Chapter 1
The Responsibility of Science: An Introduction

Harald A. Mieg

Abstract This is the introduction to the book *The Responsibility of Science*, containing three parts. I explain both the concept of responsibility and science as an institution. I then present lines of argumentation that run through the essays of this volume and combine them. (i) Responsibility is a relational concept, derived from the verb "to respond." Therefore, the concept of responsibility refers to a relation involving at least three elements: Someone is responsible for something to someone else. Moreover, responsibility is attributive, that is, resulting from a social attribution of guilt or duties to a person. (ii) Science is meant here to refer to historically developed, institutionalized research and to be thought of independently of the objects of that research. Therefore, by 'science,' I am referring to natural and social sciences as well as humanities, and make no distinction between pure and applied science. (iii) This volume lives through the many references that link the chapters and the lines of argumentation that develop in the work, such as Responsible Research and Innovation (RRI) as a new approach within EU research policy; the ethical question of the moral person in science; and the effects of the institutionalization and professionalization of science.

Immediately prior to his death, Einstein was drafting a public speech intended to mediate in the Israeli–Egyptian conflict. Indicating that he was addressing issues of personal responsibility primarily as a member of humankind, it began: "In matters concerning truth and justice there can be no distinction between big problems and small; for the general principles which determine the conduct of men are indivisible."[1] He died before finishing the draft, silencing his passionate voice for peace. Einstein's note might suggest a parallelism of scientific and ethical that would be disputed by those in science. Questions of truth are usually settled differently than questions of

[1] O. Nathan & H. Norden H. (ed.), Einstein on peace. Schocken books, NY. p. 639.

H. A. Mieg (✉)
Institute of Geography, Humboldt-Universität zu Berlin, Berlin, Germany
e-mail: harald.mieg@hu-berlin.de

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justice. Science feels first and foremost committed to the search for truth and valid evidence. Do ethics disturb science, we may ask, or is science in some way based on ethics? Do we find any justification for ethical issues in the scientific task, or in the people who do science?

Much has been written about the ethics of science since the first atomic bomb was dropped. I would not dare to publish this book if I felt that today the question of the responsibility of science would mainly refer to problems of the type "Should nuclear research be used for bombs?" This type of problem challenges the scientist as a moral person who must come to terms with their conscience. The current issue of climate change has a different quality, as knowledge is being driven forward by the scientific community through public research communication together with massive of deployment of human and financial resources. This type of project would be inconceivable for some eminent scientists, who repeatedly admonish politics. Rather, climate change research is evidence of a profound institutionalization of science and is supported by new scientific organizations such as the IPCC (Intergovernmental Panel on Climate Change). I am convinced that the current forms of scientific institutionalization are an expression of its professionalization. Science has become a *profession*. This changed the focus from ethics to social responsibility, which is not a big change and neither makes the ethical question disappear nor provides new answers concerning the social contribution of science. The difference is that today, in addition to an individual responsibility, there is a *corporate* responsibility of science—as a profession that may have to prove its social responsibility as do some other professions. Since science as a profession only emerged in the twentieth century and is thus young compared to doctors or engineers, the question of the responsibility of science must also be asked anew, for it cannot be so easily reduced to the responsibility of individual scientists. Hence the subtitle of our book: essays on the extents of the scientific profession's (moral) responses to societal concerns.

This volume has three parts. The first part is entitled "Principles of the Responsibility of Science" and discusses the concept of responsibility, not least with a focus on corporate responsibility. The second part has the awkward title "Insights into the quest for responsibility in the interaction of science and society". If science is a profession and enjoys not only freedoms but also considerable resources, then it must be able to justify their benefits and in this context, even more than before, keep in mind the sometimes-unintended consequences of scientific work. This second part demonstrates how research policy and legislation can respond, for example in the paradigm of RRI (Responsible Research and Innovation) or the Precautionary Principle. The third part unites reflections on the topic of "science and responsibility," ranging from a very personal, emotional statement to an institutional program. This third part testifies both to the effort to negotiate the scientific discourse for truth against social appropriation and relativization, as well as new forms of value-based coproduction of knowledge of science and society.

