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What can science do in the face of pandemics?

Abstract

In 2020, the Austrian Academy of Sciences (ÖAW) publicly announced a prize question: "What can science do in the face of pandemics?" (2021). For this journal article the prize-winning essay submitted by the author was translated, updated and – thanks to helpful reviewer comments – revised. Science, it is argued, has different roles in times of crisis: First of all, it must educate about the (changing) crisis situation and provide as robust data, studies and facts as possible. In order to stabilize public trust in science, it is also necessary to provide the public an insight into the logic of scientific knowledge production and related uncertainties and insufficiencies. Last but not least, science has to educate about the limits of its own responsibility and authority. This means that the basic difference between science and politics should not be blurred. Especially in times of crisis, when the political value of science is particularly evident, science should avoid the impression that it can replace political decision-making thanks to its findings.

Keywords: COVID-19, policy advice, scientism, science denialism, epistemic conflicts

1. The scientific demystification of epidemics

When Hegel died unexpectedly in November 1831, doctors diagnosed him with "cholera sicca", a particularly virulent variant of the disease. The hearse that brought the philosopher to his final resting place at the *Dorotheenstädtischer Friedhof* in Berlin was thoroughly disinfected; the pallbearers had to be quarantined together with their horses for five days. Cholera was the first pandemic of the late modern era and rolled across Europe in six waves in the 19th century. The cause of the epidemic was unclear at the time. Hegel himself suggested that epidemics could arise when an organism was away from its familiar milieu (Kaube, 2020, 497). Other rumors were that cholera was due to weather fluctuations or poisonous vapors. Conjecture about the causes of the disease was not put to rest until the 1890s by Robert Koch. Koch successfully demonstrated that cholera was caused by a bacteriological pathogen ("Vibrio cholera") and thus promoted the development of modern, scientifically informed medicine.

When severe pneumonia with an unknown cause was detected in the Chinese city of Wuhan in December 2019, it took less than four weeks to identify the pathogen. Shortly after the turn of the year, the genome sequence of the new Coronavirus was also decoded and a detection method was available (Fangerau & Labisch, 2020, 150). Molecular biology studies showed that SARS-CoV-2 had probably emerged in November 2019 through transmission from bats. Within weeks, scientific findings on the origin, host range, and mutation rate of the virus were published. Even though the virus' pedigree and its variants have not yet been fully elucidated,

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the pace at which the scientific decoding of the new disease (COVID-19) has progressed has been breath-taking.

This pace points to the fertility of the biomedical paradigm that began to establish itself in the age of virology pioneers such as Koch and Pasteur. For modern medicine, biology has become the most important reference discipline, shaped by the conviction that universal mechanisms and relationships can be understood by breaking down living organisms into their smallest units and analyzing them at the molecular level. The interpretation of the new danger (COVID-19) in the proven ways of the biomedical explanatory model led to rapid measures to contain it, but not only that: never before has a vaccine been developed in such a short time. The big vaccination launch started already in January 2021. But it is not only the speed of vaccine development that is impressive, but also the breadth and depth of vaccine technologies. In addition to conventional techniques, vaccines are also being used which stimulate the immune system to produce antibodies with the help of messenger RNA.

Assured knowledge also quickly existed about the dangerousness of the virus and its main routes of infection. Private households, travel and "superspreader events" were identified as the main drivers of the pandemic. That about ten percent of Corona cases caused 80 percent of all infections was known within a few months of the pandemic's outbreak (Lee et al., 2020). In contrast, it took many centuries to really understand how plague spreads and the role of rats and fleas. Because of this, the death toll from the plague was immense compared to the current pandemic. Between 1331 and 1353, the Black Death claimed a total of 137.5 million lives; extrapolated to today's world population, that would be 2.68 billion dead! (see Cirillo & Taleb, 2020) In fact, as of early 2022, John Hopkins University recorded approximately 6 million deaths worldwide. This difference emphatically underlines the beneficial effect of scientifically based crisis management.

