



CITIZEN SCIENCE

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I. SUMMARY

The relations between science and society have altered profoundly over the course of history. Since the 1970s, the notion of progress has come under fire with growing awareness of its impacts on the environment and human health. Today, this puts the spotlight on the questions citizens ask of researchers and research institutions, as well as the need for researchers to explain the nature and importance of their approach to society as a whole. Here, COMETS expresses the urgent need for a relationship of trust to be built between citizens and scientists. Two avenues are considered: participatory science and a renewed dialogue between science and citizens.

Participatory science, a fast developing phenomenon today thanks to the Internet, involves amateur citizens in scientific activities for the collection of data and sometimes the joint formulation or interpretation of results. This brings considerable mutual benefits, firstly through its contribution to the production of knowledge, and secondly in educating citizens in the scientific method and mindset. It is also an approach that encourages scientific vocations amongst young people. COMETS puts forward recommendations on the establishment of frameworks for the practices of amateur networks, on the importance of validating results, on the respect for anonymity in the case of private data, and finally on the status and recognition owed to contributors.

In a world shaken by successive crises and riven by controversies on sensitive subjects, COMETS is of the view that researchers and their institutions need to listen to the public's questions on the impacts of their choices. While reaffirming the autonomy of the scientific sphere, it considers it necessary to reflect on the forms that the public debate around research questions should take. It strongly stresses the importance of disseminating scientific culture and actively promoting it at all levels of society. It recommends that the assessments made by scientists on issues that have a societal impact should be conducted in the absence of conflicts of interest, within an interdisciplinary and if possible international framework. It recommends that CNRS should support the involvement of research teams in the analysis of perceptions of science and encourage initiatives that tackle sensitive topics. Finally, it suggests that CNRS should develop a collective expertise that can be applied in responding to approaches from public decision-makers and democratic bodies.

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II. SELF-REFERRAL

The concept of “citizen science” encompasses several very topical phenomena that COMETS has chosen to tackle, although its treatment will be far from exhaustive. First, the concept refers to science to which citizen amateurs contribute alongside research professionals. It is also understood as science that possesses civic virtues, which serves society in its organisation and implementation.

Amateurs and people driven by curiosity have long – in particular since the 19th century – been associated with the advance of scientific activities and practices, be it in astronomy or meteorology, in the natural sciences or in Earth sciences. They have participated in the collection of data for the description of plant and animal species, for observation of the stars and of celestial or atmospheric phenomena. This early phase persists today thanks to information technologies, in particular the Internet, which has massively boosted the opportunities for participation. The production of relevant observations can benefit from the involvement of citizens, whether scientists or amateurs. Very much in vogue today, this research practice raises a number of questions about its effectiveness, its benefits, the nature of the contribution of amateurs and, more generally, about the role that they can hope to play in the production of knowledge.

The relations between science and society have gradually changed. In the aftermath of the Second World War, scientific progress was seen as the primary driver of economic and social development, and science proved to be at the heart of state security. The 1970s saw a shift in attitudes, with the growing perception of the limitations of the forms of growth associated with the post-war years, reflected in the steady rise of environmentalist concerns bolstered by increasing awareness that the earth’s resources are not infinitely renewable. With the consciousness of new risks (chemical, nuclear accidents, genetic manipulation, etc.), public opinion has become increasingly divided between admiration at the meteoric progress of science, in particular in the medical sphere, and worry about certain technological developments that arouse controversies across the world. Moreover, the complexity of knowledge means that unequivocal responses are no longer possible. In many countries, we are witnessing the emergence of critiques from citizens and groups demanding transparency, and opposition to – even control over – scientific choices.

The questions raised by citizen science are highly topical. On the one hand, with regard to participatory science, cooperation between researchers and amateur contributors is a fast-growing phenomenon, in particular with “crowdsourcing”, defined as the participatory production of knowledge. It is breathing new life into a practice of research in which everyone can be involved. This fact raises a number of questions about the effectiveness of such science, about its virtues, about the nature of the contribution of citizens and, more generally, about the role that they can hope to play in the production of knowledge. On the other hand, it is important to re-establish a dialogue of trust between science and citizens, and to elucidate the controversies around the consequences of the large-scale deployment of science. Researchers have a frontline role to play in making expert assessments that are not tainted by conflicts of interest and in becoming involved in

debates with their fellow citizens. Without claiming to provide a a full account of the fundamental questions raised here, for which solutions remain to be found in a fast-changing world, COMETS proposes to analyse the ethical implications of the two facets of citizen sciences outlined above, emphasising the particular role that researchers and their institutions have to play.

