

THE MORAL SUBSTANCE OF SCIENCE

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Science and morals form an ancient topic. Plato and Aristotle had already connected the idea of science with that of morals – in the notion of what the Greeks called a good life, which had to have both a theoretical and a practical form. A theoretical life (βίος θεωρητικός) and a practical life (βίος πρακτικός) go hand in hand. When a practical life lacks a theoretical element it cannot recognise itself (*homo sapiens* without *sapientia*). And when science lacks a moral orientation, that is to say an orientation towards the good life, it remains senseless (a tool without an end). In such cases, a rational culture in which praxis is guided by theoretical considerations, that is to say in which praxis understands itself as being reflected, and in which theory is related both to practice and to life, could not come into being.

This idea of the interrelation of science and morals seems to have got lost along the long roads followed by science and ethics, and along the long road of reflection about science and morals. At least since Max Weber, the idea has taken hold that science is value-free, and that science is formed according to rules differing from those of morals. Conversely, many think that morality has no need of science, in that it is something radically different from scientific rationality. On the side of the sciences, there is also the view that this rationality of the sciences, above all of the exact and empirical sciences, constitutes the whole of rationality. It then follows by definition that any points of view which seek to constrain scientific practice, whether by reference to ‘practical’ or normative considerations, are in fact unauthorised points of view, or indeed ones damaging to science.

But this point of view is itself too radical, for it overlooks the fact that science is not value-free, as the Greeks had pointed out already, and that it rather has a moral substance. This will be taken up in the following under the rubrics ‘Science as Idea’, ‘The Measure of Progress’ and ‘Ethos in the Sciences’.

1. *Science as Idea*

As a rule, the concept of scientific rationality refers to a particular *form of knowledge* and its production, that is to say to theories, methods and the special criteria of rationality to which theories and methods are subjected. Among these criteria, whose fulfilment represents a condition on knowledge- and truth-claims, are, for instance, the reproducibility and controllability of scientific results and procedures, the linguistic and conceptual clarity of scientific representations, the intersubjectivity and testability of scientific results and procedures, as well as methods of justification. If such criteria are abrogated, science loses its claim to objectivity and truth, so that science and opinion become indistinguishable. But this is only one meaning of the concept of science, although it is, from the scientific point of view, the most important one.

A second meaning of the concept of science is given by the fact that science is also a *social organization*, that is, the particular social form in which science is realised as a special form of knowledge formation. Here, we speak of science as an *institution*, for instance the university. The formation of science stands under particular socially defined conditions, among which we may include the pedagogical and research responsibilities of the university. Science becomes visible as an institution, even if only symbolically, when one thinks of the invocation of truth and of the spirit which earlier adorned the portals of our universities.

But the concept of science is still not exhausted by this second, institutional meaning. There is a third one extending beyond those of its theoretical and institutional characters. This can be illustrated in connection with the above-mentioned criteria of rationality. These criteria cannot be restricted to purely methodological aspects, especially if, following the sociologist of science Merton,¹ we add to them such criteria as disinterestedness, truthfulness, and organized scepticism, that is, the general invocation to criticise. On the contrary, these criteria connect scientific rationality to a *moral form*. With regard to this moral form, science is not only methodically enlightened rationality or a means to differentiate and stabilize the social organization of consumption and the satisfaction of needs, but it is also an *idea* that relates to the second nature of Man, i.e. his epistemic or rational nature, or, even more, a *form of life*.

¹ R.K. Merton, *Social Theory and Social Structure*, New York and London, 2nd ed., 1968, pp. 604-615.

This third meaning, which transcends everything methodological or theoretical and everything institutional, was once the essential meaning of science. Greek philosophy, to which we owe the theory-form of knowledge, spoke expressly of the *bios theoretikos*, the theoretical life, and not of theories that, in the sense familiar today, make up the contents of textbooks. *Theoria*, according to Aristotle, is a general orientation with regard to life; theory in this sense – not in the sense of our textbook concept – is one of the highest forms of practice.² The scientific or epistemological subject and the ‘civic’ subject are still one here, and therefore the truth-orientation of science cannot be played off against its social relevance and vice versa. With *theoria* as a form of life, truth also becomes a form of life, that is, according to the distinctions I have introduced, it belongs not to the methodological but to the moral form, and thus to the idea of science. In this sense both the work of Man on his rational nature and truth are moral. How does this express itself in actual scientific and social developments? Is what I have called ‘the idea of science’ also actual?

