jury while important evidence was concealed from them. The better solution is not to ask the jury to take the science classes first but to ensure that the verdict be made at least before taking all the available information into account, and of course including those offered by specialists with contributory expertise. But there is no legitimate reason why citizens without specialist expertise should be disqualified from offering propositions, be they technical or political, for the Collective to take into consideration in the first place as long as they are suitable for the questions at issue.

Once all the available propositions are taken into account for a decision-making, according to Latour, the weight and value of each proposition needs further to be ranked conforming to their compatibility with those that are currently instituted. It is at this stage that *meta-expertise* as defined by Collins and Evans may render some help in answering the question of whether the proposition is realistic and reasonable. It is also because of this stage that the due process approach for scientific decision-making is not entirely out of touch with the form-of-life of *sciences*, if

sciences mean the specially trained skills to participate in search of propositions and wisdom with both imagination and reasoning ability.[33] However, as Latour also made clear, the help from scientists is not mutually exclusive with other means of ranking compatibility. Citizens and people from other callings are all still allowed to participate in jointly finding a way to make as many of those potentially contradictory beings to live together in a common world as possible.[34]

Worries that lay public would credulously accept a wrong hypothesis or hastily disapprove the correct one are not the reason to stop the lay public from offering their propositions for consideration and from answering the question of compatibility. What is really wrong with *extrinsic* politics in science, or justice alike, is not that politics of outsiders encroaches on the prerogative of the inside players of the game. It is wrong because the politics, be it extrinsic or intrinsic, is not taken in the course of due process.

Unlike the normative theory that *unilaterally* imposes eligibility criteria only on those who have institutional disadvantages in participation in decision-making, the normative theory of due process *equally* requires all parties to follow the procedural rules to make scientific or technical decisions in forming a common world. The latter theory promises more room for citizens to participate in the production of regulatory science and is of better outlook to make the best use of the empowering potential of citizen science without abandoning the value of scientific knowledge production.

[33] LATOUR, *supra* 23, at 137-143.
[34] *Id.* at 143-161.