Responsibility

Responsibility is a *relational* concept, derived from the verb "to respond."[2] Therefore, the concept of responsibility refers to a relation involving at least three elements: Someone is responsible for something to someone else. If the context is clear, we can use abbreviated versions such as "someone is responsible for something" or simply "someone is responsible."

Moreover, responsibility is *attributive*, that is, resulting from a social attribution of guilt or duties to a person. Responsibility is often classified according to the type of attribution: moral responsibility may be evoked in case to attributing guilt; role responsibility in the context of allocating socially defined tasks to someone; social responsibility is linked to the attribution of unspecified prosocial contribution, etc.

Further characteristics are:

- To some extent, responsibility presupposes both *causality* and *freedom*. Responsibility requires causality; For if we could not cause anything through our actions, we could not be held responsible. Responsibility also requires freedom; For only if we have freedom to act in a chosen way can we be held responsible. Total causality (everything is predetermined) as well as total arbitrariness (what happens is mere chance) are incompatible with the idea of responsibility.
- Responsibility has an inherent *temporal* component. Because either something has already happened and the person responsible is being sought, or someone is given the responsibility to take care of something. Therefore, we also speak of retrospective and prospective responsibility.
- Insofar as responsibility is socially relevant, it concerns behavior among people and is therefore *morally* relevant. This has ethical implications.

Responsibility has much in common with the concept of accountability. The difference is the inclusion of the temporal dimension, so that we can explicitly speak of a future responsibility.

With the question of responsibility, we enter the realm of ethics, in which, however, the concept of responsibility has long played a subordinate role. Ethics tends toward absoluteness, as in Kant's categorical imperative. Categorical, absolute principles such as "Thou shalt not lie" are useful as ideals and regulative ideas. Taken absolutely, however, they are almost useless, for example in both politics and everyday life. For this reason alone, Max Weber called for responsibility to be made a principle, in marked contrast to absolute ethics.[3] In philosophy, the concept of responsibility was disregarded for a long time, because it seemed to raise more questions than it answered. It was not until the publication of *Das Prinzip Verantwortung* (1979; English: The Imperative of Responsibility, 1984) by Hans

[2] For details, please refer to the chapters in Part 1.

[3] Weber, M. (2004). Politics as a vocation. In M. Weber, The vocation lectures (edited by D. Owen & T. B. Strong, translated by R Livingstone, pp. 32–94). Indianapolis: Hackett. (The lecture took place in January 1919).

Jonas that responsibility received new attention. Jonas focused on our responsibility for the future: that we maintain a grip on what is technically possible and do not unintentionally destroy our own basis of life. Science has very much its own ambivalent role in this, on the one hand in supporting innovation and prosperity and finding ways to improve our lives; on the other hand, in developing technologies that we humans no longer seem able to control. Hence, with such far-reaching capabilities of science come myriad forms of responsibilities.

Science

Science is meant here to refer to historically developed, institutionalized research and to be thought of independently of the objects of that research. Therefore, by 'science,' I am referring to natural and social sciences as well as humanities. I also make no distinction here between pure and applied science. Since science has existed in the form of systematic research, it has always served many purposes, new methods of growing crops, as well as healing and warfare.

Science has characteristics that can quickly lead to ethical implications. Three of these characteristics are:

- *Ambivalence*: As such, scientific findings do not necessarily determine the nature of their use; hence ambivalence is inherent in science. In addition to peaceful use, there are sometimes military applications or potential for criminal misuse. Today, this is regarded as a problem of *dual use*. Professionalization has led to dual use being addressed within the framework of codes of conduct.
- *Innovation*: Science is innovative per se, because the goal is new knowledge, including new processes and techniques. In recent decades, science-based innovation in food, medicines, or agricultural technology has sometimes had unintended consequences for the environment and health. Therefore, policy and legislation must find new ways of risk assessment and precaution.
- *Formalization*: The mathematical formulation of physical relationships as well as the representation of contractual forms in the language of jurisprudence are examples of formalization in science, which can give outsiders the feeling that their own life world is only reflected in a very reduced way in the formulas. For this reason, some scholars consider a parallelization of machines and humans, as in the paradigm of artificial intelligence, as a dangerous ethical reduction.