So, what does science do in pandemics? Nothing less than this: It is the decisive source of the demystification of pandemics. Under the pressure of scientific enlightenment, all that is magical and mythical evaporates, and a pre-modern belief in fate is replaced, as Max Weber (1995, 19) noted, by the typically modern "belief that if one only wanted to [...] one could control all things – in principle – by calculation". In the scientific-technical civilization, the world appears as a self-contained, logical causal connection. Crises, catastrophes and natural hazards are understood as challenges to human creative abilities. The new credo is that history is not made by chance, fate or God, but by man himself, who in this way, however, also has more and more to do. He is constantly called upon to shape an open and therefore decision-dependent future on the basis of rational analysis. Following Luhmann's terminology, one could also say: in the course of scientific world disenchantment, pandemics change their character; they are soon no longer regarded as a (fateful) danger that was countered primarily with rites and rituals (for example, through the

establishment of so-called cordon sanitaires), but as a calculable risk that must be countered preventively on the basis of scientific insights (Luhmann, 1991).

2. The scientific demystification of science

Thanks to the scientific world demystification, pandemics are now seen primarily as a challenge for scientifically informed crisis management. But this creates new crises and conflicts in which science itself is at the center. The Corona Year 2020 made this abundantly clear: Throughout the year there was extensive debate, about routes of infection and the dangers of the virus, about the sense of protective masks and travel restrictions, about the benefits and dangers of school closures and production stops in key industries. As a key point of reference for political crisis management, scientific expertise thus became the focus of public attention and political debate. Consequently, there were (and still are) arguments about the correct interpretation of the available figures, data and studies, about the provisional nature and uncertainties of the available knowledge, and about the dangers of accelerated publishing for scientific quality assurance (peer review). The debate is therefore about science, and also within science.

"COVID-19: Where is the evidence?" asked the German Network for Evidence-Based Medicine in September 2020, insinuating in its position paper that restrictive measures would now cause more harm than the virus itself due to a lack of evidence. Opposition came from the German Cochrane Foundation, a network of evidence experts organised by the Freiburg University Hospital (Cochrane Deutschland Stiftung, 2022). They had searched through tens of thousands of publications for scientific evidence of the effectiveness of quarantine, contact tracing and travel restrictions and had come to the conclusion that quarantine in particular is important for reducing incidence and mortality during the pandemic – even if there is still uncertainty about the exact extent of these effects.

Only shortly afterwards, in early October 2020, the intra-scientific dispute about the right strategy against the pandemic went global. Three scholars working at top British and US universities, respectively, drafted a document in Great Barrington (Massachusetts), formulated as a petition against the scientific majority opinion, which was signed in a short time by more than half a million concerned citizens and professionals from medicine and the health sciences (Great Barrington Declaration, 2022). The "Great Barrington Declaration" called on pandemic policymakers to rethink. The lockdown policy, the document states at the outset, contributes to a deterioration of public health and a worsening of social inequality in the medium term. Instead, it recommends a strategy of "focused protection". The majority of people should lead a normal life, so that herd immunity is established through natural infection, which then also protects those at risk. Persons at risk, on the other hand, should be isolated for the time being.

"This is a dangerous fallacy that is not supported by scientific evidence", said the authors of a counter-memorandum published in the medical journal "The Lancet" and signed online by about 7000 scientists (Alwan et al., 2020). Against the strategy of herd immunity, they pointed to scientific consensus on the following points: The mortality rate of COVID-19 is many times higher than that of influenza; infections could also lead to long-lasting illnesses in younger people, and there is also a risk of second infections. It also remains unclear how to effectively protect the (large) group of people at risk, which in some regions of Europe amounts to up to 30 per cent.

Experts disagree (which usually leads to productive debates), and they also change their minds in this time of crisis. German's leading virologist Christian Drosten declared at the end of February 2020 that there was "no scientific evidence" for the benefit of wearing masks. Lothar Wieler, President of the Robert Koch Institute in Berlin, took a similar view (Probst, 2020). Soon afterwards, both changed their position. But this change of position is of course not least an indication of the speed with which findings and data are compiled in Corona times. At the same time, many questions remain unanswered, many estimates erroneous and many findings provisional. This is not detrimental to science, as long as uncertainties and risks of error are communicated. Experts like Christian Drosten have risen to the rank of chief advisor not least because they have demonstrated in exemplary fashion in their public discussion contributions and podcasts that scientific credibility can only be established through open communication of the limits and uncertainties of currently available findings.