2. *The Measure of Progress*

Another fact that seems to speak against my suggestion that science has a moral substance, and that scientific rationality orients our life is the progress made by science, and in consequence by technology. For science seems to go where it wills. Furthermore, scientific and technical developments are inter-dependent. Progress in the one drives progress in the other, and vice versa. Progress in science and technology is, at its essence, *immeasurable*, excessive, or to put it differently: if there is an internal measure of science and technology, then it is that they exceed all measure. For measure means definition, or limitation, whereas scientific and technical rationality define themselves precisely through the provisional character of what limits they may have.

Still, that is not all that one can say. If scientific (and technical) progress has no internal measure, a measure which could of course be a moral one, then this means nothing more than that the limits of progress are self-imposed limits, and thus that the measure of progress can only be a self-imposed measure. The idea that the world, that nature itself has limits that cannot be surpassed by the scientific understanding, and that progress also

² *Eth. Nic.* K7.1177a12ff.

has a measure that delimits it from inside, does not in fact make sense. It is an idea that can be disproved at any time on both historical and systematic grounds. Thus the boundaries of progress do not lie at those points where they are evidently impassable, but rather where they *should* lie, in other words where Man decides that he may not proceed further. Self-imposed limits in this sense are *moral* or *ethical* boundaries. The same is true from the point of view of measurement. If there is a measure of progress, then it is not a 'natural' measure, but an ethical one. For it assumes an answer to the question concerning which forms of progress Man wants, and which he does not, that is to say which forms can be justified by ethical norms and which cannot. At least regarding his ethical nature, Man remains the *measure of all things*, just insofar as he resists assimilation by the world – not only in moral and political matters, but also in scientific and technical ones. And this is an idea that has attached to the concept of science from the very beginning, that is to say from its foundations in Greek thought.

Generally speaking, ethical problems in research and in science, problems concerning the consequences of scientific praxis and progress, are problems of *practical* reason, not of theoretical or technical reason. By this it is meant that in rational or technical cultures, the rational or technical understanding is not in a position to solve the problem of justified progress, or to respond to the demand for an orienting form of knowledge that goes beyond knowledge as a form of mastery. Already Max Weber claimed that 'All natural sciences give us answers to the question: What should we do, *if* we want to master life technically? *Whether* we want to master it technically, and whether that indeed makes sense – they leave such questions unanswered, or they assume [the answers] in pursuing their ends'.³ Answering such questions is not the responsibility of science from Weber's point of view. But this just makes the problem concerning a form of practical reason that guides action, thus of a justified progress, all the more troublesome. Science has acknowledged this itself, and has indeed regretted the weakness of practical reason. As Albert Einstein observed in 1948: 'The tragedy of modern Man lies in the fact that he has created for himself existential conditions that are beyond the capacities given him by his phylogenetic history'.⁴ Put otherwise, the drives of the subcortical structures are

³ M. Weber, *Gesammelte Aufsätze zur Wissenschaftslehre*, ed. J. Winckelmann, Tübingen, 3rd ed., 1968, pp. 599f.

⁴ A. Einstein, *Über den Frieden: Weltordnung oder Weltuntergang?*, ed. O. Nathan/H. Norden, Bern 1975, p. 494.

stronger than the cortical control. One might well ask in this situation whether science, in its freedom of research, still bears responsibility for what it does and what it affects.

Freedom and responsibility are difficult concepts not just in the context of science and research. They are among those that everyone has on their lips and some in their hearts as well, even if they do little more with these concepts than to apply them rhetorically. We know that freedom of research or freedom of science is written into the programme of the enlightenment and into many modern constitutions, that research and development serve social purposes, and that responsibility is one of the virtues of a citizen in a democratic society. But it remains difficult to state more precisely what responsible freedom of research or science *are*, and where they begin and where they end.

In the case of science, the problem begins already with the fact that freedom of research or science means on the one hand freedom of the *scientist* and on the other hand freedom of the *institution* of science. The restriction of the one freedom is often justified by the claims of the other: Since the institution of science is losing its freedom increasingly to the state – so say the scientists – the personal freedom of the scientists must be all the more unrestricted. Since the freedom of the scientist is claimed and exercised without restriction – so say the governmental administrators – there must be regulatory influence of the state on institutional affairs. This seems to mean that it is no longer possible to take both the freedom of the scientist and the freedom of the institution of science together. Wherever the one is exercised without restriction, the other must accordingly be limited.