III. ANALYSIS

A. Participatory science: contribution of citizen amateurs to scientific knowledge

There have always been citizens who have contributed in an amateur capacity to the advancement of scientific knowledge. They are generally motivated by curiosity, the satisfaction of searching and finding, the intellectual stimulation that it entails, and the pleasure in the sense of belonging to a community.

1. History of participatory science

The term “citizen science” was coined by Alan Irwin in his 1995 book of the same name,¹ where he explains how knowledge about the environment can be obtained from reports of individual experience by large numbers of people. At roughly the same time, in the United States, the term “citizen science” came to be used in reference to public participation in research.² It is often associated with Rick Bonney’s work in an ornithology laboratory administered by New York’s Cornell University, where in the 1950s the laboratory’s founder Arthur Allen recruited amateurs to report observations on different species of birds. Previously, through learned societies or research networks (cartography, meteorological, astronomy, etc.), voluntary contributions from across the world were often the source of data relevant to scientific research. In astronomy, a plethora of amateurs has contributed to the discovery of comets or variable stars. Before the 20th century, it was commonplace to cite the work of amateurs who, despite having received no formal scientific education, were considered great scientists. In fact, it was only in the 19th century that the word “scientist” began to be used substantively in reference to people who devoted themselves exclusively to a science.^{3[1]}

2. The upsurge of participatory science today

In recent years, the upsurge of participatory science has been spectacular: in the USA, the “American Association for the Advancement of Science” (AAAS) sponsors the “citizen science” association. A programme of the same name is being developed in the UK.

1 Alan Irwin, *Citizen Science: A Study of People, Expertise and Sustainable Development*, Psychology Press, 1995

2 Rosner, H. (2013). Data on wings. *Scientific American*, 308(2), 68–73. DOI: 10.1038/scientificamerican0213-68

3 Alain Rey, *Dictionnaire historique de la langue française*, p. 1895, article on “Science”, published by the Robert dictionaries.

In 2013, the European Community produced a report on Environmental Citizen Science.⁴ In France, citizen observatories are being set up all over the country, for purposes such as collecting data about the France's coasts. Note that the CNRS's Ecology and Environment Institute (INEE) runs several units dedicated to participatory science.

In recent years, information technology has given a very sharp boost to the methods of participatory science, both conceptually and practically. As regards the principle, these methods are inspired by the peer collaboration practices employed in the development of open source software. To encourage cooperation, a range of so-called "free" licences have been developed to facilitate the reproduction, distribution and modification of such software. The results are convincing: numerous pieces of software produced in this way compete on equal terms with proprietary industrial software.

This is the model on which a growing proportion of scientific activity is developing. Internet progress now makes it possible to coordinate the activity and contributions of a large number of people. This has given rise to what is called crowdsourcing, a way of aggregating the conscious or unconscious contributions of multiple citizens. The term is derived from "outsourcing", which in business management refers to the use of external contractors to provide certain skills. Crowdsourcing draws too on the technologies of the social web, also called web 2.0 (or indeed the "participatory web", because it asks users to give their recommendations for sites, books, films, etc.). In short, it is a form of outsourcing that uses the web to get a large number of nonspecialists to perform certain tasks. Using these techniques, collaborative science websites can recruit anyone who wishes to contribute to the collection – or even interpretation – of observations for scientific purposes.⁵

Amateurs participate in various ways, through a gradation of contributions. The European report on citizen science identifies four degrees of participation, from the simple gathering of observations where citizens are used as collectors or elementary processors, to so-called "distributed" science where citizens are not restricted to observation and calculation, but interpret the data, to a third level where citizens are stakeholders in the design of the project, and finally to a fourth so-called "extreme citizen science" level where citizens participate in the analysis of the data collected and make a theoretical contribution. For the present position paper, we will concentrate on two forms of participation, which cut across the four gradations above: data collection, on the one hand, co-creation and co-design, on the other.

3. Collection of scientific data by amateurs

In the first form of participation, citizens take part in data collection, either reporting observations after some preliminary instruction, or agreeing to become objects of investigation by contributing, whether passively or actively, to the evaluation of an experiment. In the first case, data collection partly overlaps with the very topical theme of

⁴ Science Communication Unit, University of the West of England, Bristol (2013). Science for Environment Policy In-depth Report: Environmental Citizen Science. Report produced for the European Commission DG Environment, December 2013. Available here ici: <http://ec.europa.eu/science-environment-policy>

⁵ <https://www.zooniverse.org/> or <http://scistarter.com/>

crowdsourcing, referred to above, which has applications to numerous domains, in particular astronomy, where amateurs contribute with observations ⁶ or annotations,⁷ biodiversity with the collection of plants, insects or fish, meteorology and climate science with distributed local measurements, geography with detailed mapping,⁸ the humanities with the annotation of texts or images,⁹ archaeology with the observations carried out by local populations, etc.