In the Coronavirus crisis, science demonstrates its own learning processes publicly and in real time, so to speak. In this way, central aspects of the ethos that distinguishes science more than any other form of cognitive practice become apparent, namely the unbiased examination of all knowledge claims on the basis of logical and empirical standards and a persistent skepticism, even towards one's own research achievements. Of course, important principles of scientific quality assurance, such as the internal evaluation of research achievements (peer review), are coming under pressure because the crisis-related demand for rapid results is reinforcing the trend towards publishing preprints. But again, it is the scientific community itself that draws public attention to the risks of this practice (as well as its potential benefits for research) and then discusses how an erosion of scientific quality standards in the course of accelerated research can be prevented (London & Kimmelman, 2020). In this case, too, the performance of science is measured by its capacity for self-criticism.

So it is science itself that, in pandemic times if you like, is engaged in a salutary demystification of science. The interested public is made aware that scientific findings do not owe their existence to some higher wisdom, but rather to a methodical approach and the willingness to engage in persistent (self-)criticism. Furthermore,

it becomes clear that contemporary science is by no means based on the belief in an absolute truth, i.e. on the superstition "that truth is divine", as Nietzsche (2000, 237) sneered. In fact, scientific progress, as the pandemic has also made clear in places, is realized in a rapid and incessant succession of increasingly well-founded knowledge claims that are, however, always in need of revision.

The idea of absolute, unquestionable truth is not compatible with science, or as Karl Popper (1974, 26) remarked: "The game of science has basically no end." But those who no longer question truth claims drop out of this game. Incidentally, the disrespect with which science meets every claim to truth has the effect of stabilizing the system. After all, the continued evolution of the system of science is only secured by dissent and contradiction, but not by unquestionable agreement. The cessation of critique would be the end of science.

3. Truth, politics and the danger of scientism

When cholera ravaged Madrid in 1834, violence escalated: an enraged mob lynched 80 clergymen after a rumor spread that the Jesuits had poisoned the wells. Police stations and dispensaries were looted, healers and (alleged) poisoners hunted down. There were riots and uprisings elsewhere, too, in Königsberg, Paris, and St. Petersburg. In some regions, hit by the second cholera pandemic of this century, there was a mass exodus (Aschmann, 2020). In many places, total loss of order and anomie threatened.

How different the situation in the Corona year 2020! There were neither lynchings nor looted supermarkets or pharmacies, at most some panic buying. The alarming images from Lombardy in March 2020 generated a broad societal consensus. In the face of thousands of deaths in Italy and Spain, health protection was soon given top priority everywhere. The legitimacy of state-executive action was fed by the fundamental trust of the population that politics is capable of protecting public safety and health. This trust is not unfounded; after all, politics can rely on powerful help from outside.

Indeed, the politicians, surprised by the virus, immediately turned their attention to science, or rather to the temporary leading disciplines of virology and epidemiology. The most authoritative statements, interviews and podcasts came from virologists who were almost pop stars during the crisis. The names of Anthony Fauci (USA), Anders Tegnell (Sweden) or Christian Drosten (Germany) were omnipresent in the media. Politicians based their strategies on the experts' warnings. Even the British Prime Minister, Boris Johnson, rejected his idiosyncratic strategy of herd immunity when researchers predicted a quarter of a million deaths and imposed a lockdown – far too late, as many experts complained. It is therefore only logical that former German Science Minister Anja Karliczek (2020), referring to the relationship between science and politics, stated: "Scientific findings guide politics and guide us as rarely before."

These were reassuring words at the time – especially in view of the USA led by Donald Trump. In deliberate demarcation from populism, to which scientific findings are of little value, the governments of Europe's consolidated liberal democracies sought close cooperation with science. Policy was made on the basis of reason and scientific expertise. As gratifying as this undoubtedly is, it remains the task of science to analyze the downsides of such a scientification of politics. What are the dangers here?

