Revisiting Science's Social Contract

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Making an impassioned plea for marrying innovative approaches in the field, including SRI, in crop cultivation with scientific research by academia, the article looks at the prevalent resistance of the latter to practices on the ground and hopes for more openness and collaboration between theory and experience, and a re-working of the social contract between science and society

Citizen's Science

Adding innovation to India's Science and Technology policy would ideally have been an opportunity to democratize knowledge and be more open to sources of innovation from the margins, often outside formal science. However, there is little that is innovative about India's recent Science Technology and Innovation Policy (STIP 2013).

This article looks at an innovation in agriculture, System of Rice Intensification (SRI), which has spread rapidly among farmers in the last decade but has, so far, failed to evoke requisite interest from the agricultural establishment. SRI is an example of how the social contract between science and society is being re-worked and shaped for the people by several actors, in a manner that may be called 'citizen science', outside the state and the market. If Indian science is keen on ushering in a new paradigm, as STIP suggests, the establishment would do well to listen to and learn from such experiments.

The idea of a science with strong civil society origins finds increasing resonance in recent debates on science studies and innovation policy globally. India's STIP though remains caught in a time warp, presenting old thinking on science and society, and a weak understanding of how innovation is shaped in contemporary India and the world. Specifically, I refer to recent manifestoes on Science and Technology that have articulated the need for science policies to be more responsive to innovation and the implications of sustainability ideas for scientific futures—an imperative of diversity and plurality. These manifestoes also talk of distribution of innovation and cognitive justice of expressing the right of different forms of knowledge to co-exist.

The insights gained from SRI, on the possible reshaping of science and society in India, could help provide newer meaning to 'Knowledge Swaraj', a vision of self-rule, wherein scientists and citizens shape a 'post-academic science', more relevant to the climate-stressed times—a vision that enables scientists and society to rebuild scientific institutions that have become both unwieldy and unrepresentative. Developments on the margins are the new sites of innovation, with civil society acting through networks as important enablers of conversations and dialogues on knowledge and democracy.

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Bihar has been in the news for its agriculture, with several people visiting—from farmer groups in Afghanistan and Latin America to Nobel Laureates such as Joseph Stiglitz. An Indian farmer from Bihar breaking a world record in rice or potato production would have been considered impossible in the past. In February 2013, *The Guardian* 'broke' the news of 'India's Rice Revolution' about a Bihar farmer, Sumant Kumar, achieving this feat through a new innovation called SRI that many farmers across India have adapted from Madagascar, which allows for more production using fewer seeds, fertilizer, irrigation water and, often times, labour.

SRI 'UFOS'

The innovation involves a set of practices—transplanting young and single rice seedlings, widely apart, in un-flooded conditions, aerating the soil and increasing the proportion of organic matter in the fields. The SRI experiment challenges global research trends that continue to focus on varietal changes on miracle seeds, earlier through improvements of pure lines and the evolution of hybrids, and now increasingly through genetic engineering. Policies to extend the Green Revolution of Asia to Africa and India's eastern region are ambitiously drawn, even as farmers in the existing Green Revolution areas face acute environmental stress and declining yields due to poor soil fertility. Farmers need to spend more as the costs of agro-chemical inputs soar or the availability of irrigation water decreases.

After speaking to the farmers in Sumant Kumar's home district, Nalanda, Stiglitz remarked that the farmers were better than the scientists and called for their experience to be researched for wider replicability. *The Guardian* reopened an older debate and scientific controversy. Scientists at International Rice Research Institute (IRRI) had, in 2004, derisively dismissed SRI as 'UFOs' (unverified field observations) and not worthy of attention. Over the past decade, however, there has been some moderation in its stance, with IRRI now even hosting an SRI page. A closer look though reveals a deeper knowledge debate. The pictures hosted on the SRI page of the IRRI website mislead and refer to conventional rice fields and urge readers to see SRI as nothing but IRRI's own 'Best Management Practices (BMP)' and how collaboration with IRRI on their programmes could reduce the animosity about what SRI is.