In the second of the two forms of participation, individuals can themselves actively take part in studies in which they are the experimental subjects. In medicine, for example, the term usually employed to describe the involvement of patients in observation and care is patient engagement.¹⁰ When participants themselves become objects of investigation, it is important both to protect their privacy and to obtain informed consent, in other words that the researchers responsible for the study ensure that the participants understand the goals of the research and also the risks incurred, whatever their nature. The techniques of contributor profiling employed for validation must meet these principles, in so far as participants must be warned that they such profiling is taking place. In addition, care must be taken that information obtained for research is not reused for other purposes, in particular commercial and especially professional or police purposes.

The importance of validating observations is crucial. This validation needs to be automated, with no human intervention, otherwise the cost of verification would rapidly become prohibitive and wipe out the advantages of collaborative data gathering. The principle usually applied relies on the fact that the involvement of multiple observers leads to a convergence of observations and/or interpretations. Majority judgement here constitutes proof, which – it should be noted – runs counter to the usual scientific approach. This consideration has led to the establishment of different systems of validation, some of them entailing a statistical count of convergent responses, others a competency model, which is either established *a priori* or derived by automatic induction using machine learning algorithms. Empirical studies show that none of these models is superior to the others, since the results depend on the context of the study, the motivation of the contributors and the task to be performed. Whatever the procedure chosen, epistemological questions arise regarding the nature of evidence in these conditions. Moreover, it can appear problematic in that a number of observations are eliminated because they are deemed either redundant or aberrant. The evaluation criteria need to be clearly specified in order to maintain the necessary scientific rigour.

Generally speaking, collaborative annotations require a common terminology, which are achieved through the establishment of so-called ontologies. Some are established from

⁶ The French Astronomy Association did a census of the collaborative astronomy programmes conducted in France. The results of this census can be viewed in a report published in 2013 (cf. <http://www.afanet.fr/pdf/sciences-participatives-afa.pdf>)

⁷ Galaxy image annotation website: <http://www.galaxyzoo.org/>

⁸ The OpenStreetMap project (<http://fr.flossmanuals.net/openstreetmap/>) is a good example of the possibilities.

⁹ Example, one website asks people to help annotate the notebooks of soldiers in the great War. [http://operationwardiary.org/?utm_source=Zooniverse Home&utm_medium=Web&utm_campaign=Homepage Catalogue](http://operationwardiary.org/?utm_source=Zooniverse+Home&utm_medium=Web&utm_campaign=Homepage+Catalogue)

¹⁰ This theme is currently very topical, as evidenced by a number of scientific events: <http://www.patientengagementsummit.com/>

scratch, others derived from words in general use. The English term for these is *folksonomies*, i.e. words used by “folk” belonging to the same community. In any case, the researcher needs to play a decisive role in establishing these terminologies, which are at the heart of the collaborative scientific approach.

4. Amateurs work with researchers in co-creation and co-design

Is participatory science restricted to the involvement of citizen amateurs in the ancillary role of collecting observational data? First, it should be noted that observation is a not insignificant part of normal scientific activity. There is nothing passive about the tasks of annotation and interpretation – they always require significant individual input. In addition, there is a whole gradation of participatory activities, extending to very active involvement by nonspecialists involved in data collection networks. For example, amateur astronomers discover new celestial objects by comparing their observations with established sky maps. Similarly, amateur botanists are involved in the classification of their finds. Another example is the *ReClam the Bay* project, which seeks to re-establish an oyster and shellfish ecosystem.¹¹ An extreme case is the network of nonprofessional mathematicians on the *Polymath* website, which produces collective demonstrations of theorems to which all the online members contribute. Here, we can reasonably speak of genuine networked science.¹²

The benefits deriving from these kinds of participatory practice are twofold. On the one hand, they contribute to the establishment of big data banks of observations and annotations. Indeed, there are many tedious activities of collection and – in particular – interpretation that cannot yet be automated, and yet are crucial to the advancement of knowledge. In these cases, the participation of large numbers of amateurs is of value to scientists. In return, the participants acquire knowledge of scientific practices and problems, and training in rigorous research methodology. It is also a way of instilling a vocation for scientific work and of reducing cultural and social barriers.

