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Science and Public Trust

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In my free hours, of which I have many, I have considered my case and wondered how the world of science, of which I am no longer a part, will have to judge it. […] The pursuit of science seems to me […] to demand a particular kind of courage. It deals in knowledge, gained through doubt. Creating knowledge about everything for everyone, it strives to make doubters of everyone. […] I consider that the only objective of science consists in easing the arduousness of human existence. If scientists, intimidated by selfish rulers, content themselves with accumulating knowledge for the sake of knowledge, then science may be made a cripple. […] You may in the course of time discover everything there is to be discovered, and your progress will still only be a progress away from humanity. The gulf between you and it may one day become so vast that the response to your cries of jubilation over some new achievement could be a universal cry of horror.
Galilei from Bert Brecht's "Leben des Galilei" 1

Introduction: knowledge is power

Knowledge is power, Francis Bacon wrote in his "Essayes", published in 1597. The aim of science is to generate knowledge in a certain field through methodical observations and experiments, conceptual analysis and other research processes in the sense of making true discoveries. Those who understand and can use these discoveries will put themselves in a position of economic and thus equally societal and ultimately also political power. Perhaps this explains why Bacon added that "science itself is power". *2* But power requires legitimation. Legitimation is the prerequisite for public trust and confidence.

Power requires legitimation

The term "power" invokes mostly sceptical associations, because power, as Max Weber once defined it "…means seizing every opportunity to assert one's own will in a social relationship even in face of reluctance, no matter on what this opportunity is based."[3] And who wants to have the will of others foisted on them at any cost, against their own will? But Max Weber's definition has an major weakness: It assumes a zero sum game, in which the powerful win what they take from the less powerful or even the impotent. That this is not the case – or at least does not have to be – can be shown especially in the context of science. The accumulated results of the last 200 years of science have immensely improved the face of the Earth and people's quality of life.

Needless to say, power also has to do with access to resources and influence over their distribution. We therefore find gradients of power everywhere and in many different ways. The power resources of modern societies, however, are manifold and by no means only economical, but also symbolic or moral in nature. Precisely in the struggle for social acceptance of scientific research, a major role is played by informal power resources, whether it be for example the esteem in which a debating party is held, his perceived moral weight, his prestige or his ability to

1 *Brecht B.: Gesammelte Werke 3 (Stücke 3) Werkausgabe, Buchclub Ex Libris (Suhrkamp Verlag), Zürich 1976 (Frankfurt 1967), p.1339 et seq.*
2 *"scientia potestas est" – this concept of power derives from the Latin verb "posse", i.e. being capable of doing something. In Roman law "auctoritas" is also enshrined as a type of power as well as "potestas", and French tot distinguishes between "puissance" and "pouvoir", i.e. between the ability to do something and the exercise of power.*
3 *Weber M.: Soziologische Grundbegriffe. J.C.B.Mohr / UTB (Paul Siebeck), Tübingen, 6te Auflage 1984, p. 89.*

encourage support through charismatic personalities or access to the mass media. Formal power resources such as the financial potential of a research-based company, for example, can even prove a burden on trust in any public analysis of the pros and cons, because for many people institutional size and a large purse can be perceived as a vague threat, in contrast to the opportunity offered by the ethical motivation of a "Robin Hood", which is seen as pure.

Power is more than authority

To associate power exclusively with antagonism and conflict in asymmetric relations is to underestimate the potential of power which comes from cooperation and efforts to exhaust all the options available for negotiation. *4* In modern societies, upholding power through coercion is only conceivable within very narrow limits (e.g. the power monopoly of the state). In normal sociopolitical circumstances, power can only produce sustainable effects if it is perceived as legitimate, in a way which extends beyond formal legalities. Legitimate power is based on "checks and balances", power is balanced by public controls, by political government, by Non-Governmental Organizations (NGOs), by the media and other elements of civil society. All society's actors are bound together in one way or another in a nexus of mutual dependence. Through this they have "bargaining power", i.e. the opportunity to influence decisions. Power, as Ralf Dahrendorf put it, is a "…currency in which every citizen has a share". *5*

Collective legitimation takes place in modern societies on the basis of values shared (consensus of values) by democratic majorities and is thus subject to constant control. Nevertheless, precisely in the area of science a potential for criticism remains which is not only nourished by conflicts of interest, but also determined by the individual judgment of what is considered "legitimate". The "normative force" of the facts rarely lasts; normality in pluralistic societies is the constant need to seek legitimacy. The greatest successes in this respect are achieved through communicative action and active participation in the political process.

4 For more on this discussions see Burkolter-Trachsel V.: Zur Theorie sozialer Macht. Verlag Paul Haupt Bern und Stuttgart 1981, which is still as worth reading as ever

5 Dahrendorf R.: Soziale Klassen und Klassenkonflikt in der Industriellen Gesellschaft, Stuttgart 1957, p. 311.

Power can be put to both good and bad uses

Amitai Etzioni once pointed out that the idea of evil being forced on people through power, while good soars free by its own innate strength presupposes an optimistic view of human nature, for which there are few grounds.[6] An *a priori* negative interpretation of power is thus out of place. Power is also necessary to set processes in motion through which people can make positive changes in the status quo. Anyone who supports the thesis of the English historian John Acton that, while power corrupts, absolute power corrupts absolutely ignores the corrupting forces of impotence.

