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Petra Lehmann / Volker Rother

A Hippocratic Oath for Natural Scientists and Engineers ?

Problems of individual and institutional responsibility

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Foreword

That scientists should bear responsibility for the consequences of their work was one of the motives leading to the establishment of the Berghof Foundation for Conflict Research. Understandably, the same applies to those who sponsor research. It is in this sense that the present paper was drawn up.

Prof. Dr. Georg Zundel

This paper was written in preparation for the International Congress "Challenges - Science and Peace in a Rapidly Changing Environment". The elaboration of the working paper was sponsored by the Berghof Foundation for Conflict Research.

Abstract

The disastrous consequences of the explosion of the atomic bombs over Hiroshima and Nagasaki evoked a discussion about co-responsibility for scientific research and development among natural scientists and engineers. The attempts to prevent the use of knowledge or developments for arms production by means of voluntarily-assumed obligations - analogously to the Hippocratic oath for doctors - is one possibility of assuming responsibility.

Besides the concept of individual ethics of responsibility, various possibilities of the institutionalisation of responsibility are evaluated. Among these are the concept of "concerted technology assessment", the concept of institutional and corporative responsibility and the proposal to establish "science courts".

1. The Problem

At the latest since the explosion of atomic bombs over Hiroshima and Nagasaki, mankind has been drastically aware that modern technologies can not only be life-enhancing; they also make possible the destruction of all life. Negative effects do not result alone from weapon systems: they may also occur in well-meant developments for the benefit of humankind, through cumulative effects or through the synergetic interaction of various factors.[1] In view of this, the natural scientist and technologist can no longer evade the question as to his[2] co-responsibility for the consequences of his discoveries and developments. These considerations have given rise to attempts to develop a hippocratic oath for natural scientists and engineers as an expression of an individual ethics of responsibility. Proponents of an oath intend that natural scientists and technologists should, through a self-imposed commitment, as far as possible prevent their knowledge and their developments from being used in weapons research and production. Beside the individual assumption of responsibility we shall also discuss the concept of institutional direction and control of technology using the example of genetic engineering.

A hippocratic oath is, however, only meaningful if one can basically affirm that such an individual responsibility of technologists and natural scientists exists. But can an individual be held responsible in view of the complexity of research and development processes and their ambivalence with respect to the civilian-military distinction? Are all responsible, as Weizenbaum suggests?[3] What is the responsibility borne by the natural scientist as the discoverer of a truth; what is the responsibility of a technologist who places the scientific discovery at the disposal of society? Is a scientist responsible only for knowledge, for its development and exposition, but not for the consequences that may result from it? In other words: Does society alone bear sole responsibility for the use made of a specific piece of knowledge, or is a co-responsibility to be demanded of scientists and technologists?

These questions must be answered in order to be able to explore the desirability of a hippocratic oath for natural and technical scientists. But the discourse on responsibility is also necessary if the thesis on the ambivalence of all scientific research and development is not to lead to an assertion of the "collective innocence" (Hammer) of scientists, technologists, politicians, etc. Nevertheless, given the extreme complexity of the research and development process, it is not meaningful to ascribe responsibility only to those scientists and technologists that work in areas directly related with arms production. Rather, a normative discourse on an individual ethics of responsibility in science and technology in general must be held. The analysis must distinguish - in particular with respect to options for action - between natural scientists and technologists, and between basic research at the universities and researchers and engineers employed in industry.

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1 Cf. Lenk, H., "Mitverantwortung ist anteilig zu tragen - auch in der Wissenschaft", in: Baumgartner, H.M./Staudinger, H. (eds.) *Entmoralisierung der Wissenschaft?* (Ethik der Wissenschaft, vol. 2) (Munich etc., 1985), p. 102

2 The masculine form should be taken throughout to include female scientists and engineers.

3 Weizenbaum, J., *Die Macht der Computer und die Ohnmacht der Vernunft* (Frankfurt, 1977), p. 349

2. The discourse of responsibility

It will first be necessary to define the concept of responsibility.[4] Concepts of responsibility are concepts about relations: "A person is responsible towards someone, for something, before an authority, with respect to standards and a norm system. Thus "responsibility" is a concept referring to at least a five-way relation - and moral responsibility is merely a special form."[5]

Lenk refers here to the need for an analytical distinction between different types and dimensions of responsibility;[6] it should be observed that it is precisely from their overlapping that conflicts of responsibility arise in practice.[7] The engineer or natural scientist is to bear responsibility for the common good, but is also simultaneously bound to a role responsibility towards his employer or his client, must give attention to the maintenance of group standards and/or is also committed to his own career interests and/or responsibility for the family.

2.1. The internal and external responsibility of natural scientists and technologists

As a contribution to clarifying and distinguishing the terms, an analytical distinction between "internal" and "external" responsibility of natural scientists and technologists will first be made.[8]

Internal responsibility is borne by natural scientists and technologists with respect to the requirements and rules of technical and scientific work. The scientific and technical virtues include truthfulness, objectivity, tolerance, disciplined scepticism and selfless dedication to the goal set as well as observation of the basic principle of generalisation.[9] One may supplement this list by drawing attention to the need for openness and publicity in science.[10] Internal responsibility thus reflects an internal normative code of the "guild" or the regulations of natural scientists and technologists; thus, it is an expression of a professional ethos.

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4 On this, see Luck, W., *Homo investigans. Der soziale Wissenschaftler* (Darmstadt, 1976), p. 206. For definitions of other relevant concepts, see Albrecht, U., "Rüstungsdynamik und technologische Entwicklung", in: Heisenberg, W./Lutz, D. (eds.), *Sicherheitspolitik kontrovers. Neue Waffentechnologien. Politische und militärische Modelle der Sicherheit* (Bonn, 1990), p. 45 (for a definition of "technology"); Schaper, A.: *Die Rolle von Forschung und Entwicklung in der Rüstungsdynamik*; Schaper, A., *Die Begrenzung rüstungsrelevanter Forschung und Entwicklung.* Both as IANUS-Arbeitspapier 8/1989 (Darmstadt, 1989) (for a definition of "arms dynamics")

5 Lenk, H., "Zu einer praxisnahen Ethik der Verantwortung", in: Lenk, H.(ed.), *Wissenschaft und Ethik* (Stuttgart, 1991), pp. 61-64. Subdivision of concepts of responsibility in four dimensions and levels: 1. responsibility for actions (results); 2. responsibility for duties and roles; 3. universal moral responsibility; 4. legal responsibility.

6 See Lenk, H., "Zu einer praxisnahen Ethik", pp. 61-64; Lenk, H., "Über Verantwortungsbegriffe und das Verantwortungsproblem in der Technik", in: Lenk, H./Ropohl, G.(eds.), *Technik und Ethik* (Stuttgart, 1987), p. 115-125. Lenk, H., "Ethikkodizes für Ingenieure. Beispiele der US-Ingenieurvereinigungen" in: ibid., pp. 198-204, uses specific examples to discuss the different types of responsibility.