As a leading producer of rice, with a strong research establishment, India's stake in the discussions on rice, one would think, would be high. An innovation in rice that seems, prima facie, to be climate smart, and has spread with modest investments across the world to over 50 countries, should merit serious attention. More so, because Indian farmers (over two

million of them in different states have tried SRI) have been at the forefront in adopting the system locally and have even been extending its ideas to other crops. Yet, these developments have met with a strange silence from the Indian establishment. It may be exercising prudence in avoiding the controversy over a super yield; however, strangely, the establishment has not even felt the need to examine the phenomenon, the science behind it and evaluate whether the technology has a future worth investing in.

Instead of being mute spectators, Indian rice researchers could use this as an opportunity to be active participants by not only verifying the claims but also carrying out knowledge dialogues between the two ways of growing rice—the SRI way and the IRRI, or the Green Revolution, way.

After all, *The Guardian* was only carrying a result reported earlier (July 2012) in *Agriculture Today,* one of India's premier agriculture monthlies. The authors of the article had an innovative collaboration of actors, not often seen in Indian agriculture. Along with the officials from India's Directorate of Rice Development in Patna and the Agriculture department's extension personnel involved in verifying the records were two outsiders: Anil Verma, from the civil society organization (CSO) PRADAN that piloted SRI (the potential for which was picked up by state's livelihood programme for up-scaling) in Bihar, and Norman Upoff, a political scientist from Cornell University, instrumental in taking SRI from Madagascar to the rest of the world.

The farmers' fields in Bihar have invited the attention of several actors. What is strange, though, is the absence of any statement from the scientific establishment on the issue or an expression of research interest in examining the phenomenon and possibly explaining the high yield. What was common among other farmers in the area who had high, if not super yields? How, if at all, and under what conditions could these be sustained? Would rice yields be significantly lower in a drought year through SRI, like the current one in Bihar, or would it offer better chances for farmers to adapt climate change?

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Over the years, SRI has given rise to interesting dialogues and conversations among actors, who normally would not meet. A non-governmental actor and CSO, World Wide Fund for Nature (WWF), which was keen to explore the water-saving potential of SRI, carried out evaluations on SRI with an agricultural university. WWF organized national symposiums on SRI (in 2005, 2007 and 2008 at the agricultural universities of Andhra Pradesh, Tripura and Tamil Nadu, respectively) to bring together researchers, extensionists, civil society actors, farmers and policy makers. The National Consortium on SRI (NCS), a loose network of actors, has built upon this to carry out policy dialogues with the Planning Commission and the Ministry of Agriculture on the science, policy and practice of SRI. Despite India's Directorate of Rice Research being involved in these symposiums and sharing their own assessments of the method, the Indian agricultural establishment has largely been reluctant to pursue research on SRI.

There is a déjà vu to this official silence that reflects knowledge hierarchies and rigidities. In 2012, an international, multi-

institutional initiative to improve productivity and livelihoods in the eastern region of India invoked a participatory rhetoric and invited ideas about ways to improve productivity. In their presentations, research institutions, both central and state, and leading civil society actors pointed to SRI as an important option for food security and productivity enhancement. However, in spite of the international contestations, the lead institution chose to ignore local voices and let its sister organization and partner, the IRRI, promote its own package of practices (PoP).

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SRI TO ITS OWN

Within India's linear model of innovation, agricultural innovations outside the formal establishment are rarely accepted, unless validated for extension by scientists. With the scientific establishment reluctant to do so, most state departments of agriculture have ignored SRI, even as other rural development departments have promoted SRI through women's Self Help Groups (SHGs) to improve small farmer agricultural livelihoods. Different regions of India have responded differently to SRI. There has been no interest in SRI in the Green Revolution areas such as Punjab and Haryana, even as the institutional arrangements have enabled its spread in Tamil Nadu and Tripura where the state departments of agriculture have backed the innovation. In most parts of rain-fed India—Bihar, Odisha, Andhra Pradesh, among others, SRI has spread through a complex combination of actors with civil society organizations (CSOs) working with farmers, extension departments of various ministries and researchers, in learning alliances to discuss and take the innovation further.

SELF RELIANCE IN SCIENCE—AN IMPOSSIBILITY

Indian science has had an uneasy relationship with the alternative vision of science and any form of dissent. The SRI phenomenon can be read at several levels. At one level, it is about the scientific controversy around rice, the nature of the arguments about what is good science, what does one value in research—super yields or greater choice for farmers and scientists? At another level, it is about the power of a kind of international science and the inability of India, despite its strong research establishment, to chart its own course in science and articulate an alternative vision. How does one see self-reliance in science that is increasingly globalized?