It can therefore not be a question of abolishing or suppressing power. Instead we have to openly address the issues of power and make them transparent, so that they can be relativized and made controllable by legitimation. The legitimation of scientific activity, i.e. the rational explanation that this activity, because it is morally justified, has social legitimacy, is a difficult undertaking, because people in modern societies do not always agree on what activity is morally necessary, forbidden or permitted. *7*

Science which is widely perceived by society as legitimate has to be active in seeking public confidence.

Science and trust

Debates on the legitimation of scientific progress and the technical advances resulting from it are nothing new. The whole of the 20th century, as observed by one of the leading historians of our time, Eric Hobsbawm,

> "was not at ease with the science which was its most extraordinary achievement, and on which it depended. The progress of the natural sciences took place against a background glow of suspicion and fear, occasionally flaring up into flames of hatred and rejection of reason and all its products" *8*

Deficits of trust, not advances of trust, are and were the rule. Even the first railways unleashed a sense of panic, as did the motor car, and later on also medical advances such as penicillin and vaccines had to overcome stubborn prejudices. Hobsbawm draws a distinction between four kinds of "feeling" which have fed the suspicion and fear of science::

- that science was incomprehensible;
- that its practical (and hence also moral) consequences were unpredictable and probably catastrophic;
- that it underlined the helplessness of the individual and undermined authority; and
- that it was inherently dangerous because it interfered with the natural order of things.

6 Etzioni A.: Die aktive Gesellschaft. Westdeutscher Verlag, Opladen 1975, p.341.
7 See Höffe O.: Lexikon der Ethik, C.H. Beck Munich 1992, p.22 et seq.
8 E. Hobsbawm, "The Age of Extremes", London, Michael Joseph, p. 530

According to Hobsbawm, the first two variants were observed equally among scientists and the lay public, and the last two in particular among non-scientists. Many people feel, in addition to an erosion of their competence for solving problems, also an increase in the power of science and research to create problems, and there is a growing sense of scepticism that is making people wonder "…whether the problem areas created by science and technology are not increasing more rapidly than the opportunities for solving the problems."[9] In such a situation and in view of the immense importance of science for the sustainable global development of a world population that will grow by 50 percent in the next 50 years, the need to find an answer to the question as to how one creates a broad basis of public confidence in science is stronger and more urgent than ever.

Today I offer you a provisional answer in the sense of a rough strategy made up of three components. I do so in the hope that together we can develop it further and bring it to a successful fruition. At the same time, allow me to sound a note of caution that any successful strategy aimed at confidence building in a complex area such as the natural sciences is always about politics in the sense, as Max Weber put it, of a "slow and strong drilling through hard boards with a combination of passion and a sense of judgment".*10*

Prerequisites for public confidence in scientific activities

Where institutions and their activities enjoy social or political confidence, purposeful activity with a minimum of friction is possible. By contrast, where vague or even concrete mistrust prevails, the cost of interaction is high. Confidence emerges in those places where the actors concerned share values and objectives, where mutual obligations are perceived and a spirit of cooperation is cultivated, where people communicate openly and honestly with each other and there are no doubts as to the goodwill of the other party. So that Hobsbawm's different kinds of feeling have as little space as possible to develop, and in order to gain public confidence on a broad basis, at least three essential prerequisites must be met: Science must

- meet high ethical standards
- establish trust in ongoing dialogue with the relevant stakeholders and, last but not least
- achieve tangible results with a discernibly positive benefit-risk ratio.

9 Thus Günther Mack in "Die Suche nach einem zukunftsfähigen Wissenschafts-Paradigma". In: Küng H. / Kuschel K.-J. (Ed.): Wissenschaft und Weltethos. Piper, Munich 2001, p. 313.

10 See Max Weber's definition of "Politics" in: Weber M.: Soziologie. Universalgeschichtliche Analysen. Politik. With an introduction by Eduard Baumgarten. Edited with explanatory notes by Johannes Winckelmann. Alfred Kröner Verlag, Stuttgart 1973, p. 185.

Public confidence in science calls for high ethical standards

Public confidence in science requires that science meets high ethical standards both in its ends and in the means it employs to achieve these ends. In science, as in other areas, the quality of the ends must be reflected in the choice of the means. It would be fatal to adopt the attitude that "You have to break an egg to make an omelette". On the contrary: "The nobler the ends, the more illegitimate it is to be indifferent towards any means that are not equally noble." *11*

The principle still applies that science is primarily concerned not with "Good", but with "Truth". 12 Science therefore never brings simply "… blessings, but also brings a curse with it, not just through the practical application of scientific discoveries for purposes that are hostile to life, but also in itself through the artificiality of its abstraction […]".*13* Although, as Arnold Gehlen once remarked, there is a social obligation on the citizen and a human obligation on the individual, there is "no social commitment on the part of creative forces".[14] However, the question as to whether, from an ethical viewpoint, we may be allowed to do everything which science and technology enable us to do, has long since been answered: We may not. It is true that successful scientific work is dependent on a maximum of freedom from ideological and political constraints or any other kind of intellectual spoonfeeding – on a **freedom of science** as anchored in our constitutional law. But in view of the potentialities that reside in scientific work, this very **"freedom from"** is subject to obligations. The first obligation is to come up an ethically acceptable answer to the question **"freedom to do what?"**.