7 Cf. Lenk, H., "Zu einer praxisnahen Ethik", p. 61

8 Cf. Lenk, H., "Zu einer praxisnahen Ethik", p. 56 passim, p. 70 passim

9 Cf. on this Mohr, H., "Homo investigans und die Ethik der Wissenschaft" in: Lenk, H. (ed.) *Wissenschaft und Ethik*, pp. 79-83. On the basis of the norms governing the scientific ethos, Mohr draws up behavioural guidelines. A discussion of these is to be found in Lenk, H., "Über Verantwortungsbegriffe und das Verantwortungsproblem der Technik", p. 136, FN 1, and Lenk, H., "Ethikkodizes für Ingenieure", p. 56 passim.

10 See Rotblat, J., *Societal Verification* (paper presented to the Pugwash Symposium, Turin, March 1991, unpublished MS; see appendix). See also Rilling, R., "Militärische Wissenschaftspolitik und Geheimhaltung in den USA seit

External responsibility, on the other hand, is borne by the natural scientist or technologist with respect to the non-injury of third persons, in other words, for the good of society. Here we can speak of ethics or universal morality. It is important to apply the distinction made by Max Weber between the ethics of conviction and the ethics of responsibility. For the specific characteristic of an action governed by the ethics of responsibility is that the consequences of the action serve as an orientation; it is not sufficient that the intention should have been "good".[11]

2.2. The responsibility of the natural scientist

The professional ethos of the scientific community is respected and breaches are severely sanctioned; here, a general consensus exists. The issue of an external responsibility of natural scientists and/or of their institutions[12] (or the question whether a scientist or technologist may or indeed must pursue societal policy goals in his or her actions)[13], on the other hand, has been the subject of a controversial discussion, the main aspects of which will briefly be presented here.[14]

On the one hand it is argued that science, as a contemplative investigation of the laws of nature, is by definition value-free. Thus, science has no ethical or moral quality; in other words, it is morally neutral. Therefore, a natural scientist cannot be made responsible for the possibly negative consequences of his knowledge. Responsibility lies exclusively with society[15] (whereby it is omitted to observe that the scientist is also a part of society and as such shares the obligations common to all its members). As Edward Teller has put it, the scientist is responsible only for knowledge and its development and explanation, but not for the use to which that knowledge is put.[16]

Proponents of the contrary position argue that there must be limitations or special responsibilities for natural scientists involved in areas of research in which the risks to humankind are especially great. "The scientist cannot simply wash his hands in innocence if he discovers something that could be catastrophic for humanity".[17] Should one therefore adopt the idea of a "voluntary

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Anfang der 80er Jahre", in: Bechmann, G./Rammert, W., *Technik und Gesellschaft*, Yearbook 4 (Frankfurt/New York, 1987), p. 233 passim

11 Cf. Weber, M., Politik als Beruf, in: *Gesammelte Politische Schriften* (Munich, 1921), pp. 396-450.

12 Cf. Maring, M., "Institutionelle und korporative Verantwortung in der Wissenschaft", in: Lenk, H. (ed.), Wissenschaft und Ethik, pp. 135-150

13 As one example among many of the societal policy commitment of natural scientists see Dürr, H.-P., "Gesellschaftliche Verantwortung in der Praxis. Erfahrungen eines Mitglieds der Max-Planck-Gesellschaft", in: Füllgraf, G./Falter, A. (eds.), *Wissenschaft in der Verantwortung* (Frankfurt & New York, 1990), pp. 97-104

14 See also Rotblat, J., "Dilemmas for scientists with a social conscience", in: *Global Problems and Security, Proceedings of the Thirty-eighth Pugwash Conference on Science and World Affairs*, Dagomys, USSR, 29th August-3rd September 1988, p. 106 passim

15 Cf. Lenk, H., "Zu einer praxisnahen Ethik", p. 58; see also Altmann, J., "'Star Wars' und die Verantwortung der Wissenschaftler. Eindrücke aus den USA", in: Guha, A./Papcke, S. (eds.), *Entfesselte Forschung. Die Folgen einer Wissenschaft ohne Verantwortung* (Frankfurt, 1987), p. 52

16 See Lenk, H., "Moralische Herausforderung der Wissenschaft", in: Lenk, H., (ed.), *Wissenschaft und Ethik*, p. 9

17 Lenk, H., "Zu einer praxisnahen Ethik", p. 58; see also Wille, J., "Wissenschaft im Gen-Rausch", in: Guha, A./Papcke, S. (eds.), *Entfesselte Forschung*, p. 120 passim. Wille recalls in this article the conference that took place in Asilomar (California) in 1975. At this conference, 140 scientists discussed the potential dangers of DNA-recombination technologies and forms of voluntary control for researchers. A consensus was reached in favour of minimum safety standards at work; voluntary termination of research in the case of experiments regarded as

limitation on curiosity" for researchers, or the notion of a "hippocratic oath" for natural scientists and technologists? [18] That science is per se and "in the person of its servants" morally neutral, is a view that Jonas regards as "plausible, but too simple. The qualms of conscience of the atomic researchers after Hiroshima are an indication of this."[19]

Can natural scientists keep aloof from debates on responsibility; can they deny their co-responsibility (e.g. for the use of their knowledge in arms production), by alleging that they merely research pure theory?[20] The answer may be found by looking at the present-day research process. Is a distinction between basic research and technological application still possible?

Jonas characterises the relationship between "pure theory" and practice on the basis of the following four points: [21]

1. Science today lives to a high degree from intellectual feedback, a feedback it receives precisely from the technological applications to which it is put. [22]

2. The problem of commissioned research. Scientists receive commissions to carry out research; these commissions determine the areas of in which research is carried out and the problems to be solved.

3. The inter-relations between science and technology. Science uses advanced technology for the solution of problems and in general for its own further development. "In this sense, even the purest science shares the profits of technology, as technology shares those of science."[23]

4. The inter-relations between the financing and the use of research. The economic components of science are borne by the public purse or by sponsors, who have for their part, even if not expressly, expectations about the practical uses to which the research can be put. Thus it is frequently the case that an application for financial support emphasises the use of that which is to be researched. Papcke speaks in this connection of the "dictate of usefulness".[24]

Science is thus no longer art for art's sake, but is increasingly entering into interaction with extra-scientific areas; the distinction between theory and practice becomes blurred. To illustrate this tendency, two examples from modern science may be cited. Bayertz sees as a characteristic of modern science "that the knowledge it creates is in principle technologically usable." This means,

especially dangerous was also recommended. Later these recommendations were included in the US Health Administration's binding guidelines for genetic engineering and related research.