For this kind of crowdsourcing to be successful, several conditions must be met. First, the participants need to be motivated. In many cases, the incentive comes simply from the playful nature of the activity. In other cases, people are motivated by the idea of taking part in an effort that can benefit society as a whole, for example in the spheres of health or the environment. Contributors can also be rewarded for participation, whether in symbolic or material ways, which raises ethical questions about the implication of the remunerative approach.¹³ The dominant approach, essentially utilitarian, is to offer fair rewards, so that contributors – who in any case vary in their degree of autonomy – are motivated without concerns about the sharing of benefits. Paradoxically, it would seem that in some cases reducing the reward leads to a better quality of contributions. Nonetheless, participatory science raises problems about the attribution of ownership, whether under moral or property rights, for research carried out by large populations.

¹¹ <http://reclamthebay.org/>

¹² Nielsen, Michael (2012). *Reinventing discovery: the new era of networked science*. Princeton NJ: Princeton University Press

¹³ There is even a game (cf. <http://www.metadatagames.org/>) designed to motivate people who agree to annotate

The idea of active participation by the entire population in the construction of knowledge is undoubtedly exciting. Nonetheless, professional scientists retain an important role in these creative processes that involve lay citizens. The balance between amateurs and scientists is not symmetrical. Scientists must contribute to the management of the collective work by providing essential methodological inputs: the protocols for handling the data collected must be well-established, the body of data defined as clearly as possible, sources cited with maximum rigour, ontologies specified to describe the objects of knowledge. It is the task of the scientists to ensure that the methods employed are rigorously managed, and to validate the contributions or at least to establish the validation procedures. One possibility is that appropriate training should be developed and provided for scientists involved in participatory research, where practices are currently developing so fast that it is not always easy for the most appropriate ethical practices to be defined.

B. Renewing the dialogue between scientists and citizens

Science does not occupy a position on the margins of society. This could have been the view in the past, when scientists worked alone, sometimes relying on sponsors, and more recently when scientific results were not expected to produce social and technical innovations. However, the relations between science and citizens have evolved with time. Societies have gradually become scientific societies, because in the last two centuries science has taken up a position at the centre of economic and technological development, at the heart of the state and national security.

Modern science is both a way of knowing and an instrumental activity intended to effect changes in the world. Scientists themselves are motivated primarily by the production of knowledge, always in the belief that they contribute to a common good. Yet they are increasingly obliged to justify their work by its profitable spin-offs in the world of technology. While they do not necessarily control these spin-offs, the public nevertheless calls them to account. With the awareness of the intrinsically limited nature of knowledge, in a world where systems are increasingly complex and less and less controllable, the pact of trust between scientists, citizens and decision-makers has been damaged.¹⁴ The contract between scientists and the state has changed. The aim of this chapter is to identify the conditions required to establish a new contract. In order to make scientific strategies more democratic, it is important for researchers and their institutions to try to answer the public's questions about the impact of scientific choices and to elucidate controversies around sensitive subjects, while maintaining the degree of freedom essential to the creativity of research.

¹⁴ *Agir dans un monde incertain. Essai sur la démocratie technique*, par Michel Callon, Pierre Lascoumes, Yannick Barthe, éditions du Seuil (2001), ISBN 978-2-02-040432-7

1. Bringing together science and society by disseminating scientific culture

Disseminating scientific culture is one of the goals of researchers, alongside the progress of knowledge and its transfer to society.¹⁵ While the first step is to consolidate the elementary notions taught in school, the principal aim is to communicate the research process, its operational procedures, and the possible uses of results. It is also important for the research community to instill an enthusiasm for discovery into young people. Although there is still insufficient recognition of the role of cultural dissemination in the evaluation of work done by researchers, many take it seriously.

The domains of knowledge today extend into every dimension. Their fragmentation and complexity make it harder than in the past for the public to understand the world. The extraordinary development of the Internet means that people believe they can understand everything by looking at the information available on the web. These possibilities are cause for celebration, and indeed are positively exploited in participatory science. Nonetheless, citizens are not always able to manage the information they obtain in this way, because they do not necessarily have a sufficient grasp of the basic notions needed to think critically. When tackling questions where the stakes are high, such as the dangers of vaccination, many lack a clear understanding of the meaning and interpretation of probabilities. Sometimes beliefs form within networks,¹⁶ on the basis of unfounded arguments that coalesce into certainties through quantity and repetition.¹⁷ For example, three in five Americans firmly believe that there is a creationist alternative to the Darwinian theory of evolution, drawing on pseudoscientific arguments with political implications, propagated with large financial resources.¹⁸ ¹⁹ Risks relating to the environment and health can encourage such irrational excesses.