The primacy of science or medicine supported a policy of no alternatives in the early phase of the crisis. Virologists explained the risks of infection, doubling times and reproduction rates and provided politicians with the arguments for their actions. Talk shows explained and informed, not argued. Fear of the new virus generated societal consensus on an unimagined scale – parliament was not initially called upon as a genuine venue for controversial debate. Even though many experts repeatedly stressed that they had no political mandate whatsoever, the idea became widely established in the Coronavirus crisis that whoever listens to science, whoever follows the majority of experts, will make the right policy. Behind this is the idea that there is such a thing as ideology-free politics, when the policy in question is determined by a higher authority – be it technical constraint, scientific evidence, or expert consensus. What we call scientism is the strong belief that science is able to settle public disagreements and expertise is preferable to democracy in terms of providing superior solutions.

Hannah Arendt already pointed out the fundamental difference between the realm of science ("truth") and politics ("values"). She clearly noticed that scientific expertise is valued and protected by politics as a resource for argumentation and legitimation (at least in liberal democracies). But at the same time, politics is also afraid of science, because "truth" (in the sense of methodically generated and therefore superior knowledge) has a coercive effect from which politics cannot escape. Truth, according to Arendt (2000, 555), "carries within itself an element of coercion. (…) Seen from the point of view of politics, truth has a despotic character." This means that truth does not have to (and must not) take into account social values or political interests, provided it wants to be accepted as truth. Once truth claims have been successfully asserted, the discussion is over until further notice. Better knowledge (or what counts as better knowledge) creates immediate constraints on policy action, at least when commonly shared values (such as health) are at stake: Being aware that it is mainly older people who die from COVID-19 creates immediate pressure for political action.

This tendency to understand political conflicts ("values") as epistemic conflicts ("truth") is currently most visible in the climate field: the tough battle over the question of whether there is a solid expert consensus in the description and interpretation of global warming can only be explained by the shared expectation of all parties to the conflict that politics must follow the expert consensus. In the

meantime, a small research field of its own has even been established: Experts from the climate sciences use elaborate literature and meta-analyses to calculate how high the expert consensus really is on the issue of anthropogenic climate change (Oreskes, 2004; Cook et al., 2013). But the power of scientific knowledge also becomes abundantly clear in the Corona crisis: some key figures, such as the doubling time or the mortality rate, formulate an urgent need for political action when a certain threshold value is reached.

No question: a (quasi-automated) policy of facts and figures is legitimate as long as quasi-incontestable goals and values are at stake, i.e. a state of emergency prevails. But it must be remembered that the facts never speak for themselves. Anyone who believes that everything has been said, even in political terms, when science has spoken, endangers the autonomy of politics. Politics is thus short-circuited with the idea of truth, or in other words, truth becomes the mode of legitimation of politics. Even if this may sound promising for science – it should alarm living democracies. Due to the liberal model the essence of politics lies in constructively handling societal pluralism (Mouffe, 2005). That means, democratic politics deals with transparently organising (shifting) majorities and forging temporary compromises in order to temporarily pacify conflicts of interest and values. Politics should by no means exhaust itself in carrying out the directives of a knowledge elite. The dream of scientism is the end of the political.

4. The power of knowledge and the stabilisation of social order

The Corona pandemic sent society into a real-life experiment in which many taken-for-granted routines and habits were put to the test. Social distancing, several lockdowns, the deep cuts in economic life, and an unexpected intensification of family life in the form of home office and homeschooling presented new kinds of challenges for everyone involved.

Not least from a cognitive point of view, the virus has demanded a lot from us. In the course of media reporting, we had to get used to unfamiliar and difficult terms such as the basic reproduction number R, the dispersion parameter k, the viral load threshold or the incubation period. We learned and understood new concepts such as excess mortality, herd immunity, incidence and infectivity. In short, we became aware that scientific expertise is the central prerequisite for participating in the public discourse on the virus and Corona policy.

The Coronavirus crisis shares this high degree of scientification with other crises and conflicts. Even when it comes to dealing with the climate crisis, the use of pesticides in agriculture (glyphosate), driving bans in polluted urban areas, the risks of electromagnetic fields (5G networks) or combination vaccines – in all these cases, the discussion and dispute is about the reliability of data and observations, the credibility of scenarios and models or the validity of limit values and key figures. Epistemic aspects, i.e. facts, evidence, cognitive competences and scientific

expertise, are therefore becoming the focus of attention and debate. Of course, this does not mean that today's disputes are automatically more intelligent or informed than in the past, but only that knowledge is becoming both the decisive resource and the central object in many disputes.