But this surely involves a misunderstanding, one which indeed occurs whenever one fails to make an adequate distinction between freedom and arbitrariness. Often the social good of the freedom of science deteriorates into mere whims on the part of the scientific actors, namely the right to do what they like. Concepts like justification and (social) responsibility seem in the minds of many scientists to belong to the vocabulary of the unfree. But this is mistaken. Freedom, rightly understood, is always *responsible* freedom, otherwise it is arbitrariness. Consequently, both freedoms, the freedom of the scientist and the freedom of the institution go together. Freedom of science understood as a boundless subjective freedom of the scientist is unacceptable from the point of view of science because the old Humboldtian ideal of research in 'solitude and freedom' cannot be demarcated effectively enough against misunderstandings of unbounded scientific subjectivity. Even genius, which in scientific affairs

is not nearly so common as scientists like to think, does not justify expansion without limit. This holds in science as well.

So much for the concept of freedom of research. The concept of responsibility with regard to this freedom still remains to be discussed. In fact, wherever a claim is made to freedom of research or science, this freedom must be related to structures of responsibility. This leads us then to ethical or moral arguments. What I mean is again that the usual distinction between science as a particular form of knowledge formation and science as an institution is not exhaustive. This has been made clear by norms which, serving as criteria of scientific rationality, are above all practical, as opposed to theoretical, in kind. They are aimed at superseding mere subjectivity. Scientific states of affairs are strictly speaking *inter-* or *trans-subjective* states. Not in the sense that scientific subjects disappear, but in that they are distinguished by a morally determined generality of scientific norms such as those mentioned. Those who do not subordinate their work to these norms, which are not purely methodological norms, not only overstep the bounds of scientific rationality, but they also overlook the normative lines that connect scientific work with the life-world. Science has not only a *knowledge*-task but also an *orientation*-task. It has a cultural meaning.

3. *Ethos in the Sciences*

In this context, the notion of a scientific ethics is a popular topic of conversation these days. It is supposed to counter the suspicion that not all is well with the ethical bonds that once held between science and society. One hears more and more talk in connection with the sciences about arrogance and immoderation, indeed even about treachery in the ranks. Science's supposedly divine nature has evidently given way to quite human urges.

On the other hand, there is much evidence that the expectations directed towards an 'ethics of the sciences' and to its realisation are too great. It may even be that the call for such an ethics may lead us in the wrong direction, at least in so far as one thinks of an ethics of the sciences as a special ethics *for scientists*. There cannot be such a thing, for the simple reason that an ethics is always an ethics of the *citizen*. It cannot be divided along social lines, that is to say in a scientific ethics which is the ethics of the scientists, and a non-scientific ethics, which is the standard ethics of society as a whole. And the same holds for morals. There are, strictly speaking, no closed ethical or moral worlds, in each of which a single ethics or set of morals holds sway.

This objection is directed not only at the exaggerated hopes for an ethics of the sciences, but also at the idea that the scientist has more responsibilities than the average citizen. A scientist does of course have a special responsibility, which derives from the essential uncontrollability of scientific knowledge by extra-scientific knowledge, as well as from the dependence of modern society on the special competence of the scientific understanding. However, this special responsibility does not translate into a special ethics. What is needed is rather a better *ethos*, as for instance has long been the case with the socially realised professional ethos of physicians. All rules, all norms which one might like to prescribe to the practice of science in order to strengthen the responsibility of science and of scientific rationality, are superfluous once we have such an ethos of the scientist and once it is in fact observed. Of course that it is in fact often not observed is obvious enough. But that doesn't mean that an ethics of the sciences has failed, or that it must be improved, but rather that the norms of general, civic ethics, were violated, and the ethos of the scientist was violated by base personal motives. I suspect that there is little more that can be said about the ethics of the sciences, except perhaps that the attention of science as an institution towards the observance of the scientist's ethos should be more strongly enforced in the future.

As an example of this sort of institutional attention we might take a so-called 'code of conduct' published in 1998 by the German Physical Society (DPG). Here we may read that 'Every member is also a member of the community of scientists, and shares in their special responsibility towards coming generations. The members support the development of science. At the same time, they acknowledge and respect the fundamental principle that holds for all science in all countries, namely that of honesty towards oneself and others. The DPG condemns scientific misconduct and disapproves both of fraud in science and of the deliberate misuse of science'.⁵ Clearly enough, notions deriving from a general civic ethics are being translated onto science and the special circumstances of scientific practice. These rules do not constitute an ethics of the sciences in a distinct sense.