The legitimation of freedom to do research consists in the responsibility to observe certain limits in our wishes and actions so that the wishes and actions of other people are not compromised in an impermissible way. The ethical limits are of particular importance here. But if we look for generally binding criteria for moral behaviour in day-to-day activities – including science – then we meet with a large measure of uncertainty in modern societies:

> "Nowhere are differences of opinion and contradictions between incompatible standpoints greater than in the judgment of actions in terms of their rectitude and morality. What one person finds good, the other strictly rejects, often not even being prepared to expound the problems of his standpoint, i.e. to defer criticism and address the counter-arguments." *15*

This is not the place to enter into the detail of an in-depth discussion on the ethics of science and specific ethical prerequisites for the acceptance of the means and ends of science. Others have already done this with great success. *16* But one thing is clear: In addition to the requirement of the responsibility ethic, the moral claims of relevance for science lie within a relatively clearly

11 Siehe dazu Künzli A.: Trikolore auf Halbmast. Limmat Verlag, Zürich 1992 S. 33.
12 Brunner E.: Das Gebot und die Ordnungen. Theologischer Verlag Zürich, 1939, p.478.
13 Ibid. p.484.
14 Gehlen A.: Gesamtausgabe. Band 7: Einblicke, Vittorio Klostermann, Frankfurt am Main 1978, p.201
15 Pieper A.: Ethik und Moral. Eine Einführung in die praktische Philosophie. C. H. Beck, Munich 1985, p.23.
16 See Otfried Höffe's contribution "Wissenschaftsethik" and the literature cited there. In: Höffe O. (Ed.): Lexikon der Ethik. Beck´sche Reihe, Munich 5th revised and enlarged edition 1997, p.341 -345.

defined corridor of globally binding values: Wherever the question is put to people of differing nationality, religious or cultural affinity and spheres of interest, the standards which apply – apart from observance of the universal principles of human rights – are those timeless and intercultural standards to which Hans Küng drew attention in his work on the Global Ethic. *17* the overwhelming majority of people consider that responsible, fair and sincere dealings with one another represent a social pattern of behaviour worth striving for and are morally valuable. *18* Values such as non-violence, truthfulness, solidarity with those in need, tolerance, and observance of the ethic of reciprocity known as the Golden Rule form the basis of all world religions.

For an outline of the specific framework for scientific work, it is worth considering Jean Starobinski, who in his essay *"Thirteen theories on ethics in medicine"* brought the essential ethical criteria for scientific down to the briefest of denominators:

> "[...] the serious investigation of theories which one wishes to refute or to overhaul; respect for the problem; the willpower to understand and not satisfy oneself with an overhasty understanding; the effort to establish the validity of observations made and tests carried out; the willpower to draw conclusions when an insufficient number of results is available; insight into sources of error; honesty in the publication of results." *19*

A signpost function is served by national and international standards of law, which are constantly being adapted to the ever-changing state of the art. But the law cannot always serve only as the ethical minimum, because in times of dynamic change the elaboration of legal standards may not be sufficiently rapid to prevent problem activities. Therefore not everything which is legal is also legitimate. For a sensitization to this difference and a responsible handling of legal grey areas, the work of ethics committees can be helpful. Additional criteria for ethically appropriate behaviour may be introduced through the elaboration of codes of conduct or self-imposed guidelines of the various professions or professional associations. Not that there might be any special "professional ethics", but codes of conduct like this can make it easier to meet ethical requirements in the practice of the professions concerned, not least also because they ensure that no competitor has an unfair advantage. *20*

Notwithstanding all these factors, ongoing dialogue and sociopolitical analysis addressing the moral quality of scientific activity remain essential. The basic ethical question is "... wherever it becomes concrete, a question to which there is no simple unequivocal answer that can bring harmony to conflicts and engender peace". *21* The moral consensus - the currently "accepted set of standards" - in modern societies generally comprises only a lowest common denominator

17 See Küng H. / Kuschel K.-J. (Ed.) Wissenschaft und Weltethos. Piper, Munich, paperback edition 2001; and also Küng H.: Projekt Weltethos. Piper, Munich / Zürich 1990; and also Küng H.: Weltethos für Weltpolitik und Weltwirtschaft. Piper, Munich / Zürich 1997.

18 Loges W.E. / Kidder R.M.: Global Values, Moral Boundaries. A Pilot Survey. Camden, Maine (The Institute for Global Ethics) 1997.