Participatory science certainly contributes to the dialogue between science and society in the sense that it educates the public in critical thinking and in particular in scientific methods. However, it only reaches a tiny proportion of the population. Yet there are numerous traditional ways in which scientific culture is spread: in France, centres for scientific, technical and industrial culture (CCSTI) and science museums like the Palais de la Découverte in Paris or Espace des Sciences in Rennes, especially when they have highly professional communicators, offer exceptional opportunities for discovery, particularly for

¹⁵ Research Code (*Art. L411-1*) "Staff working in public research contribute to the transfer of knowledge and its application in companies and all domains that contribute to the progress of society".

¹⁶ *La démocratie des crédules*, Gérald Bronner, aux éditions Presses Universitaires de France (PUF), ISBN-13: 978-2130607298

¹⁷ We would note the existence of websites dedicated to thwarting the spread of false, out of date or unverifiable information (hoaxes) propagated by Internet users.

¹⁸ See, for example, the lavish tome by Harun Yahia, entitled 'The Atlas of Creation', whose superb illustrations mask a serious penury of scientific knowledge, especially in palaeontology. This very expensive book was distributed free to a considerable number of people involved in the dissemination of knowledge (teachers, journalists...).

¹⁹ For example, 'Global Publishing', which published the books of Adnan Oktar (under the pseudonym Arun Yahia), writes in a note on the author "*Harun Yahia is well-known as the author of important works disclosing the imposture of evolutionists, their invalid claims, and the dark liaisons between Darwinism and such bloody ideologies as fascism and communism.*" Other excesses can be mentioned associated with the spread of denialist claims.

young audiences. Science bars run by scientists encourage often passionate debate. Open scientific workshops and “FabLabs” are places where people can participate in and experience different types of knowledge.²⁰ Researchers regularly hold laboratory open days, prepare for the annual week-long festival of science, organise events during international celebrations like physics year 2005 or chemistry year in 2013, or attempt to draw public attention through collaborations between the arts and science. However, these kinds of events are one-offs, and rural areas that are remote from academic institutions do not receive the same attention. It should not be forgotten that the process whereby citizens learn the scientific method needs to be long-term. In this respect, the most effective sources are undoubtedly primary and secondary school teachers, and scientists should undoubtedly be encouraged to work with them.

Researchers who involve themselves in the dissemination of scientific knowledge, in particular early in their careers, encounter plenty of obstacles: time spent to the detriment of their research, limited resources to design events, continuing lack of recognition from their institutions. We should also note the difficulties specific to communication with the mainstream media. The press, radio and in certain cases television should in principle be the obvious mediators between knowledge producers and the population. However, the role of science journalists as communicators could be developed much further: the space they are allocated in the main daily or weekly papers, or in the audiovisual media, is always very limited. Paradoxically, at a time when science is everywhere, the notion of scientific culture as an integral part of general culture is no longer self-evident... Moreover, scientists who make the effort to write articles for the general public often feel frustrated, because they are asked to provide simplified explanations, which run counter to their instincts as specialists, and they are not entirely in control of what gets printed.²¹

Apart from approaches initiated by scientists themselves, other methods of disseminating scientific culture entail more direct participation by the population. Citizen debates and citizen lectures around major questions of societal interest are another very rich avenue for bringing knowledge to the public, which we will return to in the next chapter.

2. Controversies around the societal impact of scientific and technical choices

No one can fail to be aware that growing numbers of citizens hold an attitude of distrust towards advances in science and particularly in technology, perceiving them as exclusively dedicated to the development of industry, beyond democratic control and unconcerned with public well-being. Even the stunning successes and advances in medicine can fall under suspicion through misgivings over possible collusions of interests. A climate of scepticism is emerging, often reinforced by worries about the future in a society that is changing at a rapid pace. In some cases, there are challenges to the very purpose of major research programmes on sensitive issues. These include, in no particular order, a wide

²⁰ “FabLabs”, fabrication laboratories, were created in the late 1990s at MIT in order to make machine tools available to anyone who wanted them – entrepreneurs, tinkerers, designers, artists, etc. – to build prototypes. In the last few years, the arrival of 3-D printers has breathed new life into these workshops.