Indian scientists, especially from the public sector scientific institutions, are being encouraged to link up with multinational companies to enhance their industry interface, as the only way of becoming competitive and remaining a globally competitive scientific power. India's science policy is reduced to managing research and development (R&D) to remain among the top five. Encouraged by India's success in information technology, biotechnology, pharmaceuticals or the auto industry, and visions of India becoming a global R&D hub, India has become the site of innovation, with management experts seeing it as a centre of 'reverse', *jugaad* and 'frugal' innovations. Greater and faster integration with the rest of the world seems but natural.

The story of Bihar farmers and SRI in India should help us pause and reflect upon the question: Is there another way, or ways, of science? Would being more competitive help us solve our own and the world's problems,

wherein the rules of the game are being changed globally and locally because of climate change? We are living in an age where international reports involving several scientists, whether from the Inter governmental Panel on Climate Change (IPCC), the Millennium Ecosystem Assessment (MEA) or even the International Agricultural Assessment for Science, Technology and Development (IAASTD) are asking questions and thinking about a different science to deal with complex problems?

The SRI story shows that there are indeed diverse paths that could include a different, and even equal, engagement with peers in creating a new science; of involving groups other than scientists in discussions on science; of maintaining one's identity and yet benefitting from global developments by treating knowledge as commons.

The SRI story needs to be situated within these larger concerns—of a newer vision for science in a complex world, about the scientific questions relating to the emerging fields of knowledge that are multi-, inter- and trans-disciplinary. The SRI story shows that there are indeed diverse paths that could include a different, and even equal, engagement with peers in creating a new science; of involving groups other than scientists in discussions on science; of maintaining one's identity and yet benefitting from global developments by treating knowledge as commons. It raises questions about science-society relationship, about expertise and the reluctance to engage with society. It is also about the space for innovation outside the formal field of R&D. How are these concerns, ideas and opportunities reflected in India's new science policy document?

After a decade, the Indian scientific establishment released the much-awaited STIP in 2013, adding innovation to the earlier science and technology policies. Public policies in India, in the last decade, have seen many arms of the government moving towards wider consultative processes, social audits for better transparency and governance, and a rights-based approach. Unfortunately, STIP 2013 shows no change in thinking in the policy processes. The policies continue to be made by a few technocrats, with little consultation with the actors involved, and remain 'out of sync' with other sectors and aspects of public life. Analysts have criticized the document for its supply-side focus and for ignoring the non-R&D aspects of innovation, for the absence of a dialogue, a lack of a review or analysis, and a mistaken reliance on the private sector, for being high on rhetoric and poor on mechanisms for transforming existing institutions, to create an inclusive and sustainable vision for systemic innovation. Here, the focus is on the relationship between science and society and how this is seen in STIP 2013.

Despite the rhetoric of 'shaping the future of an aspiring India' and the talk of a 'new paradigm', STIP 2013 actually reiterates and reinforces a one-sided relationship between science and society—a vision that privileges the know-all technical expert, and relies on him/her to deliver goods and scientific temper to the citizen, who is seen as lacking knowledge and scientific temper. The last decade has seen new thinking and rich debates on the science-society relationship that STIP seems to have by-passed.

A 3D AGENDA FOR SCIENCE

A new social contract with science was articulated by M. Gibbons when he suggested a shift in the production of knowledge from a mode-1 system, in which problems could be solved within specialized disciplines

and there existed a linear relationship between theoretical development and practical problem-solving, to a mode-2 system, in which knowledge is trans-disciplinary and produced within the context of application. In mode-2, systems knowledge needed to be not just be 'reliable' but more 'socially robust'. Gibbons called for a rethinking of science's relationship with society that reflected this complexity and diversity, a blurring of professional identities, and the co-evolution of knowledge between the state and the market, with society 'speaking back' and transforming science. Gibbons also spoke of the need for constructing narratives of expertise and bringing together different 'knowledge dimensions'.