19 Starobinski J.: Dreizehn Thesen zur Ethik in der Medizin. In: Pieper A. (Ed.): Die Macht der Freiheit. Verlag Benziger, Zürich 1990, p.125f

20 In view of the international pressure of competition this is of the utmost importance, because sustainable success is associated not only with increases in income and standing, but also with a certain pattern of resource allocation. This pressure results from time to time in attempted fraud and counterfeiting practices.

21 Rich A.: Wirtschaftsethik. Grundfragen in theologischer Perspektive. Band 1, Gütersloher Verlagshaus, 3t Auflage 1987, p.18.

of basic values, as guaranteed for example in constitutions. Anything which goes beyond this generally falls victim to a highly developed pluralism and can often only be found in the core of individual particular interests. These may remain incompatible with the interests of a scientific institution. *22*

Fact-based knowledge and value-based knowledge

The acquisition of new knowledge through science remains the task of specialists in their various scientific disciplines. We currently have no other accepted mode of discovery at our disposal than the scientific approach. Scientific evaluations must also form the basis for political decisions - political rules for science tend to mislead. However, “expert knowledge” in a discipline, in the sense of a preservation of specialist competence and methodology, must be complemented by inter- and transdisciplinary scientific work, otherwise a sense of reality is lost. *23*

However, while holistic fact-based knowledge will do, it is not enough. It is not totally sufficient for a political assessment. To confer legitimacy on activities, the discoveries made need to be classified into a larger whole and the aims and methods assessed from a moral standpoint. In other words: Both holistic fact-based knowledge and relativizing value-based knowledge are required – ideally in the sense of that “responsibility for the whole” which was described so impressively in its potential depth by Dietrich Bonhoeffer. *24* The value system according to which this must happen does not lie at the level of science, but is constantly being modified and redefined by experiences with science and its consequences.

Public confidence in science requires communication

It is plain that only to a limited extent can the science institutions in modern societies decide for themselves what is perceived in a society as ethically acceptable. Neither universities nor privately run research institutions represent an autonomous cosmos unto themselves. They are a living part of a living society and through ongoing interaction influence their environment just as their environment influences them. In modern pluralistic societies it is completely normal to be confronted with outside attempts to exert influence in a wide variety of ways and for a wide variety of purposes. This can give rise to conflicts which should first be acknowledged as legitimate – social change is not possible without conflicting interests and an examination of their values. For this reason, conflicts should also be seen in the context of science as a constructive element, but resolved in a regulated manner and subject to the observance of certain rules of play (e.g. no violence). *25*

These observations do not, however, mean that the responsibility for what in content is ultimately a scientific decision can be delegated from science as a sub-system of society. For all the importance of value-based knowledge, responsibility cannot be delegated without a deep understand-

22 Just for the sake of completeness, let it be noted that the global picture of the average person is far from coherent and modes of behaviour anything but consistent. This is shown, for example, by the fact that there are people who argue in favour of allowing abortion during the third three months of pregnancy, while at the same time having major ethical reservations about research with embryonic stem cells.

23 Mack G.: "Die Suche nach einem zukunftsfähigen Wissenschafts-Paradigma". In: Küng H. / Kuschel K.-J. (Ed.): Wissenschaft und Weltethos. Piper, München 2001, p.316.

24 See Bonhoeffer D.: Ethik. Chr. Kaiser Verlag, second revised edition, Munich 1998, p. 289 - 299.

ing of the fundamental facts and interdependencies. The demands of other actors in society cannot just be adopted without any further ado, if only for the sake of preserving self-interest. Science, however, must face up to the demands made of it in a constructive and unprejudiced manner. At the very least this will help to create a broader basis for one's own decisions. Anyone who listens to others, takes their concerns seriously, is responsive to them and makes clear his own position in the process becomes part of a communication-oriented community. This helps to convey not only knowledge of one's own activities and the way in which these are assessed, but also knowledge about the personalities behind the positions of the different stakeholders involved. Although even the most enlightened scientific institution will never be equally open to all stakeholders, it is in the interest of all science institutions to know what demands are being made by whom and with what legitimacy.

Only a sober professional analysis allows meaningful conclusions to be drawn as to the validity of claims made on institutions of all kinds, including science, by outside stakeholders.[26] Not only does dissent on essential aspects need to be accepted, it also offers the opportunity to find higher-quality solutions. Evasive strategies, such as "sitting out" conflicts, ideological explanations for a rejection or a self-prescribed unwillingness to compromise, will leave scientific institutions just as much out in the cold as will a populist fixation on compromise and acquiescence without the presentation of any counterargument. The very fact that a scientific institution delegates people to enter into a dialogue with stakeholder groups in order to present its own positions, to respond rationally to counterarguments and to listen in turn to the other side keeps the institution from sinking into the kind of anonymity which is so often responsible for vague feelings of disquiet and unease.

25 Dahrendorf R.: Gesellschaft und Freiheit. Piper Verlag, Munich 1981.
26 See Clarkson Center for Business Ethics: Principles of Stakeholder Management. "The Clarkson Principles". Toronto 1999.