18 Jonas, H., "Wissenschaft und Forschungsfreiheit" in: Lenk, (ed.), *Wissenschaft und Ethik*, p. 214; Hammer, F., *Selbstzensur für Forscher? Schwerpunkte einer Wissenschaftsethik* (Zurich, 1983), p. 99

19 Jonas, H., "Wissenschaft und Forschungsfreiheit", p. 201

20 See Lenk, H., "Moralische Herausforderung der Wissenschaft", p. 10

21 See Jonas, H., "Wissenschaft und Forschungsfreiheit", p. 202 passim

22 See also on this Papcke, S., "Ethische Verantwortung der Naturwissenschaften", in: Guha, A./Papcke S., (eds.), *Entfesselte Forschung*, p. 20

23 Jonas, H., "Wissenschaft und Forschungsfreiheit", p. 202

24 Papcke, S., "Ethische Verantwortung der Naturwissenschaften", p. 20; see also Altmann, J., "'Star Wars' und die Verantwortung der Wissenschaftler", in the same volume, p. 45; and Eigen, M., "Wir müssen wissen, wir werden wissen", in: Lenk, H. (ed.), *Wissenschaft und Ethik*, p. 33

for example, that a merger is taking place between biological sciences and biotechnology. Thus, on the one hand advances in scientific knowledge in the field of molecular genetics are immediately related to the development of technical processes. At the same time, new discoveries can immediately be used in industrial technology.[25] "A decoupling of the development in basic research from applied biology is not possible (...) in principle it may be asserted that whoever says yes to basic research also accepts the potential biotechnological application."[26]

In modern physics, too, one may observe, beside the interlinking of basic research and technology[27], an increasing interconnection of research and technology for civil and military purposes.[28] Thus, the US physicist E.L. Woollett criticises the interlinkage of discoveries in physics with military requirements, to be found in five areas. First, the most obvious contribution to arms research and development takes place through the cooperation of physics research in the solution of problems directly related to the improvement of military abilities.[29] Secondly, physics participates with research on potentially break-through ideas in areas that are two or three steps distant from military technology. Thirdly, there is the activity of physicists in advisory bodies that provide scientific assessment to the US Department of Defense (DoD) and to the President. Fourthly, there is the teaching of natural sciences to students, in particular in those areas regarded as relevant by the DoD. But also, and finally, - and this must be emphasised -, theoretical physicists, even those working in fields not directly related with arms research and development (for example astrophysics), make a contribution to the waging of war: "The ingenious experiment often involves a breakthrough in technology applied in the interest of pure science. The basic ideas expressed by this technological state of the art, and the specific techniques, are transferable not only to areas of applied physics relevant to military needs, but in some cases can form the basis of new elements in weapon systems directly."[30]

Woollett's provocative conclusion is this: "In summary we can say that a member of the physics enterprise can minimize his possible contributions to military needs by either not teaching or

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25 Cf. Bayertz, K., "Wissenschaft als moralisches Problem. Die ethische Besonderheit der Biowissenschaften", in: Lenk, H. (ed.), *Wissenschaft und Ethik*, p. 297

26 P.H. Hoffschneider, quoted in Bayertz, K. (see FN 24), p. 297, FN 16; on the specific problems of modern biological technologies see Part 4 of this paper

27 Cf. Bundesminister für Forschung und Technologie (ed.), *Bundesbericht Forschung 1984*, Deutscher Bundestag, Drucksache 10/1543, Bonn 1984, p. 21 passim

28 See on this Rilling, R., "Konsequenzen der 'Strategic Defense Initiative' für die Forschungspolitik", *Blätter für deutsche und internationale Politik*, 6/1985, p. 672 passim, where further bibliography is also to be found; Altmann, J., "Naturwissenschaftler brauchen ein 'fundiertes Gewissen'", *Blätter für deutsche und internationale Politik*, 6/1983, p. 804 passim, with examples of a possible military use of new technological developments and further bibliography; Albrecht, U., "Rüstungsdynamik und technologische Entwicklung", p. 44 passim. Albrecht argues that in 'emerging technologies', the distinction between the civil and the military sphere is dissolved. "To categorise them according to whether they are financed out of civil or military budgets would be superficial."

29 See on this Woollett, E.L., "Physics and modern warfare: the awkward silence", *American Journal of Physics*, Vol. 48, Nr. 2 (Feb 1980), p. 106, FN 27: "Of the world's physical and engineering scientists who work in research and development, more than half work full-time on military R&D."

30 Woollett, E.L., "Physics and modern warfare", p. 106; see also Altmann, J., "Naturwissenschaftler brauchen ein 'fundiertes Gewissen'", p. 809

teaching poorly, and either not doing research or by doing research unrelated to winning advances in basic or applied knowledge."[31]

Scientists involved in basic research employed in industry or by government should not be able to evade the question of the application to which their scientific results are put. But in contrast to their colleagues at universities, they are subject not only to the ethos of the scientific community; rather, they also bear a special internal responsibility (role responsibility) towards the employer and the client. A typical conflict of responsibility is discernable here; the dilemma of the natural scientist and technologist between his responsibility towards his employer, his own career interests, and his responsibility for the common good. Such a conflict arises, for example, when the obligation to treat specific research projects or results with secrecy as demanded by the employer or the government (whereby it is irrelevant whether such projects or results are intended to serve civil or military purposes) confronts the responsibility to publish, demanded by the professional ethos of the scientific community and by the ethical responsibility of scientists for the common good.[32]

It must further be taken into consideration that scientists and technologists - here too because of the employer-employee relationship - are subject to greater pressure to observe internal group standards (e.g. not to criticise a colleague in public[33]) - than are scientists working at universities, who undoubtedly dispose of greater internal freedom of manoeuvre and thus also wider possibilities of action.

The above-mentioned problem of the secrecy of scientific R&D processes and results, justified by reference to alleged "objective compulsions"[34] of military or weapons policy, will increasingly become relevant for natural scientists at the universities in the Federal Republic of Germany. This assertion is based on the observation that (military) technology in numerous fields results directly from basic research[35] , and some 70-80% of basic research in the Federal Republic is conducted at the universities.[36] Furthermore, as the Community of the Ten observed in 1983, "the new technologies of the present generation of weapons are largely the result of research efforts aimed at the satisfaction of civil needs."[37]

The object here is not to offer a forecast or analysis for government research policy; rather, the intention is simply to draw attention to the urgency of a debate on the individual ethics of

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31 Woollett, E.L., "Physics and modern warfare", p. 106

32 Examples of role conflicts experienced by engineers may be found in Lenk, H., "Ethikkodizes für Ingenieure",p p. 194-221

33 See Dürr, H.P., "Gesellschaftliche Verantwortung in der Praxis", p. 100 passim

34 See Rilling, R.,"Militärische Wissenschaftspolitik und Geheimhaltung in den USA seit Anfang der 80er Jahre"; Schaper, A., *Die Rolle von Forschung und Entwicklung in der Rüstungsdynamik*, discusses the background to and motives of research and development relevant to weapons production.