Rules such as these, which science imposes upon itself in order to tie its freedom to some ethical measure, sound like rules of reparation. They hint dimly at some forgotten scientific ethos which conceived of science as an idea and a form of life. Indeed, the ethos of science has today lost much of

⁵ 'Verhaltenskodex für DPG-Mitglieder', *Physikalische Blätter* 54 (1998), No. 5, p. 398.

its effectiveness, and thus also its subjects. However, to the extent to which it has become unrecognisable, it has also lost sight of society and its relation to science. The crisis of confidence that has grasped hold of science is also an ethical crisis, a crisis of a scientific ethos. Thus it is of utmost importance to overcome this crisis that science is itself responsible for.

In this connection I would like to draw your attention to three arguments, which on the one hand explain why it has come to a crisis of confidence both with and within the sciences, while at the same time making clear what must be kept in mind in the future.⁶ Among the causes of this crisis of confidence is first of all an increasing 'scientific incompetence' on the part of society, of which science is of course a part, by which I mean the inability to understand the production of scientific knowledge. A second cause is the 'desymbolisation' of science, which has not led to 'emancipatory progress', but rather to a loss of 'ethical self-consciousness'. Third, there has been increased competitive pressure, that is to say an uncritical importation of the market model into the practice of science. Here it is largely a question of reversing this trend whenever possible by appeal to the forms of (social) interaction that are specific to the sciences, and which speak against using an economic paradigm, or indeed using a 'professional code' of 'institutional procedures'.

These are indeed essential factors in questions of confidence and ethics, and yet, in the final analysis, it is a matter of most importance to bring back a scientific ethos to scientific consciousness. We understand under the notion of an ethos an orientation towards largely implicit, and implicitly observed rules, which are conceived as holding self-evidently both for individual and social actions. Whether we conceive of these rules as the simple rules of conduct to which one usually holds (rules of etiquette), or whether they are rules to be evaluated morally or ethically, such as maxims – in both cases it is a matter of implicit knowledge. And this knowledge demands being followed practically rather than being theoretically mastered.

The connection between an ethos, morals and ethics would then be the following. Ethics is a critical theory of morals, which is above all concerned with regulating institutional morals that are often in conflict with one another. That is to say with regulating socially implanted systems of rules of action and goals by evaluating them and deciding among them by

⁶ C.F. Gethmann, 'Die Krise des Wissenschaftsethos: Wissenschaftsethische Überlegungen', in: *Ethos der Forschung / Ethics of Research (Ringberg-Symposium Oktober 1999)*, Munich 2000, pp. 38f.

providing the arguments that permit decisions. These arguments must in consequence be generally valid, and so the corresponding ethics must itself be *universal*. This means in turn that it makes universal claims of validity, and that it must be in a position to ground these claims. Kant's ethics provides an example of such a universal ethics. An ethos is, on the other hand, a part of morality, and thus of a universal morality when the latter is characterised by a universal ethics. Here, an ethos relates to a universal conception of ethics, that is to say it 'represents' the latter's claims to validity, or indeed it realises them.

And just this is the case with science. For science is the expression of universal claims to validity, and this both in the sense of being a special form of knowledge formation, that is to say of the scientific formation of knowledge, as well as in the sense of being a scientific ethos, which is also the moral form of science, as I stressed in my opening discussion. The orientation towards truth typical of the one of these follows the orientation towards truthfulness of the second. That is to say, quite simply, that *truth* determines the scientific form of knowledge, whereas *truthfulness* determines the moral form of science, which as a result belongs to the form of life of the scientist, to his ethos.

Our task for the future is thus to make these connections explicit in the practice of science, and to ensure that we act in accordance with that explicit knowledge. For if this cannot be achieved, then the crisis of confidence into which science has fallen – deservedly and undeservedly – will continue. This will in turn threaten not only the foundations of science, but also the foundations of rational cultures in general, that is to say of modern society. The question concerning the ethics and the ethos of science is therefore not merely a question concerning the future of science, but also one concerning the future of our society, concerning that of our culture.

DISCUSSION ON THE PAPER BY MITTELSTRASS

ZICHICHI: Professor Mittelstrass has raised a very crucial point which is at present extremely interesting for the future of science: the responsibility of science. If science is the study of the logic of nature, in so far as you study the logic of nature, you should do whatever you want to understand nature as quickly as possible. It is not an accident that in four hundred years we've understood far more than anybody else did during the previous ten thousand years. So, we must clearly distinguish science from technology. Science has only one responsibility: to prove that it is worth being as we are. We are the only type of living species able to understand nature; there is only one such species. This is the one we belong to. We can reach this conclusion thanks to science, which is only for man, never against.