The governance of science, technology and innovation is not about centralized mindsets and bureaucracies but, as suggested by De la Mothe, more about inter-dependence, linkages, networks, partnerships, co-evolution and mutual adjustment

Governing science in the 21st century requires understanding the complexity of the scientific endeavour and its relationship with society. As has been pointed out by science studies scholars in Europe, it requires 'taking knowledge seriously'. A vibrant (European) knowledge society, they suggest, must be built on 'collective experimentation'. They call for distributed innovation that includes diversity, not just of actors, but also of new options, or pathways. Reinventing innovation requires reinventing the commons and the suggestion is that the policy makers might want to promote a diversity of innovation models. They are critical of the Lisbon agenda of setting targets for the R&D as an end in itself, even suggesting that such indicators or measures can be both 'irrelevant and misleading'.

National science policy documents often see the knowledge question in rather limited terms and are uncritical in their engagement with science and technology. In practice though, scientists and technologists, increasingly, realize the complexity of the enterprise, its uncertainty, risks and vulnerability. The governance of science, technology and innovation is not about centralized mindsets and bureaucracies but, as suggested by De la Mothe, more about inter dependence, linkages, networks, partnerships, co-evolution and mutual adjustment.

As the SRI story suggests, this challenge is more so in India, which has a larger diversity of actors involved in the scientific enterprise. Some of these actors, especially outside the formal R&D, bring plural and multiple knowledge systems that co-exist and share space with 'universal western science'. If STIP 2013 were about a new paradigm, it needed to have aimed at creating spaces for dialogues on knowledge. In the SRI case, an absence of such spaces for knowledge dialogues, has seen the emergence of newer civil society actors pushing for it, reflecting a need from below. STIP 2013 picks Gibbons's mode-2 agenda enthusiastically but sees it within the restricted frame of R&D management. Innovation though is much more than science and technology, and knowledge; it is about production and governance. In the absence of discussions and dialogues on how transformations, even in a restricted sense of knowledge management, take place and what it means for the everyday practice of science, STIP 2013 reveals a mode-1 mindset, despite the rhetoric of a mode-2 system.

The STEPS (Social Technological and Environmental Pathways to Sustainability) Centre at Sussex, England, has been carrying several manifesto dialogues based on their 'New Manifesto' for innovation, sustainability and development. They suggest a '3D Agenda'

as a framework for innovation that looks at the direction of innovation, a more equitable distribution of its costs, and the value of diversity in innovation approaches for sustainable development. The manifesto recommends the bringing together of natural and social scientists from different fields as well as recognizing the role of citizens in the co-design and co-production of knowledge. These rich discussions on the role of knowledge, its distribution and directions are not reflected in STIP 2013.

The Knowledge Swaraj manifesto seeks to open up possibilities in Indian science and traditions for new knowledge that is more socially robust. It goes beyond Indian policy debates on self-reliance to articulating self-rule, or swaraj, for the Indian people in science and technology

Contemporary India is witnessing several instances whereby citizens, to use Gibbons's phrase, have been 'speaking back to science' and the scientific establishment. The public engagement of scientists with citizen concerns continues to be weak in India, as seen in the inter-academy report on Bt brinjal in 2010 or the more recent discussions about the risk surrounding the establishment of nuclear reactors. Whereas the Right to Information (RTI) Act has opened up spaces for questioning, the response of the establishment has been to invoke the bogey of anti-development, as and when citizens have raised concerns. Sunita Narain echoes this well in her comments on the attitudes of the scientific establishment to climate change. "Worse, because of the nature of its institutions—which are closed to outsiders on the one hand, but subservient to officialdom on the other hand—it will not engage in any public discourse… Indian science, to respond to climate change, will have to get a little less male and perhaps even a little less old."

KNOWLEDGE SWARAJ

This insularity of the scientific establishment and its notions of expertise have been increasingly under question by citizens. What if citizens, rather than the scientific establishment, were to write a science and technology manifesto? A recent effort by a network of science studies scholars and engaged science activists brought out an Indian manifesto that offered a framework of plurality, sustainability and justice (similar to the Sussex 3D framework) for the future of Indian science and technology.