35 Bundesminister für Forschung und Technologie (ed.), *Bundesbericht Forschung 1984*, p. 21 passim

36 Rilling, R., "Konsequenzen der 'Strategic Defense Initiative'", p. 683

37 Answer of the Community of the Ten to the Secretary-General of the United Nations, October 1983, unpublished MS, quoted after Albrecht, U., "Rüstungsdynamik und technologische Entwicklung", p. 45

responsibility of natural scientists (and the possibilities of institutional control) - also, or indeed especially, of those natural scientists working at universities.[38]

Besides the technical colleges in Baden-Württemberg[39] the University of Hanover has also addressed itself to the problem of scientific ethics. The Senate of the University passed a motion approving the foundation of a "Central Unit on Scientific Theory and Scientific Ethics"; from 1993 onwards, this is to organise an interdisciplinary dialogue, inter alia to assess and evaluate the consequences of research, in particular research in the natural and technical sciences.[40] At other universities, too, the issue of the civil-military ambivalence of research has been controversially discussed, in part as a consequence of the debate on the use of German weapons in the Gulf War. An example is offered by the Technical University of Brunswick; according to press reports, the Economics Minister of Lower Saxony, Helga Schuchardt, requested the Lower Saxony universities to provide information on a possible military use of their grounds, buildings, equipment and personnel. Her request was rejected by the President of the Technical University of Brunswick on the ground that the "basic right to freedom of research ..." also included "the freedom to carry out research with military ends in the service of the national defence", "even though a decision of conscience founded on principles of ethical research may lead individual researchers to a welcome abstinence in this field".[41] At the University of Tübingen a majority was not forthcoming for a proposed ethical code; the Physics Faculty of the Technical University Berlin, on the other hand, reasserted its decision not to support any project serving proven military ends; in the future as in the past there will thus be no limitations on the publication of research results from this faculty.[42]

What are the consequences of all this for the issue of scientists' responsibility? The borderline between "contemplative" science and its application no longer exists, so that, as Jonas writes, "the time-honoured alibi of pure theory no longer exists, and gone with it is the moral immunity it provided."[43] And - a further consequence: civil research and development can also be used to military ends, so that to call for self-imposed obligations only with respect to military fields of research, or the recommendation not to accept employment in weapons laboratories, is too restricted an approach.[44]

2.3 The responsibility of the technologist

How does the question of responsibility pose itself to technologists who make the knowledge of natural scientists available to society? The existence and the rules of the technologists' professional ethos are not in general called into question (though it would be worthwhile to

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38 See press reports in: *Frankfurter Rundschau*, 7.3.1991; 9.3.1991; and 11.9.1991; *Der Tagesspiegel*, 12.4.1991; *Die Welt*, 27.8.1991

39 See *Unikum*, vol. 9, Nr. 11 (Nov.1991), p. 42

40 *Die Welt*, 27.8.1991

41 *Frankfurter Rundschau*, 9.3.1991

42 *Frankfurter Rundschau*, 7.3.1991; *Der Tagesspiegel*, 12.4.1991; see appendix

43 Jonas, H., "Wissenschaft und Forschungsfreiheit", p. 201

44 Cf. Alpern, K., "Ingenieure als moralische Helden", in: Lenk, H./Ropohl, G. (eds.), *Technik und Ethik*, p. 191; Thring, M., *The engineer's conscience* (London, 1980), p. 232

subject them to a critical examination); but the question of the external responsibility of the technologist must be examined separately. In order to do this, it will be advisable to examine concepts of production-oriented and use-oriented responsibility, as well as the complexity of research and development processes and the civil-military ambivalence of science and technology.

Within the individual ethic of responsibility one must make a distinction between production-oriented and use-oriented concepts of responsibility. Ropohl draws attention to the fact that proponents of the production-oriented concept argue that the misuse of a product could not occur in the first place if the produced object had not given rise to the temptation. The entire responsibility for undesired consequences lies, in the final analysis, with the producer. The use-oriented concept of responsibility presupposes the neutrality of technology; the responsibility for the consequences of developed technologies is not within the sphere of influence of their "inventors" (C.F. v. Weizsäcker), so that the producer need not bear any responsibility for the consequences (for example, the scope of resources developed to, and the consequences of the application of weapons systems). According to this view, everything depends on how the user applies the technical product.[45] In this approach, engineers have acted and continue to act according to the technological imperative of finding practical applications for all theoretical knowledge.

Nevertheless, the debates on issues of responsibility within engineers' associations in the late 1960s and their embodiment in the form of ethical codes in the 1970s (according to the Mount Carmel Declaration[46], passed in Haifa in 1974, no aspect of technology is morally neutral) indicates that engineers reflected self-critically on their activities. Technology offered not only progress that could be life-enhancing; it also included the danger of the possibility of destroying all life. Weizenbaum is unequivocal on this point and will be quoted at some length here; he argues "that it is a prosaic truth that weapons and weapon systems that nowadays threaten everyone on earth, and furthermore through their development, production and sale impoverish all people of the world, even without being "ignited" (or "used" - what a word! as though the application of such instruments could have any benefit worthy of mankind!), (...) that these apparatuses could not have been developed in the first place without the serious - indeed enthusiastic - cooperation of information scientists and computer specialists (and specialists in other technical fields[47]). Without us it will not continue! Without us, the arms race - especially the qualitative arms race - cannot go marching on."[48]

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45 Ropohl, G., "Neue Wege, die Technik zu verantworten", in: Lenk, H./Ropohl, G. (eds.); *Technik und Ethik*, p. 158 passim

46 The Mount Carmel Declaration was issued at the close of an international symposium on ethics in an age of pervasive technology held in Israel in December 1974; it was signed by numerous world-famous philosophers and scientists.

47 The qualification in parentheses added by the author but also to be found elsewhere in Weizenbaum's writings

48 Weizenbaum, J., "'Künstliche Intelligenz' und Verantwortung der Wissenschaftler", *Blätter für deutsche und internationale Politik*, 12/1986, p. 1039. To Weizenbaum's "prosaic truth" one may add a mention of the interaction of technology and politics; on this, see Albrecht, U., "Der militärische Gebrauch von Forschung und Entwicklung", in: Kohler-Koch, B.(ed.), *Technik und internationale Politik* (Baden-Baden, 1986), pp. 449-462

At this point the call for an individual ethic of responsibility is frequently countered by pointing to the complexity of the research and development process (a complexity which admittedly does limit the possibilities for individual action):

- "limited power of action" of the individual scientist/engineer working in a "labour-division organisation"; this makes it impossible for a technologist or natural scientist to assess the final application made of his knowledge;

- the fact that "the individual is subject to his research commission and to directives"; if the engineer or scientist withholds cooperation in a specific project for which he feels unable to accept responsibility, he may be certain of being dismissed.[49] Here the demand for improved legal norms to protect those acting in this way becomes relevant (see on this Part 4.3. "Science Courts");

- "the limited expertise of interdisciplinary analyses of effects": something that in itself may be harmless, can lead to damaging results through cumulative effects (acid rain is an example of this phenomenon);

- "the limited value competence" of the scientist or engineer: how is the individual engineer or scientist to decide "what is good for all and what is not" (are technologies suitable for the production of defensive weapons good or bad?).[50]