The adversaries in these disputes may be very much divided in detail. What unites them, however, is the firm belief that the current crisis or the current issue can only be properly understood or properly formulated when it is essentially a matter of knowledge, or when we negotiate it as a problem of knowledge. The central questions are then accordingly: On what insights, surveys, data is knowledge based? How reliable are the respective knowledge claims? Are they based on internal quality assurance processes? How high is the degree of ambiguity or non-knowledge? Which knowledge is the true (or superior) knowledge? Behind this is the common conviction that only by recourse to science, i.e. through the power of facts and figures, will the disputed issues find a solution that is then also unanimously recognized as superior by all those involved.

In this way, so the obvious expectation, science contributes to the stabilization of society, since it reduces social conflicts due to its special epistemic qualities. This hope has accompanied science for a long time. As early as the early modern period, experimental science, which was still in its infancy at the time, was supposed to help overcome the turbulence in which society found itself. At that time, European societies were in a state of permanent crisis due to various causes: The overcoming of feudalism led to the expansion of political participation, the printing press to the expansion of cultural participation; the Reformation led to the shaking of spiritual authorities, the discovery of the New World to a new world view. All this ushered in a departure from that old model of unitary representation in which the monarch was the political representative, the pope the representative of God, and the Scriptures the representative of truth. The institutional crisis resulting from this process of transformation thus raised the question of how the danger of social fragmentation and disintegration could be averted. The answer was: through the stabilizing effect of superior knowledge. Science, it was hoped at the time, could strengthen order and unity, even though the conditions for this were actually lacking at the social level (Shapin & Schaffer, 1985).

The role of science in the current pandemic can be interpreted in a similar way. The numerous disputes about the appropriateness of individual political measures show very well that the opponents – despite all differences in detail – have a common understanding of reality and truth; otherwise they could not relate to each other in any meaningful way. Only the common belief that there is a "right" answer to the question in dispute transforms the mere alternative opinion into a productive dissent and leads to a (productive) dispute. In other words, the magnetism of the idea of truth prevents contradictory positions from remaining unrelated to each other.

That is, science contributes to the stabilization of the social order by enforcing a rationalist worldview, ensuring that people – regardless of class, gender, age, or ethnicity – live in the same world. After all, they refer – albeit often with different intentions – to the same infrastructure of facts, relevance and evidence developed by science. This results in a cohesion on the epistemic level that – keyword 'class society' – is missing on the social level.

The high degree of scientification of many political problems is therefore not only due to the nature of the matter; it is not only explained by the fact that it is about complicated things. The fact that we debate COVID-19 (or climate change) primarily in terms of knowledge (and less in terms of values or interests) also has to do with the suggestive power of knowledge. Better knowledge – unlike interests and preferences – is non-negotiable. Political recourse to this knowledge promises stable solutions. The knowledge-heavy nature of many crises and conflicts thus reflects not least the desire for social stability. In public discourse, this knowledge-heaviness becomes tangible not least in the terms we use to describe the fundamental opposition: We call them "climate change deniers," "evolution deniers", "Coronavirus deniers."

5. The insurrection of the ignorant

The biggest difference between the current pandemic and earlier epidemics (such as the plague) is the primacy of science. It is no longer religion that provides the authoritative interpretations of the disease and the binding rituals and symbols of crisis management. Plague crosses, devotions and pilgrimages could only be considered productive as long as the plague was regarded as a sinister fate or punishment from God. As early as the 19th century, science began to overtake religion as the authoritative interpreter of epidemics. This is evident not least from the prosaic acronyms used to describe more recent epidemics (HIV, MERS-CoV, SARS-CoV).