Dominance-free communication

An ongoing and largely "dominance-free" communication" *27* with all the relevant stakeholders of a specific scientific institution puts research institutions in the position of conveying the complex "reality of science" to the outside world and taking in the outside perceptions of important elements in the assessment of scientific activity (risks, benefits, fears, and hopes). Ideally, a "balance of perceptions" takes place regarding the reality of the situation or at least a better understanding of alternative views. One should beware, however, of any unrealistic hopes that harmony might be achieved. Any approach to discourse which assumes that only the one or the other side of the argument can enforce its interests results in an inappropriate negation of the complexity and runs a high risk of foundering.

In every phase of dialogue, tolerance – the suspicion that the other party could be right – is enormously important. A conscious effort to acknowledge the right of the other party to think differently and a respect for other ways of looking at things and other modes of behaviour foster social advances in knowledge and recognition. It is often sufficient to take a serious look at the questions posed by the other party in order to enrich one's own thinking. This does not, however, mean one can escape the fact that there are sometimes insurmountable conflicts between the interests of science and specific stakeholders of society.

A problem which also has to be openly addressed is the fact that insecurities and uncertainties exist, as well as **dilemma situations**, for which there is no resolution in the sense of a solution that is satisfactory for everyone, but which necessitate a search for the "lesser evil". One of these dilemma situations is the fact that scientific work, too, never brings just benefits, but also harbours risks. Anyone seeking trust must not only talk about the expected or actual benefits of the activity in question: One also has to talk about the risks, whether they be the risks of the specific activity itself, the risks of applying the research results in a specific social environment or the risks of non-action.

On the process of the benefit-risk analysis

Every decision to do something and every activity offers quite specific benefits or opportunities. The price we have to pay for this is a quite specific set of risks. Benefits and risks cannot be separated from one another. No benefit is attained without the acceptance of risk. Absolute "safety" is always only an approximate condition and is not actually attainable. In striving to achieve the maximum possible safety, all precautions regarded as necessary have to be taken to reduce the risks of a given activity to an "acceptable" level. Scientists must learn to communicate about these things in a language that is understandable to the public at large.

27 On the contribution of Jürgen Habermas to the ethics of discourse, see also Habermas J.: Moralbewußtsein und kommunikatives Handeln. Suhrkamp Taschenbuch, 7. Auflage, Frankfurt am Main 1999; Habermas J.: Theorie des kommunikativen Handelns. 2 Bände, Suhrkamp, Frankfurt am Main 1981; Habermas J.: Erläuterungen zur Diskursethik, Suhrkamp, Frankfurt am Main 1991; and also Habermas J.: Faktizität und Geltung. Beiträge zur Diskurstheorie des Rechts und des demokratischen Rechtsstaats. Suhrkamp, Frankfurt am Main 1992; as well as Habermas J.: Die Einbeziehung des Anderen. Studien zur political Theorie. Suhrkamp, Frankfurt am Main 1999; on the debate surrounding this construct of ideas, see Harpes J.-P. / Kuhlmann W. (Ed.): Zur Relevanz der Diskursethik. Anwendungsprobleme der Diskursethik in Wirtschaft und Politik. LIT Verlag, Münster 1997.

But what are “necessary precautions” and what is an “acceptable” risk? We all determine this first and foremost for ourselves, because we do not perceive risks “objectively”. Our individual perceptions of risk are influenced in a very complex way by our personal value judgments, philosophies of life and experiences, as well as by our knowledge of specific risks. Between our subjective perception of risks (and benefits) and what is scientifically measurable there is often a vast difference. In the case of voluntary activities (e.g. smoking, drinking, driving, hang-gliding) most people are prepared to accept much higher risks than in situations in which they feel involuntarily exposed to a risk - and this includes e.g. the feared external effects of scientific activity.

Subjective risk assessment should not be dismissed as “unscientific” or the value judgments and perceptions expressed therein be brushed aside as irrational. It neither creates trust nor serves a better public understanding of risk to suggest that scientific understanding is exclusively correct and everything else emotional or ideologically prejudiced. There are no “right” or “wrong” value judgments or moral views.

Ever more precise answers to the wrong questions

The problem of social acceptance often lies not in the question whether scientific assessments are more correct or better in their reasoning than subjective risk judgments by lay persons. What is important is their difference. Disputes or differences of opinion about risks do not go away when statistical evidence is presented by the experts in ever greater precision – e.g. the famous *parts per billion*. When conflicts remain over values, arguments “…which are built on the expert logic of economics or science often have no force.” *28* This makes many of today’s efforts by science and the research-based industry into a fruitless attempt to use ever more complex methods to provide ever more precise answers to the wrong questions. *29*

Recent years have seen the increasing importance of a further element with a negative impact on confidence: science has become ever more expensive and thus ever more influenced by those with the necessary muscle – i.e. financial resources. For refinancing purposes they in turn have been seeking to find profitable applications for their findings in technology and ways of ultilizing them according to economic criteria. But financial muscle and profit-minded giants do not exactly enjoy unstinting confidence in terms of their contribution for the benefit of society. *30*

Communicative action with the aim of building confidence has huge hurdles to overcome where divergent value judgments persist: People see and find only what they are looking for. This was described as follows many decades ago by Karl Popper with his “searchlight theory” of science:

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28 See Busch R.J. et al: Grüne Gentechnik. Ein Bewertungsmodell. Herbert Utz Verlag, Munich 2002 p.13. This is also illustrated e.g. by the fact that the National Center for Food and Agriculture Policy (NCFAP), based on 40 case studies, informed the public that the use of gene technology and biotechnology has led to higher yields, lower production costs and less use of pesticides. Washington D.C., June 2002

29 The fact that leading scientists consider genetically modified food or plant varieties to be as safe as those produced through conventional research has been of little use to getting “green” gene technology accepted. See AgraFoodBiotech, No.57, June 12, 2001, as well as Australia New Zealand Food Authority (ANZFA) Draft Risk Analysis report. Application A362 Food derived from glyphosate-tolerant corn line GA21, Canberra 2000:

30 See the survey by Environics: The Millenium Poll, New York 1999; and also ORI: Annual Business & Environment Study, London 2000.

> "The situation can best be described by comparison with a searchlight…. What the searchlight makes visible will depend on its position, our way of directing it, and its intensity, color, and so on. It will, of course, also depend very largely on the things illuminated by it. Similarly, a scientific description will depend largely on our point of view and our interests, which as a rule are connected with the theory or hypothesis we wish to test. It will also depend on the facts described. No theory is final, and every theory helps us to select and order facts." *31*

Where divergent value judgments persist, those arguments which agree with the *a priori* perceptions will be accepted as reliable and representative. Evidence which is not consistent with these perceptions is rejected as unreliable, representing particular interests and thus unconvincing. Measurements may be objective; but he assessment of measurements is always subjective. However justified it may be, scientific fact-based knowledge is not a holistic sense-based knowledge. To be successful, communicative behaviour must take this into account.

If intelligence is seen as a "moral category" *32* and duty as subject to the responsibility ethic as defined by Max Weber *33* in all actions or omissions which have consequences for other people, then it is essential that communication and discussion take place over the respective scientific "garden fences" and the public is included in these discussions. This makes the general comprehensibility of communication about science an important success factor.

31 Popper K.: Die Offene Gesellschaft und Ihre Feinde. Francke / UTB, 6te Auflage Tübingen 1980, p. 322.

32 Cf Adorno Th: Minima Moralia. Reflexionen aus dem beschädigten Leben. Suhrkamp Verlag, Frankfurt a.M. 1989, p.262.

33 See the essay by Weber M.: Politik als Beruf. In: Gesammelte Schriften, UTB, 5te Auflage Tübingen 1988, p. 551 et seq., which is as worth reading as ever

Be lucid if you want to be understood

"Scientific language" is often poorly suited to building confidence among people who do not understand the language. In terms of scientific theory the language should be clear in its expressions, methodologically controlled and free of ambiguities. For the lay person, the problem lies in the fact the key terms of scientific jargon are not part of everyday language, but are part of a highly specialized form of communication which differs fundamentally from colloquial language and its terms. It is virtually impossible to avoid science being incomprehensible in a sense, because it is occupied with things "… which are not accessible to the non-scientific mind in the same way they are to the scientific mind, at least not without lengthy courses of study." *34*

Nevertheless, it is not simply translation that is necessary here, but also less arrogance. Many years ago, when I was working in the National Science Foundation, I requested that 10 percent of research funds should be spent on translating results into a language that was comprehensible to lay people – at least the interested ones. The science pages of the large daily newspapers show that even highly complex facts can be expressed in a language that enlightened people can understand. And as far as the arrogance is concerned: Anyone who speaks to a lay public about the first trimester of gestation when he means the first three months of pregnancy should not be surprised if the concentration of the audience flags. The demand of Otfried Höffes that, in view of the major importance of science in many spheres of modern life, scientists should use a language that is understood not just by their colleagues but also by the public is as relevant as ever. Even then, not every research contribution will be readable for all, but it would no doubt enable important results and scientific controversies to be communicated to the lay public via suitable media. *35*

"Science – society" - dialogue as process not as project

Dealing with the problems outlined here remains a stony uphill path because, for science, largely the same principle applies as was once expressed on the subject of "progress" by the great German theologian Helmut Gollwitzer: Scientific progress, he wrote, is "...nothing other than a constant struggle to reap the benefit of its positive sides, a co-existence of the hazards which accompany them, and an overcoming of the losses which it causes." *36* What these "positive sides" – i.e. the benefits – or the "hazards" and "losses" are in concrete terms, however, is open to dispute, because the value of a certain effect of scientific and technical progress is a "second-order reality" *37* and rests exclusively on the meaning and value attributed to things. Depending on how the value of something gained or lost through scientific progress is assessed in the view of the individual, the level of benefit or risk associated with the loss will vary.

Recent years have seen a moralization of the scientific debate on both sides of the discourse. It is essential to counteract the trend towards moralizing fact-based issues, since

34 Mittelstraß J.: Wissenschaftskommunikation: Woran scheitert sie? In: Spektrum der Wissenschaft, August 2001, p.88 et seq.
35 Höffe O.: Wissenschaftsethik. In: Höffe O. (Ed.): Lexikon der Ethik. Beck´sche Reihe, Munich 5te überarbeitete und erweiterte Auflage 1997, p.344.
36 Gollwitzer H.: Krummes Holz - Aufrechter Gang .Zur Frage nach dem Sinn des Lebens. Chr. Kaiser, Munich 1970, p. 142.