Thus the question must be answered whether an individual can be held responsible for an action which was not his. Zimmerli shows that "technology is always identified with dynamism, and dynamism with qualitative change, whereas that which is called "responsiblity" is largely conceived of as something static". According to Zimmerli, the development of technology has led to a state of affairs where the consequences of technology (for example due to the synergetic combination of individual factors) are no longer calculable. But an analagous development of the concept of responsibility has not taken place, so that this concept still reflects the philosophy of mediaeval guilds: the person who acts bears only an internal, but not an external responsibility.[51]

The discrepancy between the development of technology and the development of the concept of responsibility is a factor that leads to what MacCormac has identified as the engineer's "lack of autonomy". Thus, because the profession acted exclusively according to the principles of their professional ethos, engineers saw themselves confronted in the late 1960s with the accusation that

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49 Countless examples could be cited; see Witt, G., "Gewissensfreiheit im Beruf", *Informationsdienst Wissenschaft und Frieden*, 1/1989, p. 15

50 Cf. Ropohl, G., "Neue Wege, die Technik zu verantworten", p. 161 passim

51 Zimmerli, W., "Wandelt sich die Verantwortung mit dem technischen Wandel?" in: Lenk, H./Ropohl, G. (eds.) *Technik und Ethik*, p. 92, p. 107 passim

they contributed to the realisation of goals that were destructive rather than useful to the common good.[52]

To quote Weizenbaum once again: "We know today with complete certainty that every scientific and technical result will if at all possible be taken up by the military and used for military purposes."[53] It must be borne in mind that the onus of proof lies in each case on the side alleging that a certain technical development is immune to the greed of the military rather than on the other side. In these conditions, those employed in technical fields cannot evade their obligation to consider the end use of their results.[54] In this sense, Zimmerli has written: "The reflexive form of technological knowledge (I know that I can never calculate the consequences of my actions in this technology) constitutes a being capable of moral responsibility."[55]

Even if the person carrying out an act and the person responsible are no longer identical, Zimmerli is nevertheless of the opinion that responsibility can (only) be borne by individuals.[56] Against this, Lenk suggests that the notion of the responsibility of institutions should be reconsidered. He comes to the conclusion that while engineers can evade neither professional social responsibility nor a moral co-responsibility, neither can they be made responsible or indeed solely responsible for everything "and especially not for those consequences of their activity that rest on political decisions".[57]

If we now attempt, on the basis of the examples presented here of concepts of responsibility, to formulate a thesis capable of generalisation, it will run thus:

Technologists and scientists have to bear, as individuals and as an organised collective, a co-responsibility for the consequences of their discovery/development. They ought to assume that measure of responsibility that corresponds to the power they derive from their role in the research and development process.[58] However, one must guard against responsibility (if only responsibility for basic research - as though this could even be separated from its applications) being "loaded off" onto scientists; for research and development do not "take place outside or alongside society, but rather with means provided by society"; moreover, they "intervene in society, alter it, penetrate every last corner of society. Therefore it should be self-evident that decision-making processes on basic scientific questions of far-reaching importance be so

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52 MacCormac, E.R., "Das Dilemma der Ingenieurethik", in: Lenk/Ropohl, *Technik und Ethik*, p. 222, p. 224; Luck, W., "Ursachen ungenügender Verantwortlichkeit", in: Luch, W., *Homo investigans*, pp. 211-220; Susskind, C., *Understanding Technology* (Baltimore & London, 1973), p. 103 passim

53 Weizenbaum, J. "'Künstliche Intelligenz' und die Verantwortung der Wissenschaftler, p. 1042

54 Weizenbaum, J., "'Künstliche Intelligenz' und Verantwortung der Wissenschaftler", p. 1042 passim

55 Zimmerli, W., "Wandelt sich die Verantwortung mit dem technischen Wandel?", p. 106 passim; see also Schubert, K., "Wissenschaft zwischen Selbstverwaltung und politischer Verantwortung", in Füllgraf, G./Falter, A., *Wissenschaft in der Verantwortung*, pp. 119-126; on p. 124 Schubert points out that "moral competence has not grown with the growth of scientific and technical abilities."

56 Zimmerli, W., "Wandelt sich die Verantwortung?", p. 106

57 Lenk, H., "Ethikkodizes für Ingenieure", p. 216

58 See Luck, W., *Homo investigans*, p. 207; Jonas, H., "Warum die Technik ein Gegenstand für die Ethik ist: Fünf Gründe", in: Lenk, H. (ed.) *Wissenschaft und Ethik*, p. 81; Rotblat, J., "Dilemmas for scientists with a social conscience", p. 105

organised that the highest degree of information, critical capacity and co-determination of the citizens be guaranteed."[59]

3. Individual assumption of responsibility through a hippocratic oath for natural scientists and engineers?

As has been shown, it is not enough today that natural scientists, engineers and their institutions base themselves exclusively on the professional ethos. The view that an individual ethic of responsibility for natural and technical sciences is necessary is reflected in the various proposals for a hippocratic oath for natural scientists and engineers that have been made since 1946.[60]

As Ropohl comments, the concept of an individual ethic of responsibility is characterised by the fact that responsibility is ascribed exclusively to the individual person. As a rule such concepts do not envisage a formal authority that would determine responsibility; instead, they "view the individual conscience as the sole guarantee that the individual will act responsibly."[61] Here is the point of departure for considerations of a hippocratic oath for natural scientists and engineers. The hippocratic oath is to strengthen the conscience of the individual scientist or engineer[62] ; it is further intended in itself to ensure that the scientist or engineer does in fact assume the responsibility acknowledged by taking the oath. This would mean that, ideally, the scientist or engineer should and could, through a voluntary self-obligation, prevent the use of his knowledge or developments for arms production.

A longer-term consideration that will have deep implications in future may be added to the pragmatic view of the individual ethic of responsibility: Weizenbaum has called on scientists and engineers to face up to their specific professional responsibility, the responsibility for the application and consequences of their acts. He states that it lies in their power, "and thus in their co-responsibility, to change the condition of world politics specifically and radically in a new life-enhancing direction."[63]

We shall now consider the effectiveness of hippocratic oaths signed by natural scientists or engineers long after completion of their studies or professional training.