For half a millennium, science has been associated with progress. With professionalization, science has gained a new standing in society. Not least because of its unbelievable expansion since the Second World War, science is now concerned with all areas of life and has been able to prove even that general expenditure on research and development (including in science) goes hand in hand with economic growth. Furthermore, science has gained methodological certainty, which does not commit it to the position of value-free research, but also allows it to work scientifally on value-laden issues such as sustainable development. It is becoming increasingly

clear that science has more to offer society than simple truths (which are often not so simple), but also an attitude—its own ethos—based, for example, on principles such as transparency and open access.

This present volume is strongly influenced by German philosophy and history. In the nineteenth century, Germany was booming, just as China is today. One driver was science, which was simultaneously a matter for both academia and industry. In 1912, the Kaiser Wilhelm Society (KWG, Kaiser-Wilhelm-Gesellschaft) was founded, the predecessor of today's Max Planck Society for the Advancement of Science. The principle of the KWG was the greatest possible freedom of research, combined with generous endowment, in a socially relevant field—be that theoretical physics or industrial iron production. The benefit was seen equally for government, science, and industry. The use of scientific advancement was thus ambivalent and multi-oriented from the outset. Thus, the use of poison gas in the First World War also fell within the context of KWG research. Responsibility therefore—as opposed to ethics understood in absolute terms—can also have a historical side and may require learning.

Some readers may wonder why medicine does not play a central role in this volume on responsibility of science. The simple answer is that medicine—like law—has been a profession in its own right for centuries. Many of the problems and solutions mentioned in our book have already been played out in the medical profession. The Hippocratic oath is over a thousand years older than the code of codes for scientists. That science is now also a profession will not add much to the ethical questions encountered in medicine. However, new light will also be shed on the large field of associated research, which has long been able to hide behind medical practice. Moreover, in the current global COVID-19 pandemic, the question of the practical responsibility of medical science is highly topical. For many readers, medicine may be considered the most obvious field through which to discuss the responsibility of science. However, the question then immediately arises of whether this can also apply to other fields such as physics and urban planning. Therefore, we have chosen to use examples directly from those other fields.

Lines of Argumentation

Although I have given all chapter in this book a place in the overall argument, each can stand on its own. Readers may begin with any chapter. Apart from the overall argument, this volume lives through the many references that link the chapters and the lines of argumentation that develop in the work. I would therefore like to highlight the most important ones here.

1. *Responsible Research and Innovation* (RRI). RRI is a new approach within EU research policy. Macnaghten (Chap. 5) introduces RRI on the basis of four dimensions: anticipation, inclusion, reflexivity, and responsiveness. In the context of a COST-EU project (in the field of urban planning) involving over 30

countries, the opportunity arose to reflect on one's own ongoing research in the light of RRI (Chap. 12). Macnaghten presents RRI as a further development of the co-production approach, which considers the involvement of citizens as essential ("inclusion"). Oevermann et al. show in Chap. 12 that implementing this requirement for inclusion is anything but easy, even in the field of planning. Nevertheless, surprisingly, on the one hand is the productive contribution of anticipation, e.g., thanks to scenario-building (speaking for RRI?); and, on the other hand, a rather low level of reflexivity in the individual projects (speaking against RRI?), which may also be due to the fact that science today is professionalized throughout Europe. Research, even if imagination remains an important factor, is in practice largely routinized work.