²¹ See position paper 109 in the CCNE archives: <http://www.upf.edu/pcstacademy/docs/CCNE-Avis109.pdf>

range of controversial topics: the causes and effects of climate change, the use of genetically modified organisms in agriculture, the toxic effects of pesticides and certain nanoparticles, human “augmentation” by brain stimulation, lasting damage to the environment from the exploitation of shale gas, the harmful effects of mobile phones, the risks of burying nuclear waste, irreversible climate modification by large-scale geo-engineering, etc.²²

Controversies within science have always existed between scientists themselves, and are a driver of progress in knowledge. They take a different form, often called “sociotechnical controversies”, when they emerge into the public sphere and relate to the environmental, societal and health impacts of scientific and technical developments. In many cases, citizens do not fully trust the assessments made by scientists, sometimes suspecting them of bias in favour of the companies that finance their contracts. Conflicts of interest have been demonstrated, for example in sectors relating to pharmaceuticals or on the damaging effects of products like tobacco or asbestos. Nevertheless, a democratic regime needs to maintain open debate with citizens. As experts, science professionals owe it to themselves to take part, to provide the knowledge that can cast light on the controversies. In so doing, they must always declare any conflict of interest, specify their functions and any links with stakeholders in the domain on which their views are sought. In reaching their assessments, they must always be careful to specify what is known, distinguishing it from what is possible or probable, explaining clearly where the uncertainties lie and the nature of the hypotheses underlying predictive models. As far as possible, they should avoid projecting their assumptions into the debate.²³ Moreover, it is obvious that scientists do not always agree, in particular on societal issues that lie outside their field of competence, where they formulate opinions in the same way as any other citizen. It is important that different disciplines should contribute collectively to nourish debate through the confrontation of ideas. From this perspective, in their conferences or workshops, researchers in the exact sciences and in the life sciences should do more to involve other disciplines, in particular from the interdisciplinary “Science Technology Society” sector, when their research fields touch on sensitive subjects, in order to try to elucidate the controversies in public understanding and perception.

Citizens increasingly communicate through the Internet, which enables them to pool their information in networks, to reinforce their fears or certainties, to refine their questions. There has been a proliferation of groups of different kinds which provide alerts and education on different social or environmental problems, or warn against the potential dangers of certain avenues of research or the risks that they present to populations worldwide. In many cases, they provide useful pointers that can only be of benefit to scientists. In agriculture, for example, growers, consumer associations and ecologists make a valuable contribution. Similarly with regard to health, patient groups, or even sometimes social insurance bodies, can provide a useful perspective, alongside doctors and pharmaceutical labs, in order to move research forward. This phenomenon forms part of the

²² Colloquium run by COMETS “Sciences à très grande échelle” on 8 and 9 January 2014

²³ COMETS position paper on natural risks, expert assessment and crisis situations, September 2013

more general framework that certain epistemologists have, since the 1990s,²⁴ christened “post-normal” science.²⁵

3. Increased democratisation of scientific strategies

Calls for transparency, or even for control of or opposition to scientific choices, are now coming from citizens and civil society organisations. However, it might be thought that – through the intermediary of democratic institutions – the population actually participates in the choice of scientific priorities: parliamentary assemblies vote on the budgets of universities, scientific infrastructures, funding agencies and research bodies. The national committees for research and innovation strategy (SNRI) are consulted by the state to decide major objectives. Elected officials in European bodies establish the principal orientations of research in Europe. Yet despite this indirect participation through their politicians, many citizens (and even scientists...) have the impression of not really being involved in these choices which, on account of their diversity and complexity, demand public debate. For one thing, it is known that certain decisions that have a big impact on the future of society do not go through Parliament; for another, politicians are not always well informed about scientific issues, except through OPECST (parliamentary office for the evaluation of scientific and technical choices), and are remote from citizens on these questions. This is why a special status was given to whistleblowers by in Article 1 of the so-called Blandin Act of 16 April 2013: “any moral or legal person has the right to make public or disseminate in good faith information concerning a fact, a piece of data or an action, provided that ignorance of that fact, that piece of data or that action would seem to constitute a serious risk to public health or to the environment.” Now it is legitimate that citizens should be able to ask for certain questions of a scientific nature to be included in discussions on the political agenda, or to raise new questions, and to be involved in one way or another in decisions that affect the future of humanity.

This was the motive behind the creation in France in 2002 of the “Citizen Sciences Foundation”, an organisation that seeks to influence parliamentary votes in favour of research policies that contribute to a democratisation of scientific choices.²⁶ In addition, in 2012, a number of associations announced the creation of a “Sciences-Society Alliance”, with the goal of enhancing and promoting interactions between science, research and society, and studying new forms of intermediation.²⁷ The purpose of citizen conferences is to involve citizens in the public debate. Imported from the Anglo-Saxon countries, which have a longer tradition of such ethical debates, they offer a real opportunity to tackle areas of uncertainty. In order to work well, they need a small-sized sample of the population, well informed about the scientific aspects of the problem, as exemplified by the consensus conferences organised on topics associated with health issues.²⁸ On the other hand, they tend to work badly in France when they are organised on a larger scale, as has been seen,

²⁴ Funtowicz, S., Ravetz, J. 1994. *The Worth of a Songbird: Ecological Economics as a Post-normal Science*, *Ecological Economics*, 10(3):197-207.