On the basis of his analysis of various forms of voluntary obligation that have been designated *ethical* codes, Lenk comes to the conclusion that these are rules of behaviour of the professional association and norms of the professional *ethos* rather than truly "ethical" codes. Thus he criticises

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59 Falter, A./Füllgraf, G., "Demokratische Verantwortung für Wissenschaft - ja. Aber wie?" in: Füllgraf/Falter (eds.), *Wissenschaft in der Verantwortung*, p. 12 passim

60 On the origin of the hippocratic oath for doctors see Edelstein, L., *Der Hippokratische Eid* (Zurich & Stuttgart, 1969). Various proposals for a hippocratic oath for engineers, codes of behaviour and ethical codes, and the statement drawn up by UNESCO on the position of the scientific researcher (1974) and the Mount Carmel Declaration on Technology and Moral Responsibility (1974) are to be found e.g. in: Lenk/Ropohl (eds.) *Technik und Ethik*, pp. 277-325. See also Weltfish, G., "Der Eid des homo sapiens, *Physikalische Blätter* 2/1946, p. 25 passim

61 Ropohl, G., "Neue Wege, die Technik zu verantworten", p. 158

62 See Lenk, H., "Zu einer praxisnahen Ethik der Verantwortung", p. 59

the fact that the regulations that refer to ethics (not to ethos!) are frequently too abstract, too general, too sweeping and fail to stipulate specific provisions about their application;[64] that "not everything may be done that is (too) risky because responsibility cannot be assumed for what is (too) risky(...)"[65] For this reason alone, according to Falter/Füllgraf, a hippocratic oath for scientists would merely exacerbate the problem: they see it as a fundamental dificiency of the concept that it places all the emphasis on individual responsibility and makes individual perceptions the guiding criteria: "even the worst weapon a scientist was working on could ultimately be grasped as serving peace."[66]

Lenk points out that the crux of the problem of such oaths is that they are "not highly effective, nor easily controlled and realised."[67] What is needed is to anchor an oath in institutional possibilities of control and sanction.But at the same time this would exceed the concept of an oath, for an oath derives its legitimation precisely from the fact that it is not susceptible to control and sanction. To this must be added the fact that every institutionalisation of oath formulae would run the risk of imposing legalistic constraints on morality. Papcke argues in this connection that inflexible rules to limit damage could have the effect of prohibiting research.[68]

As a positive example, mention may be made of the American Institute of Electrical and Electronic Engineers (IEEE), that has already introduced ethics committees. The IEEE gives awards to engineers whose "ethical behaviour" is exemplary;[69] at the same time it draws up lists of unethical businesses and entrepreneurs with the intention of deterring others from unethical practices; nevertheless, the ethics committees are mainly concerned with affairs that have to do with professional *ethos*.[70]

Internal opposition to ethical codes must be taken into consideration; what to some is self-control is to others self-limitation. As an example of this, Wille cites the fact that shortly after the Asimolar Code had been drawn up, which recommends an end to research in the case of

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63 Weizenbaum, J., "Künstliche Intelligenz", p. 1038/1039

64 Lenk, H., "Ein hippokratischer Eid für Ingenieure?", *VDI nachrichten spezial*, Nr 19, 10.5.1991, p. 8; see also Lenk, H., "Ethikkodizes für Ingenieure", p. 207 passim; Lenk, H., "Ethikkodizes", in: Lenk, H./Maring, M. (eds.), Technikverantwortung. Güterabwägung, Risikobewertung, Verhaltenskodizes (Frankfurt & New York, 1991), pp. 330-334

65 Falter, A./Füllgraf, G., "Demokratische Verantwortung", p. 11

66 Falter A./Füllgraf, G., "Demokratische Verantwortung", p. 11

67 Lenk, H., "Zu einer praxisnahen Ethik", p. 59

68 Papcke, S., "Ethische Verantwortung der Naturwissenschaften", p. 24

69 A similar example may be cited from the FRG: the German Section of International Physicians for the Prevention of Nuclear War awarded in 1991 for the first time the "Clara Immerwahr Prize" to persons who in their professions and at their place of work have actively committed themselves to working against war, armaments and threats to the bases of human life without regard to the personal consequences.

70 See Lenk, H., "Ethikkodizes für Ingenieure", p. 198. On commissions on ethics see also Michaud, J., "Die französische nationale Ethik-Kommission" and Koch, C., "Ethik-Kommissionen - Ein Ersatz?", both in: Füllgraf, G./Falter, A. (eds.), *Wissenschaft in der Verantwortung*, pp. 178-188 and pp. 189-195 respectively

experiments in molecular genetics that are regarded as especially dangerous, scientists began to organise opposition to the code on the ground that it amounted to a self-imposed limitation.[71]

Nor will a hippocratic oath immunise against ideology. During the First World War, Fritz Haber worked on the technology to make poison gas usable as a war weapon; his motto: "In peace for mankind, in war for the fatherland". Nowadays the risks inherent in the continued arms race are frequently justified by reference to the "red peril", the "yellow peril", the threat from the Orient, etc.[72] Nor would an oath call defence a priori into question: "There are people who very sincerely and with plausible arguments declare that this goal (the preservation of human civilisation, P.L./V.R.) will be furthered if we - for example - develop defensive weapons. As a defence against evil attacks from whatever direction." [73]

There are certainly other critiques to be made of the idea of a hippocratic oath for scientists and engineers;[74] but the heart of the problem would seem to lie in the fact that an oath cannot make up for the lack of holistic awareness. This is an aspect that is neglected during the professional education of natural scientists and engineers. The hippocratic oath for doctors was sworn at the same time as they were granted the licence to practise; thus, ideally, it completed a study of medicine that was directed to the external responsibility to be assumed later in the profession. For this reason, DeWitt has suggested that, besides training them for their future professions, the education of natural scientists and engineers should also include a broad humanistic background. "The problems (...) in the USA are in my opinion largely due to the limited education and training of these people... There are people there who have gone through MIT in two years, got a degree and then they throw themselves into these wonderful weapons concepts. And they haven't any idea of what they are actually doing."[75]

A (voluntary) hippocratic oath for natural and technical scientists at the end of their studies would not preserve mankind from war any more than international law does so. Nevertheless, a further argument in favour of such an oath will be mentioned here.

It is in the nature of things that scientists at the universities have the greatest room for manoeuvre, since the university is the place where critical discourse takes place and where, moreover, the freedom of discourse is explicitly present; in other words, the scientist is not bound to a role responsibility towards his employer and therefore does not run the risk of losing his work because of conflicts of responsibility. Here, the existence of an oath (that ideally would complete a comprehensive course of study) or the existence of ethical codes could serve to prompt a critical discussion of the societal and moral implications of one's own actions. This is all the more

71 See Wille, J., "Wissenschaft im Gen-Rausch", in: Guha/Papcke (eds.), *Entfesselte Forschung*, p. 121; the recent discussion at German universities offers a further example.

72 See Lenk, H. "Moralische Verantwortung in der Wissenschaft", p.8; Kreck, M., "Ethische Verantwortung in den Naturwissenschaften", in: Guha/Papcke (eds.), *Entfesselte Forschung*, p. 36 passim; Altmann, J., "'Star Wars' und die Verantwortung der Wissenschaftler", pp.39-43

73 DeWitt, H., in: "Verantwortung im Beruf: Ein hippokratischer Eid für Naturwissenschaftler und Techniker? Ein Rundtischgespräch der 'Blätter'", *Blätter für deutsche und internationale Politik* 1/1987, p. 148; see also Schubert, K.v., "Wissenschaft zwischen Selbstverwaltung und politischer Verantwortung", p. 121

74 See for example Rotblat, J., "Dilemmas for scientists with a social conscience", p. 107

necessary as the following reflections of Max Born are also relevant to natural and technical scientists: "Most workers know only their special turn of hand in a special section of the production process and almost never see the complete product. In the nature of things they do not feel themselves to be responsible for this product or its application. Whether the use to which it is put is good or bad, harmless or damaging, is beyond their scope of vision. The terrible result of this distinction between activity and effect was the destruction of millions of human beings during the Nazi regime in Germany; the murderers of Eichmann's type declared themselves not guilty, because they "did their work" and had had nothing to do with the final purpose."[76]

4. Concepts for an institutionalisation of responsibility

According to the models of action upon which traditional ethics, with its accent on the individual, is based, certain conditions must be met if one is to be able to ascribe moral responsibility for the consequences of actions to individuals. Among them are: that the action has an intended goal; that means of action are available suitable to achieve this goal; that there is the capability to carry out actions that are means to the end; that there is the capability to control the adequacy of these actions as means of reaching the desired goal; that there is the capability to carry out corrective actions if there exists no guarantee for the adequacy of the means used to achieve the desired goal.[77] Many of these conditions, however, do not exist in modern science and technology.