Using Gandhi's *Hind Swaraj* as an inspiration to think ahead, rather than look back at the past, the Knowledge Swaraj manifesto seeks to open up possibilities in Indian science and traditions for new knowledge that is more socially robust. It goes beyond Indian policy debates on self-reliance to articulating self-rule, or *swaraj,* for the Indian people in science and technology. The manifesto suggests that the counter-posing of experts versus lay people is neither useful nor relevant in understanding the current challenges. Societal challenges require expertise of different kinds and should be open to questioning the expertise of a missile scientist on building nuclear reactors. But beyond the idea of getting the right kind of technical expert, there is need to take the social dimensions of expertise more seriously. It argues that Indian science policy will be poorer if it does not recognize and re-install the citizen as an expert, as an inventor.

This idea of citizens or civil society being involved in science is not necessarily new. The physicist and science studies scholar, John Ziman, makes a case for including technically unqualified individuals as active, responsible

actors in the production of scientific knowledge as the context 'speaks through them'. They need to be included, along with scientific experts, in the groups that draft and review research programmes and project proposals. These 'non-experts', he believes, can not only open up or articulate the partisan interests motivating the research but also give the research process meaning in life-world terms.

Knowledge Swaraj argues for cognitive justice that recognizes the richness of multiple knowledge systems. India has had a rich history of social movements from the early part of the nationalist movement that have contributed significantly to a 'parliament of knowledges' for science. As Shiv Viswanathan points out, the idea of 'cognitive justice' goes beyond the concepts of voice or participation. It does not ask for mere expert representation but underlines an appeal by marginal and traditional societies, who believe that they have something to add to western science, to its ideas of complexity, time and sustainability.

The release of the recent Inter-governmental Panel on Climate Change (IPCC) report has reconfirmed the need for different growth strategies for sustainable development. Resource conservation and vulnerability reduction can turn out to be more important than productivity enhancement and resource exploitation. Sustainability science has emerged as a new field that is more problem-focused (rather than discipline-focused) that seeks to integrate and synthesize rather than merely analyze and break down. It calls the natural and social sciences to work together. Sustainability, Knowledge Swaraj suggests, offers newer frames for analysis and planning. The manifesto, however, suggests that there is need to go beyond the Harvard understanding of sustainability science, to open up questions on knowledge in subsistence systems, and re-assess and re-evaluate their contribution to planet health. The manifesto also suggests that taking forward the agenda of plurality, sustainability and justice requires a re-thinking of the science-society relations and mechanisms, to further trusteeship in science. A vibrant civil society and its contribution to science are important to this.

John Ziman in his latest book, *Science in Civil Society*, sees the scientific enterprise as in need of political correction, if science were to remain a moral enterprise. Techno-science, he suggests, has made data technicians of many scientists and mute spectators to the knowledge drama rather than producers of knowledge in the world. He does not invoke Gandhi, but re-thinks the future of 'post-academic science', suggesting that the academic scientist must endeavour to be independent of church and state, commerce and industry, political party and ethnic community. Put differently, his call is for the autonomy, or *swaraj*, of the scientist.

In this revival, Ziman argues for a greater role of human sciences and civil society. He sees civil society not just as one of the major 'sectors' of the post-modern social order, but also as one of the most important 'trading zones' between science and society. Civil society is a dynamic source of innovation, benefaction, criticism, protest, provider of ethical norms and other societal forces. The key to power in the post-modern 'knowledge society' is the research agenda. More than the conventional roles seen for civil society—as a social watch or an ethical compass—Ziman sees civil society playing a more influential role in framing research agendas and taking on the main responsibility for defining and representing the 'context of implementation'. This involves more than consultation over ethics of research or informed consent; it means having a hand in the formulation of research questions and protocols. It implies power to define problems that ought to be looked into, and to initiate

scientifically sound research on them.

An example of this is evident in SRI. A study collating the experiments from the field by CSOs on indigenous varieties of SRI from principles, was put together recently by NCS. These varieties lost out during the Green Revolution because their response to agro-chemical inputs was poor. A new research agenda has emerged with a favourable response to SRI principles, creating an opportunity to bring back nutrition, aroma, health and drought-resistance into the research agenda that traditional rice varieties were once known for. The initial favourable results indicate a need to incorporate greater diversity in testing and validating SRI, which if left to the rice establishment alone, is unlikely to be taken up because SRI is often seen by them as another way of pushing their, often costly, varieties due to its seed-saving potential. Validating the response of indigenous varieties across agro-ecological regions would require several field agronomists or investing in the hitherto unused research capacities of CSOs.