The Coronavirus crisis was and is a great moment for science as already mentioned. Policy is to a large extent guided by science. However, this does not mean that there are no more conflicts and public disagreements. On the contrary, one could almost say. But the protests against the Corona policy have a peculiar form. They are directed – probably because of the scientification of politics – against science itself and the rationalist world view. Radical opposing voices, which are particularly audible in the media, are the so-called Coronavirus deniers, i.e. people who ignore proven scientific findings and spread conspiracy theories. On the occasion of so-called "Querdenker" demonstrations in many German cities, hand-painted banners read that COVID-19 was no more threatening than any other flu epidemic. Opponents of 5G technology saw the radio masts as the real triggers of the pandemic; radical vaccination opponents saw the Coronavirus crisis as a political staging to make compulsory vaccinations enforceable. Bill Gates, with the help of his foundation, is steering the pandemic in order to make a lot of money from the

vaccinations. In addition, the vaccines are equipped with microchips in order to be able to monitor all those vaccinated without any gaps. And so on and so forth.

Coronavirus deniers are convinced that they are exposing the machinations of a small elite, that is, they are waging a legitimate liberation struggle against the "establishment" and fighting for the "suppressed" truth. This conviction, moreover, they share with other anti-scientific movements, which go under the collective term *science denialism.* This unholy alliance, which ignores scientifically proven findings and pursues politics on the basis of "alternative" insights, includes climate skeptics, supporters of creationism, advocates of the Flat Earth movement, and fundamentalist opponents of vaccination. This counter-enlightenment grassroots movement is conspiratorial in its belief in a conspiracy of know-it-alls; it accompanies the rapid rise of political populism and fuels debates around post-truth and alternative facts. In these circles, anyone who claims superior, assured knowledge is not regarded as a serious scientist, but as an enemy of democracy. Academic observers report with dismay that the rampage against rationalism and expertise has now become a mass sport (see Nichols, 2017).

Thus the anti-authoritarian revolt against science today has a strange, alien face. For it is no longer carried by the sympathizers of the past – rebellious students, critical intellectuals, socio-ecological activists – but to a large extent by demagogues and populists who confront us with doubts and questions that are sometimes amusing, sometimes disturbing: Global warming – a Chinese invention? Humans – really a result of evolution? The earth – a flat disc? SARS-CoV-2 – just a harmless flu virus? AIDS – caused by poverty and not by HIV? Or vaccination: doesn't it lead to autism?

Within the framework of their knowledge politics, the science deniers often enough refer to renowned scientists (such as the Berkeley virologist Peter Duesberg in the case of AIDS), to scientifically proven counter-experts (such as Patrick Michaels and Fred Singer in the climate dispute) or to "brilliant" outsiders who are marginalized by the "expert elite" (such as the pediatrician Andrew Wakefield in the vaccination controversy). People question the evidence claims of mainstream science, point out inconsistencies or question the methods and theories that are needed to interpret the results. One asks whether all relevant groups have really been heard in the process of knowledge generation and whether the given degree of agreement between the experts is synonymous with consensus. If this consensus actually exists, it is immediately attacked as an expression of a "circle-the-wagons mindset" (Wagenburg-Mentalität).

What is the reason for the increased visibility of conspiracy theories and alternative facts in the Coronavirus crisis? There are already a number of interesting sociological attempts to explain this (see Reichardt, 2021; Nachtwey et al., 2021). However, I believe that one aspect has remained underexposed so far, and that is the close connection between the protest and the high degree of scientification of politics

during the pandemics. We should assume that the boom in conspiracy theories is also explained, among other things, by the fact that political conflicts are fought out as epistemic conflicts. What does that mean exactly?

Many global challenges, from pandemics to climate change and digitalisation to nutrition and health issues, are now urgently asking science for answers. As a result, political disputes often focus on, or are limited to, the credibility and reliability of scientific data, diagnoses and model calculations. A sound knowledge of science thus becomes an indispensable prerequisite for being able to participate seriously in political disputes, including in the Corona case: a policy that acts in agreement with virology and epidemiology is not easily challenged. Those who do not manage (or perhaps are not even interested) to support their own normative positions by expert knowledge quickly fall behind. One way out is to turn the established factual world on its head. To put it somewhat exaggeratedly: *Alternative facts* have conjuncture when politics – thanks to its agreement with science – sees itself as having *no alternative*.