2. *Ethics and the question of the moral person in science*. Hans Lenk's introductory chapter expresses the essence of the moral person (Chap. 2). This serves both as an absolute reference point for ethics (in Lenk's terms "concrete humanity") and as a central point for attribution of responsibility. In Horst Kant's contribution on the history of nuclear fission (Chap. 6), we sense the manifold moral dilemmas of the moral person, which nuclear research imposed upon the various physicists involved. Kant introduces, among others, the renowned physicist and philosopher Carl Friedrich von Weizsäcker, who opposed nuclear armament of West Germany after World War II and was one of the founders of the VDW (Society of German Scientists). The VDW is an association of socially and politically engaged scientists who advocate for the responsibility of science. Their position paper is a prime example of the human-centered attitude with which the VDW approaches the issue of digitization (Chap. 11). Klaus Fuchs-Kittowski makes a similar point, but with considerably more force and emphasis, and his contribution almost resembles a lament or incendiary statement (Chap. 10). In no other chapter does the responsibility of science appear to be so historically anchored and so dependent on the consciences—as moral persons—of every single scientist.
3. *Institutionalization and professionalization of science*. Heinrich Parthey presents the institutionalization of science—via academies, universities, professional societies, national research institutes, etc.—as a guarantor of freedom but also for scientific progress (Chap. 7). According to Parthey, research is always confronted with interdisciplinary research situations, i.e., problems that can only be dealt with by involving different scientific disciplines (horizontal interdisciplinarity) or in cooperation with technical development and industrial production (vertical interdisciplinarity). As my own paper (Chap. 4) discusses, science became almost entirely professionalized during the twentieth century. Science is now a profession just like architecture, with university-supported training programs, professional associations, and career paths that are not always secure. My argument is that this has reorganized responsibilities, creating a new corporate responsibility at the level of self-organized professional institutions. This also means some relief for individual researchers. More people than ever before in history can devote themselves entirely to gaining knowledge on a professional basis without having to justify themselves. Rainer E. Zimmermann's statement

(Chap. 9) can also be seen in this context: The core purpose of scientific discourse must remain to test knowledge for truth.

4. *Precaution and Responsibility*. One of the great interventions, in the sense of Hans Jonas' principle of responsibility, was the introduction of the Precautionary Principle into European legislation. This was the result of the long debates on environmental protection in the late twentieth century. The Precautionary Principle has indirect effects on science, since it usually concerns innovations—for example, nanotechnology, genetically modified organisms (GMOs) in seed production or endocrine disrupting chemicals (EDC) in plastic, paint, toys, clothing, etc.—which affect the material cycles of European societies via industrial production. As de Smedt and Vos explain (in Chap. 8), the introduction of the Precautionary Principle was controversial from the outset. It was feared to have an unfavorable impact on innovation and competitiveness in Europe. To ensure that precaution cannot be reduced to prevention, the idea is to combine the Precautionary Principle with an RRI policy. Formalizing RRI will likely increase the density of regulation and unintentionally reinforce the restrictive effect of RRI policies. It would be worth trying to replace this preventative perspective with an improvement perspective. In environmental management, which corporations sometimes regard as unattractive, the principle of continuous improvement has gained acceptance, and actually become a general principle for progressive process management and refinement. A similar complement to the Precautionary Principle could be the "Principle of Responsive Adjustment" introduced by Peter French (Chap. 3). Responsive adjustment, as a form of continuous improvement, is a maxim that can find appeal not only in industry but also in science, and thus shows the way in which responsibility can be made tangible.

Science today is older than almost all nation-states. The responsibility of science has always been to regulate in dialogue with society. In the past, science depended on the genius and commitment of individual scientists, such as Aristotle or Galileo Galilei. Today, we have powerful scientific institutions and a broad anchoring of science via the integration of universities within society. In return, dialogue has also become more difficult: for example, politics, law, and education are different fields that have developed their own logic. In addition, there is the international dimension. Science has long been globalized. But the impulses are changing. Just as Germany did in the nineteenth century, China is now intervening in the development of science. China is the only country that can be said to be truly older than science. At present, China uses science and innovation for levering national development. China increasingly controls the "boring" but important operational processes of professional science, ranging from academic journals to standardization bodies. If only because of its huge population coupled with economic growth, Chinese investments in biomedical research and digitization are immense. These are two research fields with high innovation and exploitation potential. It is precisely here that the social dialogue on the responsibility of science will have to continue. Probably—and hopefully—science today is a force that, thanks to its institutions, can enter into this dialog about responsibility in a united way where necessary.