This may be demonstrated in the case of modern biological technologies, such as genetic engineering, that radically intervene in the basic concepts of life. They represent a step from a processing of existing nature to the construction and industrial use of nature. In this way, biology has penetrated the sphere of modern technologies. They may be called modern in the sense that they enable a scientific-technical command over natural processes to take place in an industrial context. Biological sciences may thus be named alongside nuclear energy and microelectronics, the first of which represents the step from the extraction of energy to the construction of energy produced in the form of nuclear reactors, the second of which represents the step from thinking with the brain to the construction of the thinking-machine that can be programmed, the computer.[78]

Characteristic of modern big technologies is that their effects are comprehensive; in comparison with earlier technologies, these effects are extended in three different ways:

1. spatially, since they are not limitable to a precisely defined, calculable area (example: the explosion in the nuclear energy plant at Tschernobyl);

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75 DeWitt, H., in:"Verantwortung im Beruf", p. 154; see also Woollett, E.L., "Physics and modern warfare", p. 104

76 Born, M., "Die Zerstörung der Ethik durch die Naturwissenschaften. Überlegungen eines Physikers", in: Guha/Papcke (eds.) *Entfesselte Forschung*, p. 203

77 See Zimmerli, W., "Verantwortung des Individuums - Basis einer Ethik von Technik und Wissenschaft", in: Lenk/Maring (eds.) *Technikverantwortung*, p. 84

78 See Joerges, B. et al., *Technologieentwicklung zwischen Eigendynamik und öffentlichem Diskurs, Mikroelektronik und Gentechnologie in vergleichender Perspektive* (Internationales Institut für Umwelt und Gesellschaft, Berlin, 1985)

2. in time; here, too, limits are not possible (radioactive waste demands safe storage for thousands of years)

3. through cumulative effects; that which in itself may be harmless can lead, through the frequency of the occurrence and its combination with other substances, to damage (acid rain is regarded as an example of this phenomenon).

The sociologist Ulrich Beck has spoken of a "threefold Not" with respect to the risks of ecological, atomic, chemical and genetic dangers on a large scale.[79] Such dangers

1. are not limitable spatially, in time, or socially; besides the affected producers and consumers they affect "uninvolved third parties", including those still unborn;

2. responsibility for them cannot be assigned on the basis of the laws of causality, guilt, and liability; and they

3. cannot be compensated through a barter "destruction for money", since they are global and irreversible.

Moreover, technological actions are carried out at the supra-individual level, so that teams, groups, firms, institutions, multinationals or states have become the perpetrators of actions. And in another respect, too, these technologies represent a special case: as mentioned above, the distinction between research and its application can no longer be maintained. This finds expression not only in the way research is defined,[80] but also in the way it is organised: with respect to the three fields mentioned above (atomic energy, microelectronics, genetic engineering), it has been observed that "in the field of scientific production the institutional distinction between academic research and industrial research and development has effectively been abolished. Large research complexes have developed or are developing with a strong management in science and technology policy, in which a close cooperation and mutual processes of negotiation take place between actors from the scientific system, the industrial system and the political-administrative system."[81]

We are thus dealing here with a close interweaving between scientific-technical and economic interests. Such application-oriented scientific disciplines exist in a field of tension created by differing and in part contradictory motives, demands, and standards. This results from the external goals set by the state and industry, and from the internal dynamics of the scientific enterprise.[82]

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79 Beck, U., *Gegengifte. Die organisierte Unverantwortlichkeit* (Frankfurt, 1988), p. 120

80 Genetic engineering is the application-oriented science of the characterisation and planned alteration of the genes of living beings and the synthesis of genes and their use in living beings and/or biological systems

81 Joerges, B. et al, *Technologieentwicklung*, p. 14

82 See Buchholz, K., "Die gezielte Förderung und Entwicklung der Biotechnologie" in: Daele, v.d. et al. (eds.), *Geplante Forschung. Vergleichende Studie über den Einfluß politischer Programme auf die Wissenschaftsentwicklung* (Frankfurt, 1979)

Given the relevance of the effects of these sciences and the ambivalence of their goals, the creation of a broad social consensus on their application is called for. Such a consensus does not yet exist; nevertheless, intensive research is taking place in these fields. Societal participation must be demanded at the research stage, given the impossibility of distinguishing between research and its application.

For this reason, in the more recent debate on science and ethics, proposals have increasingly been made that do not view the scientist as an *individual* as the bearer of responsibility, but rather discuss the assumption of responsibility at the *institutional* level, while at the same time avoiding the pitfall of making society, hence in the final analysis nobody, responsible. Some approaches to the concept of responsibility at the supra-individual level will be presented in what follows.

4.1. The concept of "concerted technology assessment"

For Günter Ropohl's concept of institutionalised control the point of departure is the consideration that the individual ethics of responsibility is only meaningful to a limited degree, since the consequences of technological developments can seldom be ascribed to individuals. "Technical developments have become separated from their individual originators, they are no longer the result of individual actions but rather of the combination of various contributions to action in the context of the societal system."[83] From this he draws the conclusion that if the responsibility for technology cannot be borne by individuals it must be borne by institutions. As a theoretical solution he presents an extremely centralised model for the technological sphere: he envisages a separation of the level of conceptual action and the level of assumption of responsibility. At the level of conceptual action, the technical experts are to continue to develop their ideas as they have until now. These are then to be presented to a "State Bureau for Technology Control", in which experts from various fields examine the ecological and societal implications of the draft proposals. "They analyse all its possible consequences in the most various fields where it could have effects and measure these consequences against that which is societally desirable. In the case of uncertain prognoses they permit, if necessary, a pilot project which will be subjected to a scientifical and critical observation, re-examine the proposal and permit or prohibit, according to the result, the execution and dissemination of the draft."[84] Ropohl sees technology assessment thus organised as a procedure of an institutionalised ethic of technological action. The advantage of this in his view lies in the fact that the institution would assume prospective responsibility by assessing and evaluating the possible consequences of technological innovations *before* these innovations had spread. The following problems related to the individual concept of responsibility would, so Ropohl believes, not arise in his model:[85]

- mutual ascribing of responsibility to the other between producers and users would no longer occur; only that which on the basis of the producer's draft appears safe would be free to be used.