In the struggle for responsible climate policy or adequate safeguards against the COVID-19 pandemic, the science deniers may be mostly annoying. But for their society, these wild protests are useful. They are a constant reminder that even if all political problems can be successfully translated into questions of knowledge, the real problems will still remain unsolved even if these questions of knowledge are properly addressed. After all, the dispute about the right climate or anti-COVID-19 measures is not simply about which data, figures and facts are really correct. Rather, such epistemic conflicts are always fueled by divergent views about what we consider to be a good life, what kind of future we want, and what restrictions we are willing to accept in order to achieve this.

6. Conclusions

The Coronavirus crisis is a great moment for science. The pandemic shows us that without science we would not be able to recognize, explain and treat many threats. Without science, the Coronavirus would not be a virus at all, but a dark visitation of fate. And without science, we would have no hope of containing COVID-19 to the point where a reasonably compatible coexistence with the new virus seems possible in the long term.

The Coronavirus crisis also revealed an impressive level of scientific self-reflection. Everywhere, scientific experts provided a sympathetic public – in addition to concrete findings and recommendations – with indications of all that shakes the common belief in the scientific truth, namely the tentativeness of current knowledge, the fallibility of scientific research, the normative prerequisites of scientific conclusions, ambiguities in the data situation, and more.

In the current crisis, science demonstrated its own learning process live and in real time, so to speak. In this process, the logic of scientific knowledge production became somewhat transparent for all outsiders. With regard to the high importance of modelling and simulation in the COVID-19 crisis the interested public learned that in science, every calculation is based on certain assumptions that are not further problematized. Therefore, stating a numerical value without specifying error limits, without information about its production process, is scientifically questionable. It became clear that an open discussion about the assumptions contained in epidemic models is crucial for their quality.

To make things even more complicated, science often does not speak with one voice, and this is not only due to the omnipresent colleague criticism within tightly circled research areas (which, incidentally, is the basis of the dynamics of science in the first place). In the course of the COVID-19 crisis, it became clear that a multiplication of viewpoints results primarily from the (sub-)disciplinary structure of science.

In reality, "science" is a conglomeration of different, sometimes contradictory paradigms, research styles and specialist cultures. It is therefore only logical that, with regard to politically relevant questions (such as: Does another lockdown make sense? and if so, in what form?) there can be no such thing as a unanimous overall model from which an unanimously superior conclusion can be drawn by correctly weighting all factors and effects. Indeed, in the course of such questions, the diversity or even contradictoriness of (sub-)disciplinary perspectives becomes openly apparent: while experts from virology welcomed a next hard lockdown with a view to the current state of the reproductive number R, economists warned of its serious effects on the economic situation; while health professionals pointed to the contagiousness of young people, educationalists warned of renewed nationwide school closures, and so on.

But this polyphony is not a deficit of science either, on the contrary. The high-resolution analytical capacity of science can only be had at the price of extreme selectivity, i.e. by excluding many other (and equally legitimate) perspectives. In sum, this makes it clear that the concrete political decision (or measure) can only be the result of a political weighing process – good news for democracy, by the way! If science were actually to speak with one voice in novel problem constellations where canonical knowledge is lacking, this would not only lack credibility. It would also severely restrict the scope for political decision-making at a time when political action necessarily has an experimental character.

A science that, by means of the polyphony of its perspectives and heterogeneous recommendations, underlines that political deliberation is urgently needed, does more for its society than if it pretends that political decision-making can be replaced by recourse to scientific expertise. Note that this is not a plea for a policy that does not give a damn about science. The COVID-19 pandemic in particular

has made it clear how devastating the effects of a policy hostile to science and information can be (see USA, Brazil, or Russia). And of course a central function of science, especially in crisis situations, is to warn against the consequences of ignorance, fake news and naive belief in miracles. However, it would be wrong to try to give science a political mandate – out of (understandable) enthusiasm for its learning and performance capabilities. Neither should political power determine truth, nor should truth be regarded as a mode of political legitimation. This would miss or endanger the character of the political.

So what science can do in pandemics is not just enlighten or educate or give the public an insight into the logic of its knowledge production. Especially in time of crisis, when science is in many ways indispensable, it must educate about its own limits, about its cognitive limits, but above all about the limits of its competence and responsibility. The latter means that we should also see this as an important achievement of science in times of crisis: namely, to warn its society against "too much" science.