> "From that moment on when the use of technology is defined as a moral issue, it is possible to join in the discussion without any detailed knowledge on the function and effects of a given technology. It is sufficient that fundamentally negative effects are possible and thus subject to moral categories. [...] But if positions on a technology are equated with moral positions, [...] there is no longer any discussion on the appropriateness of a technology, but only on the moral judgments of its advocates or opponents." *38*

Where conflicts over fact-based issues are made into questions of belief in this way, it is almost impossible to reach a mutually agreed solution. Under these conditions, scientific debates become conflicts of prestige on how people see themselves and the world and thus debates about the meaningfulness behind the structures of human coexistence within a society and about interpretations of reality that confer meaning.

The history of progress shows that scientific discoveries, especially when they represent paradigm shifts (e.g. the discoveries made by Galileo or Charles Darwin) can at least temporarily encounter a dramatic rejection. Ultimately every society has to decide for itself what risks it accepts or expects of itself. Since different individuals see things so differently, it does not only require information here, but also dialogue to foster mutual understanding. To reduce the steepness of the gradient in different risk assessments, a "long deep breath" is needed, with all parties taking each other seriously and making a constructive effort. Trust and confidence emerge under positive conditions as a consequence of sustained communication, only then can an objectification of the risk discussion be achieved. Only then will people also be receptive to arguments with which risks can be relativized and made acceptable: the benefit dimension of scientific action.

Tangible results with a discernibly positive benefit-risk ratio create public trust.

The third precondition for public trust and confidence is precisely this benefit dimension. People generally are only willing to run risks if the benefit to be expected appears to justify this. If one looks at the results of science over the last 200 years, it becomes clear how much science has contributed to the liberation of people from external constraints and archaic restrictions. The importance of science for modern human life becomes even clearer when we realize what in the way of new results has become available over the last 10 to 15 years for coping with problems. If scientific work had been stopped in 1990 because of a lack of acceptance by society, there would not be an HIV/AIDS test and quite generally the PCR tests (polymerase chain reaction tests) for infectious diseases, which have led to enormous improvements in the safety of blood and organ donations; there would also be no

- medicines to help preserve the lives of people infected with HIV; (since the introduction of combination therapy for AIDS, the incidence of deaths from this disease in the USA has fallen by 80 percent.) and also
- Glivec®, the first causal treatment of leukaemia would not be available and no

37 For a distinction between first-order and second-order reality, see Watzlawick P.: Wie wirklich ist die Wirklichkeit? Piper 17. Auflage, Minich 1989.
38 See Roeglin H.-C./von Grebmer K.: Pharma-Industrie und Öffentlichkeit, Basler Zeitungs-Verlag, Basel 1988, p. 60 et seq.

- medicines that help to substantially reduce the suffering of patients with MS and Parkinson's disease.
- Also the World Wide Web – which is becoming more and more the most important and easily accessible source of information in the world – was only discovered in 1990 by Tim Berners-Lee.

For people who suffered a heart attack in 1980 the risk of dying was three time higher than it is today – an improvement made possible thanks to medicines which have been discovered and developed in the intervening years. *39* Not until 1980 did hepatitis B vaccine become available, and not until 1980 did the world witness that inventive leap that led to information technology as we know it today. *40*

Also the many different benefits which have emerged from biotechnology in the last few years for agriculture in developing countries would not have happened.[41]

Confidence building also means establishing context

Science does not take place in a vacuum. The need for future scientific discoveries can best be judged in the context of the social, political, economic or other developments to be expected and the resulting *research needs*. If scientific work today had to be stopped due to lack of acceptance by society and Europe were to follow the static development of the United States in Alzheimer's disease, then half of all people over the age of 85 in our societies would be in nursing homes in 50 years' time, on the assumption that life expectancy continues to increase. This would then be the greatest cost factor in healthcare and would have to be financed to the detriment of other social services.

A further example is the development of the world population compared with the natural resources needed to feed the population: *42* Already over 800 million people are starving and 170 million children aged under 5 years are suffering from clinically relevant undernourishment. *43* By the year 2050, the world population will have increased by about three billion to more than nine billion people. *44* Over the same period, the land resources available will decline as a result of erosion, overbuilding and overuse, and what remains will be less fertile. *45* Water resources, too, will decline, and what remains for agricultural use will be substantially less and much more contaminated. Most estimates with regard to the effects of global warming suggest considerable climatic risks for those developing countries which are already having problems supplying their

39 In 1980, about 300,000 died in the USA as a result of heart problems - in 2000, the figure was 100,000.

40 This is a subjective selection; due to individual preferences, inventions such as Tamagochi, Viagra or Apple MacIntosh may be more important for other observers.