²⁵ <http://www.nusap.net/> et <http://www.nusap.net/sections.php?op=viewarticle&artid=13>

²⁶ <http://sciencescitoyennes.org>

²⁷ <http://alliance-sciences-société.fr>

²⁸ <http://www.conferencedecitoyens.fr>

for example, in national conferences on nanotechnologies or nuclear waste. Clearly, these processes need to be long-term and rooted in interdisciplinary dialogue. And scientists from all backgrounds have a frontline role to play in the public conversation.

4. The limitations of a “citizen strategy” for research?

The activism of the numerous civil society groups that have grown up around science needs to be approached advisedly. Civil society activism is what gives republican soil its richness.²⁹ In practical terms, however, the limitations of citizen-controlled research should not be underestimated. First, there is a certain risk of reinforcing domains that reflect the immediate aspirations of society, to the detriment of pathways that are conceptually more promising, but less easy to put across. For example, technological innovations that have brought great benefit to society, such as the laser for the treatment of cataracts or magnetic resonance for body imaging, grew out of basic research that was not pursued with the aim of developing applications that met public demand. Similarly, citing a poorly understood idea of the precautionary principle, some people demand that toxicity studies should be conducted to a zero risk criterion, which is unreasonable in that it would absorb considerable resources for totally meaningless results. The cost-benefit ratio should not become exorbitant in order to meet this kind of requirement.

Moreover, while the organisations that concern themselves with the consequences of scientific choices (or non-choices) and seek to influence them, can play a very positive role in steering research, they are not all the same. As is the case with any form of representation, they may be exploited by pressure groups. Patient associations provide an illustration of this process: we have seen that they can be highly effective, helping to make rigid laws more flexible, or even promoting new avenues of research; however, they can also cease to be representative and become vehicles for lobbying interests. Other organisations may contribute to distorting the public debate and sometimes even try to influence political decisions unfavourable to their viewpoint, without being founded in sufficient scientific rigour.³⁰ Finally, one cannot ignore the influence brought to bear by some very well funded bodies entirely created by industrial firms, such as those set up to argue against the effects of asbestos on the lungs³¹ or of passive smoking,³² or the effect of sugary drinks on childhood obesity. Vigilance and discernment are therefore needed with regard to associations working in the scientific field. It is essential to promote and maintain high-quality interfaces between all the stakeholders, scientists, citizens and their representatives.

With such interfaces in place, researchers in public bodies should be able to feel free in their choice of research within a framework that is jointly defined. This freedom is an

²⁹ *Le parlement des invisibles*, de P. Rosanvallon (paru le 02/01/2014, Editions Raconter la Vie ISBN : 978-2-37021-016-6)

³⁰ Petition against animal experimentation conducted by the Stopvivisectionen Association in November 2013: <http://www.stopvivisection.eu/fr>, and letter sent to MEPs in February 2015 / <http://www.stopvivisection.eu/sites/default/files/meps.pdf>

³¹ *La Fabrique du Mensonge* : comment les industriels manipulent la science et nous mettent en danger, by Stéphane Foucart, Collection *Impacts*, Denoël, Published: 21-03-2013 - ISBN : 9782207115145

³² *Les Marchands de doute (Ou comment une poignée de scientifiques ont masqué la vérité sur des enjeux de société tels que le tabagisme et le réchauffement climatique)*, de N. Oreskes et E M. Conway - Collection : Essais et documents –Editions Le Pommier - ISBN 978-2-7465-0567-4

essential condition of the researcher's creativity, founded on their intuition regarding important pathways to discovery. It is an intrinsic part of the researcher's condition, as defined in UNESCO's 1974 recommendation, currently undergoing revision.³³

5. The active role of scientists and their institutions

Despite the reservations set out above, COMETS reaches the general conclusion that by listening more to citizens, researchers will be more able maintain their trust. It is of the view that it is within the competence of research bodies to take account of issues of concern to the public relating to the future of society. In 2011, CNRS mobilised several communities of researchers who contributed to elucidating the question of climate change.³⁴ It took the same initiative on the question of energy and biodiversity. Other sensitive subjects demand attention from the CNRS, which should encourage its researchers to become involved in them, possibly in partnership with other research institutions. A monitoring unit made up of researchers from all disciplines, for example with a representative from each CNRS Institute, could be formed to respond to requests from bodies such as OPECST (parliamentary office for the evaluation of scientific and technological choices), set up by the National Assembly.