References

Alwan, N. A. et al. (2020). Scientific consensus on the COVID-19 pandemic: we need to act now. *The Lancet* 396 (2020), e71–72 (published online 14 October 2020).

Arendt, H. (2000). Truth and Politics. In P. Baehr (Ed.), *The Portable Hannah Arendt (*545–575). New York: Penguin (orig. 1967).

Aschmann, B. (2020). Als die Cholera nach Europa kam. *Frankfurter Allgemeine Zeitung,* 14 September 2020, 6.

Cirillo, P. & Taleb, N. N. (2020). Tail risk of contagious diseases. *Nature Physics* 16 (2020), 606–613.

Cochrane Deutschland Stiftung – CDS (2022). Cochrane Reviews und Cochrane Rapid Reviews mit Bezug zu COVID-19. Retrieved from: https://www.cochrane.de/coronavirus-covid-19/cochrane-rapid-reviews.

Cook, J. et al. (2013), Quantifying the Consensus on Anthropogenic Global Warming in the Scientific Literature. *Environmental Research Letters* 8 (2013) no. 2.

Fangerau, H. & Labisch, A. (2020). *Pest und Corona. Pandemien in Geschichte, Gegenwart und Zukunft.* Freiburg: Herder.

German Network for Evidence-Based Medicine (2020): Covid-19: Wo ist die Evidenz? Retrieved from: https://www.ebm-netzwerk.de/de/veroeffentlichungen/covid-19.

Great Barrington Declaration (2022). The Great Barrington Declaration. Retrieved from: https://gbdeclaration.org/.

Karliczek, A. (2020). Die Stunde der Erklärer. *Frankfurter Allgemeine Zeitung,* 1 April 2020, S. N1.

Kaube, J. (2020). *Hegels Welt,* Reinbek: Rowohlt.

Lee, E. C. et al (2020): The engine of SARS-CoV-2 spread', in *Science* 370 (2020), 406–407.

London, A. J. & Kimmelman, J. (2020). Against pandemic research exceptionalism. *Science* 368 (2020), Issue 6490, 476–477.

Luhmann, N. (1991). *Soziologie des Risikos.* Berlin: de Gruyter.

Mouffe, C. (2005). *On the Political*. London/New York: Routledge.

Nachtwey, O., Frei, N. & Schäfer, R. (2021). Generalverdacht und Kritik als Selbstzweck. Empirische Befunde zu den Corona-Protesten. In W. Benz (Ed.), *Querdenken. Protestbewegung zwischen Demokratieverachtung, Hass und Aufruhr* (194–213). Berlin: Metropol.

Nichols, T. (2017). *The Death of Expertise. The Campaign Against Established Knowledge and Why it Matters*. New York: Oxford University Press.

Nietzsche, F. (2000). *Die fröhliche Wissenschaft.* Stuttgart: Reclam (orig. 1882).

Österreichische Akademie der Wissenschaften – ÖAW (2021). Was Wissenschaft in einer Pandemie leisten kann. Retrieved from: https://www.oeaw.ac.at/detail/news/was-wissenschaft-in-einer-pandemie-leisten-kann (published 21 June 2021).

Oreskes, N. (2004). The Scientific Consensus on Climate Change. *Science* 306 (2004), 1686.

Popper, K. (1974). *Logik der Forschung.* Tübingen: Mohr Siebeck (orig. 1934).

Probst, M. (2020). Hygiene: Der Irrtum des Anfangs. *Die Zeit*, 13. August 2020, S. 30.

Reichardt, S. (Hg. 2021). Die Misstrauensgemeinschaft der „Querdenker. Die Corona-Proteste aus kultur- und sozialwissenschaftlicher Perspektive. Frankfurt/New York: Campus.

Shapin, S. & Schaffer, S. (1985). *Leviathan and the Air-Pump. Hobbes, Boyle, and the Experimental Life.* Princeton: Princeton University Press.

Weber, M. (1995). *Wissenschaft als Beruf.* Stuttgart: Reclam (orig. 1919).