41 See e.g. Persley G.J. / MacIntyre L.R. (Eds.): Agricultural Biotechnlogy: Country Case Studies - A Decade of Development. CABI Publishing 2002.

42 See Leisinger K.M. / Schmitt K. / Pandya-Lorch R.: Six Billion and Counting. Population Growth and Food Security in the 21st century. Johns Hopkins University Press / IFPRI, Baltimore / Washington D.C. 2002; (Translations into Chinese, German and Portuguese).

43 International Food Policy Research Institute: Sustainable Food Security for All by 2020. Washington D.C. 2002, see also CASIN /SAA/GLOBAL 2000: Food Security in a Changing Africa, Geneva 2002.

44 According to data from the Population Reference Bureau , see also

people with food. Added to which, growths in yield have been declining for years with most crops. Although it is correct to say that political and social reforms as well as economic improvements are needed to reduce hunger, against this background it is easier to consider the benefit-ratio for example of "green" gene technology. *46* Against the background of future developments, the risks of *non-action* must also be considered.

In 1957, Carl Friedrich von Weizsäcker pointed out that "if humanity today wanted to forego technology and the planning that went with it", it must be ready and capable of "decimating the population of the world" *47*. This statement was referring at the time to a population of two and a half billion, who were only alive thanks to industry, transport and intensive farming – in short, thanks to science and technology. In the meantime, the population has grown to six billion, the poor countries with high birth rates being in the southern hemisphere. They represent four-fifths of the world population, and more than half of them live on a per capita income of less than two dollars a day. Here in particular, qualitative economic growth and social development are needed if the greatest problems for the whole planet are to be avoided. But this will not be feasible without science and the resulting new technologies.

Science and public trust

Trust can, like the biblical manna, work wonders, but unlike manna it does not fall from heaven through divine intervention. Trust and confidence, i.e. a safe expectation and firm belief that one can rely on something or someone, that rules will be observed and discretionary scope not misused, cannot be bought. It is bestowed as a gift. If "science" as a social system of activity or a specific scientific institution enjoys the trust and confidence of the public, this is generally the fruit of many years' laborious effort. This trust is an extremely delicate plant – a single case of flagrant misconduct can lead it to being withdrawn overnight. Repeated abuses of trust lead in every case to mistrust. And no partnership, no society can be built on mistrust.
Also trust and confidence in those who have the task of managing risk are essential. Unlike in former times, however, these are no longer only government authorities – such as environmental agencies, drug regulatory authorities or others – but also the media, Non-Governmental Organizations, consumer associations, and all other major stakeholders in the specific context. Open and institutionalized dialogue in conflict-free times creates the trust which is needed in times when conflicts have to be resolved. Such dialogue also establishes an early-warning system on changes taking place in the opinions of society within the general political environment.

Trust, if it is to be robust and capable of withstanding challenges, is always a trust in reciprocity. Where people trust each other, communication works more smoothly, they grant each other the benefit of the doubt, and control is perceived as a constructive means of enhancing quality. This increases the effectiveness of individual and societal activity. Asymmetries in the allocation of resources are at least partly offset by the reciprocity of trust, because mutual obligations may be perceived and expected.

45 Tilman D. et al: Forecasting Agriculturally Driven Global Environmental Change. In Science, Vol.292, 13 April 2001, p.281-84;
46 See Huang J. / Pray C. / Rozelle S.: Enhancing the crops to feed the poor. In: NATURE, Vol. 418, 8 August 2002, p.678 et seq., also the whole issue of RIS (Ed.): Asian Biotechnology and Development Review, New Delhi, May 2002
47 Von Weizsäcker C.F.: Die Verantwortung der scienceim Atomzeitalter(1957) Kleine Vandenhoeck-Reihe, 7. Auflage, Göttingen 1986.

Making scientists into ambassadors for science

In modern societies, establishing confidence in one's own actions is the most important prerequisite for sustainable success. Not only because political and regulatory obstacles to institutions that one mistrusts eventually grow and impede success, but also because without broad trust and confidence there would be no political support for certain activities - and this also has financial consequences. For this reason, all those who devote their work to science are under an obligation to engage in *PR work* for their field, whether this be through their own example of intellectual honesty and practical shrewdness and also, if necessary, civil courage. Appeals to the public that they should believe in the hopeful promises they are offered will only be heard by the very few, namely those who are already convinced.

Here, as elsewhere, a return to questions of faith will only satisfy the faithful - Heinar Kipphart in his documentary drama "In the Matter of J. Robert Oppenheimer" has the father of the hydrogen bomb, Edward Teller, say that discoveries are "… neither good nor evil, neither moral nor immoral, but are just facts. One can use them or misuse them. The combustion engine just like atomic energy. In the course of painful developments, people have always eventually learned to use them." *48* The basic capacity for both Good and Evil is inherent in all aspects of human activity – and this includes science. The fundamental ambivalence is therefore not scientific or technological, it remains the ambivalence of morality. Ultimately this can only be reflected upon in terms of ethics.

48 Kipphart H.: In Sachen J. Robert Oppenheimer Ein szenischen Bericht. Suhrkamp Verlag, Frankfurt 1964, S.91