C. Conclusion

In summary, it would seem important to make a clear distinction between the different scientific practices encompassed in the expression "citizen sciences". Experiences of participatory science have been positive in many respects. They can establish a new process of knowledge production through which individual contributions converge within extremely valuable collective activity. They help citizens to learn about science and its methods and therefore play a positive educational role. Moreover, citizen involvement in scientific questions that affect not just societal but also political issues, demands appropriate responsiveness from research bodies, which should assume their share of responsibility in the life of a democracy.

Bringing science and society closer together is essential in many respects. First of all, it leads to the dissemination of scientific culture, a process in which researchers should be much more strongly encouraged to participate. However, "citizen science" cannot be restricted to a dialogue, planned or spontaneous, between researchers and society. From the perspective of consolidating the social contract that exists between research and society,

³³ <http://portal.unesco.org/fr/ev.php-URLID=13131&URLDO=DOTOPIC&URLSECTION=201.html>

Member States should seek to encourage conditions in which scientific researchers, with the support of the public authorities, have the responsibility and the right:

(a) to work in a spirit of intellectual freedom to pursue, expound and defend the scientific truth as they see it;
 (b) to contribute to the definition of the aims and objectives of the programmes in which they are engaged and to the determination of the methods to be adopted which should be humanely, socially and ecologically responsible;

³⁴ *Le climat à découvert*, de C. Jeandel et R. Mosseri - CNRS Editions – Collections A découvert - ISBN : 978-2-271-07198-9

it is important that the state and the scientific institutions should assume their role as facilitators and show more clearly, in their objectives and through the resources they invest, the role that they propose to play in the conditions of implementation of that dialogue. The democratisation of the sciences through society's participation in research priorities is a highly topical issue, for which COMETS can only provide partial matter for reflection. The recommendations that follow more directly concern the role that scientists themselves need to play as members of their research institution.

IV. RECOMMENDATIONS

A. On participatory science

- Scientists who draw, for their research, on work originating in participatory science, should ensure that there is a rigorous framework for the methods employed, while providing the contributors with appropriate and socially useful training. They should clarify the data collection and analysis protocols so that it is possible for everyone to monitor the methods and principles underpinning the validation of the results obtained.
- The lead researchers must specify sources (corpus, methods) when they publish the results of the participatory study and recognise the work of the network of contributors on which they rely. The ownership of the results must be specified between the partners (researchers and network of amateur contributors) prior to the collection of data.
- When the participants themselves become objects of investigation, their privacy must be protected and their informed consent obtained. The researchers responsible for the study must ensure that the contributors understand both the goals of the research and the risks involved, whatever their nature. The contributors to the study must be informed of these requirements.
- The question of any rewards for occasional contributors should not be ignored; an appropriate form of reward should be determined in each case, depending on the nature of the information supplied.
- The researchers and the entire team of contributors should be vigilant regarding the possibility of the data collected being acquired and exploited for purposes other than the research objectives (commercial, strategic, military, or indeed political or religious).

B. On the dissemination and democratisation of science

- COMETS stresses the fundamental importance of disseminating scientific culture and actively promoting it at all levels of society. The work of researchers who become involved in this should be strongly encouraged, valued and recognised in their evaluations. It is part of their role and is essential to raising the general knowledge of the population and developing scientific vocations.
- COMETS asserts the need for researchers to listen to the questions emanating from citizens, to try to answer public questions about the impact of scientific choices and to elucidate controversies around sensitive subjects, while maintaining the degree of freedom essential to creativity in research.
- COMETS emphasises the importance of researchers providing rigorous assessments, in particular on sensitive subjects that are a focus of the population's questions and concerns. This necessarily collective expertise should clearly state the margins of uncertainty and incorporate viewpoints originating in different disciplines. It should seek to take an European or international perspective.
- Scientists involved in making assessments on questions that have a societal impact must provide evidence that there is no conflict of interests in the views they put forward. They must declare their positions and any links they have with stakeholders in the assessment.
- COMETS recommends that thought should be given to the procedures for discussion and public debate between researchers and society, drawing on successful experiences, which have generally involved small samples and long-term processes.
- In conferences and scientific workshops touching on sensitive subjects, it is recommended that – where appropriate – a session should be set aside to explore the science and society aspects of the subjects, which involves making the participants aware of the ethical questions raised by the development of their field and a possible elucidation of the controversies. CNRS needs to increase the involvement of research teams in the analysis of perceptions of science.
- COMETS is of the view that CNRS should encourage initiatives by research teams that wish to tackle sensitive subjects emerging from the development of science and technology.
- It recommends that each CNRS Institute should nominate a representative; these representatives would have a collective assessment role, which would be implemented in response to approaches from bodies such as OPECST.

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