Technology, however, can be for and against man. Professor Menon raised a very delicate point which was also raised in previous days about Rasetti. I totally disagree with those who agree with Rasetti, because as it happens I was young enough not to be involved in any of these dramatic suicide attempts of Europe, but not too old, in such a way that I could meet practically all the members of the Manhattan Project. They were terrified by the fact that the Hitler project for the nuclear fission bomb would arrive first. So, they were morally justified in doing what they did. Who knew what was going on in the Nazi project which had started three years earlier? A great advantage. So, I think that when we speak about technology we should be more linked to the historical events. Our fathers of the Manhattan project tried to help humanity not to be the slave of a crazy man, a criminal like Hitler. So, with regard to the Manhattan Project, I've great respect for those people who had the courage to commit their brains to being as successful as possible.

The technology for man cannot be judged just on the basis of some *a priori* definition. And I have personal experience on the topic. Once I was involved in an experiment, and in order to prove something it was necessary to devise a system to invent a gadget which was ten times more pow-

erful in time measurements than all previous gadgets. Professor Weisskopf, who was the Director General of CERN, decided not to patent this invention. Then it was used for military purposes. Am I responsible for this? No. I was trying to see if nature obeys some logic, because at that time there was a big crisis, nuclear anti-matter was not found by other experiments at the level of 1 part in 10 to the 7, and we found it at 1 part in 10 to the 8. So, even the technological inventions which later have military implications are not the responsibility of the poor guys in their lab trying to understand the logic of nature and being generous in not patenting anything.

The topic that you've discussed is extremely relevant today, and therefore I would urge you to convince as many people as you can about the fact that science is the study of the logic of nature, and has no implication whatsoever. Technology can be for man and against man, but even the technology which could appear at first instance to be a responsibility with a negative sign can turn out to be in fact the other way round.

BERTI: I'll try to defend Max Weber's conception of science a bit as well, because it is true that Weber said that science is a free value, but he also conceived science as a form of life, as a profession, as, in German, a *Beruf*, and this implies a set of ethics and some rules, and when he said that science is a free value he meant, I suppose, that the judgements given by science are not judgements of value, but judgements of fact, they are descriptions of the facts, of a reality, and in this sense I think that they are free from values.

MITTELSTRASS: I think I agree. It was not my intention to attack Weber at that point, but what I wanted to say is that Weber was not only talking about science in the strict sense – he was also talking about the social sciences and the humanities, so, talking about value-free procedures and results is not enough. This cannot mean that science has no contact with the realm of responsibilities and values, with culture in general. I don't know whether the distinction he made between science, its procedures, its results and society using these results is a clear distinction. I have my doubts. But this was not an attack on Weber but the hint that this cannot be the last word – the statement that science is value-free.

SINGER: I'll try to be brief. I think the Manhattan example is a poor example, because the main scientific discoveries had been made. It was an engineering problem; the Manhattan Project was an application prob-

lem. What I would like to have your opinion on is whether one can't also formulate the necessity of science more positively, seeing it as a moral obligation, because if humanity decides to interact with its biotope and its future, then I think it follows that there is a moral obligation to try to know as much as possible before one acts. So, science becomes not only a necessity, it also becomes a moral obligation. We are condemned to know if we want to act with responsibility, and therefore there must be unrestrained search for knowledge. Application is something else.

MITTELSTRASS: I agree. I mean, mankind wouldn't have a future if we didn't invest in science, in research. What I wanted to stress is exactly that science also in this respect is not only a means, it's also a purpose in itself.

CABIBBO: I wanted to say something more about Rasetti. I think his choice was correct, but maybe also the opposite choice of other people was correct. I think he gave an example of peacefulness. Of course he also had a particular problem because he was an Italian citizen in the United States, in Canada and, although he didn't like Fascism, he probably didn't want to work on a weapon which could be used against Italy, perhaps that was part of the problem. Finally, I recall the fact that when he came back to Rome in the early 70s he helped develop a very practical, in the end, gadget to measure the density of plasmas, ionized gases, which could have applications outside the peculiar scientific investigation that he was interested in. I think he had no problem with that. So, in the case of Prof. Zichichi, I recall that he invented this chronotron to measure the muon lifetime. I mean it's unavoidable that what science does will be used by someone else later on, but it's a wider problem. To do nothing because of the dangers of this fact would be to do no science at all.