In a significant step, scientists at the Indian Agricultural Research Institute in collaboration with PRADAN, have initiated and coordinated on-station experiments on SRI at the Pusa campus to see 'if' and 'how' SRI and its extension in wheat works.

CITIZEN SCIENTISTS AND KNOWLEDGE COMMONS

Translating some of the ideas in Knowledge Swaraj or Ziman or IDS, or taking European knowledge society seriously would require a re-think on the role of civil society that is often relegated to the end of the innovation chain as extension agents, or worse sub-contractors of the state in remote and conflict-prone areas. Civil society involvement in science has taken several forms in the past. These include citizen juries and consensus conferences that have provided opportunities for citizens to have their say about science. However, the research formulation and execution capacities of civil society in science or their ability to promote 'citizen scientists furthering collective experimentation and in setting research agendas and protocols have not been explored. Together with mainstream science, these could create new knowledge commons.

India has witnessed several citizen scientists playing an important role in the freedom movement. Some were actively sought by Gandhi in his experiments on khadi and village industries. More recently, these citizen scientists have been at the forefront of people's science movements, creating institutions that have forged newer alliances between science and society. Some such as C.V. Seshadri and Amulya Reddy have gone beyond the earlier thinking on providing appropriate technology for India and the rural poor by articulating alternative visions for a sustainable future. Civil society has shown different ways of organizing science, of creating new knowledge commons. Science policy documents often miss out on these processes and experiments that emerge from the ground, from the fields and laboratories across India.

Not all is negative about Indian science nor is it right to posit mainstream science and civil society in opposition. What follows are some emerging possibilities from the field that indicate the scope for civil society-science interactions in SRI.

The SRI story in India had a curious twist to the innovation tale, again from the margins. In July 2013, a video on SRI in Meghalaya was released by the National Agricultural Innovation Project (NAIP) of the Indian

Council of Agricultural Research (ICAR) that spoke about the 'success story' in the Garo Hills of improving rice productivity through SRI. Whereas the film captured the technical aspects of SRI innovation rather well, it glossed over the social processes around the innovation, making it appear as though ICAR had taken the technology from Madagascar and made it a success in the Garo Hills through rigorous scientific work.

In a significant step, scientists at the Indian Agricultural Research Institute (IARI) in collaboration with PRADAN, have initiated and coordinated on-station experiments on SRI at the Pusa campus to see 'if' and 'how' SRI and its extension in wheat (SWI) works. Interestingly, the research protocols were decided in collaboration with civil society actors. There was cognitive justice in the experiment with a multi-disciplinary team of IARI scientists working together in the experiment that had the knowledge of a farmer (Sanjay) from Bihar, supplemented with inputs from PRADAN and the Peoples Science Institute (PSI).

In distant Alfred State University in New York, engineering students have recently chosen to work on a design for an up-land weeder for SRI, based on collaboration between SRI-Rice, the international network on SRI, and the SRI-Global, an NGO. The students came up with interesting designs and posted them on Facebook, inviting comments from SRI equipment users and manufacturers. If students, who have never seen a rice plant, could think about global problems, surely there is greater scope for such experiments in India's agricultural engineering programmes and the interactions with scores of CSOs in the region. There, indeed, is a case for civil society to augment its own research capacity in areas such as the hills of Uttarakhand, or in using SRI principles for wheat and other crops, where there has been little research by agricultural scientists. Taking the processes and protocols from IARI in Delhi out to different locations has the potential to create enormous new knowledge.

Preliminary analysis of the global research on SRI indicates that Indian researchers have been leaders in the field, contributing over a third of all papers that have emerged on SRI in the last decade. It required a network of CSOs, including social scientists, to point out to the scientific establishment that this was indeed an opportunity to emerge as a leader in the field. It might not be easy for mainstream science to accept this completely, but what the SRI story shows us is that there is indeed enormous scope for 'sustainability science' in India, if only the scientific establishment would promote diversity and collective experimentation and shape, to use the Rio+20 slogan, 'The future we want' (The Rio+20, a United Nations conference on sustainable development, took place in Rio de Janeiro; its focus was on achieving a sustainable future–the future we want).

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