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83 Ropohl, G., "Neue Wege, die Technik zu verantworten", p. 164

84 Ropohl, G., "Neue Wege", p. 165

85 Ropohl, G., "Neue Wege", p. 166 passim

- The division of labour in development and production would be compensated for by a comprehensive assessment and evaluation of the effects.

- The dependence on commissions and directives would no longer exist if the central institution and its members were granted an independent status such as that enjoyed by the judiciary.

- The basic limitations on individual expertise would be compensated for by interdisciplinary cooperation in the central institution.

- In place of arbitrary individual preferences, the state institution would enjoy a democratic and constitutional legitimacy which would bestow upon it the appropriate competence in making evaluations.

He does himself, however, see a number of problems with this proposal; in this radical form, he therefore regards it as not realisable. The problems are:[86]

The limitations on entrepreneurial freedom of production. This form of institutional control would lead to a significant increase in state intervention in the economic system.

- *The bureaucratisation of technological development.* The problems would lie in the slow and sluggish decision-making processes, in the tendency to maintain the status quo; in barriers to innovation; and in certain authoritarian traditions of the bureaucracy which would tend to a hierarchical tutelage of producers and users.

- *The repetition of expertise.* The central controlling authority would have to develop expertise of its own in each new development, expertise that went at least as far, and ideally would go further, than the competence of the inventor. The question arises whether this would be possible and whether it could be financed.

- *Prevention instead of promotion*: Such a central authority would above all be concerned with the prevention of negative effects. The promotion and development of positive elements of responsibility would exceed its capabilities.

Thus, institutional responsibility organised in the way described above would solve the problems that cannot be overcome in the individual approach, but at the same time it would create others. For this reason, Ropohl proposes a synthesis of the two approaches, one that he describes as *concerted technology assessment*. "Concerted technology assessment must combine institutional support for individuals with individual support for institutions. On the one hand, a variety of institutions is to be created whose function would be to strengthen and support the individual willingness and ability to assume responsibility; on the other hand, individuals' awareness and commitment must be promoted so that they participate in suitable institutions."[87] Given the novelty of this approach, Ropohl does not present a detailed organisational model for such a concerted technology assessment. However, the draft guideline of the Association of German

86 Ropohl, G., "Neue Wege", p. 168 passim

Engineers (Vereinigung Deutscher Ingenieure, VDI) serves to indicate the general tendency. Thus, with respect to individual responsibility this guideline should:

- enlighten the engineer as to the fact that technical actions are value-related and help him to overcome a technological professional deformation;

- reveal the relativity and the instrumental character of technical and economic values;

- make the engineer receptive to the importance of non-technical values;

- provide the practical engineer with a list of criteria which would help him to examine his technical actions and their consequences;

- transmit basic methodological knowledge for the assumption of individual responsibility;

- provide an overview of those institutions that could support the individual in case of problems of responsibility;

- represent a kind of "safe conduct" for the engineer to which he can refer in the case of conflicts of responsibility with the sponsor or the employer.

With respect to institutions, the guideline should:

- encourage the establishment, in all spheres and at all levels, of forecasting and assessment capacities; these should exist for example in enterprises, to anticipate later criticism of the authorities and the public; in engineers' associations, to provide help and protection to their members and to provide the public with a competent basis for assessments; and also in the universities, to prepare students and the younger generation of academics for the problems of responsibility in technology;

- promote the establishment of special institutes of technology assessment and work out standards for their methods of analysis and evaluation;

- create a point of reference for administrative and legal regulations, so that for example through directives or legislation the granting of a permit to set up or disseminate a new technology is dependent on proof that the technology evaluation on the basis of the guideline has resulted in a positive assessment.[88]

4.2. Institutional and corporate responsibility

Matthias Maring looks at how moral responsibility can be ascribed to members of a group. Following David Cooper, he first makes a methodological distinction between distributive and

87 Ropohl, G., "Neue Wege", p. 170

88 Ropohl, G., "Neue Wege", p. 172

non-distributive responsibility. Responsibility is collective and distributive if it can be allocated to all group members without a "surplus" remaining.[89] Group responsibility is thus simply the sum of individual responsibilities. Responsibility is collective and non-distributive when it is not "equivalent" to individual responsibilities. In such a case, group and individual responsibilities can be connected in the following ways:

- group responsibility without individual responsibility

- group responsibility and the non-exhaustive partial responsibility of some individuals

- group responsibility that is more than the sum of the individual responsibility of all members of the group.

In summing up he describes the conditions under which non-distributive collective moral responsibility may be ascribed to groups or systems:

1. Group members act undesirably

2. These actions may in part be explained as occurring in accordance with the usual principles of action within the group, i.e. in harmony with the "rules, customs, usages etc. of the group",

3. these actions are below the level that one can "reasonably expect of the group", and

4. the actions of the group members are "not necessarily" below the level that one "can reasonably expect of individuals".

For an assumption of responsibility oriented towards the consequences of actions, this approach does not appear very helpful. Clearly, responsibility in scientific working groups is of the non-distributive type. To clarify this with a specific example: how could one, for example after the accidental release of an organism that has been genetically altered, distribute the responsibility in a hierarchically-organised group working with a clear division of labour, so that this responsibility can be ascribed to the group's individual members without any remaining "surplus"? This illustration shows that problems can occur even in cases where no group member has acted "undesirably" or where the action is not below the group level. It thus appears that Maring's approach is more concerned with the internal consequences for science than with the external consequences; Maring writes: "Members of groups and corporations are in particular responsible for tolerating, for not intervening in certain general practices, in other words for an omission that contributes to creating an atmosphere that encourages or does not hinder the undesirable and damaging actions of individuals."[90]

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89 See Maring, M., "Institutionelle und korporative Verantwortung in der Wissenschaft", in: Lenk, H. (ed.), *Wissenschaft und Ethik*, p. 137. The following discussion of Maring is virtually a verbatim although abbreviated presentation of this text.

90 Maring, M., "Institutionelle und korporative Verantwortung", p. 138. On internal and external responsibility see also Part 2.1 of this paper

These problems of ascribing moral responsibility are also seen by Maring himself; he quotes Virginia Held, who has remarked that questions of the just distribution of responsibility remain open "with respect to all the various components of an action, presupposing that the action can be dissected into components".[91] His detailed analysis of the concept of *science*, on the other hand, may lead us further.

"Science as (1) an institutional structure and social sub-system, (2) as the real structure of the actions and results of research activity and the research community, (3) as the entirety of ideal-type guiding norms and value systems of the scientific ethos, (4) as theoretical concepts and statement systems, (5) as applied results and material realisations and (6) as productive power and means of production(...)"[92]. In his view, science can bear responsibility only in the first two of these defintions. If the assumption of responsibility for (1) is relatively undefined, it is more specific in (2). It is true that, here too, science is not the bearer of responsibility but simply an "aggregate collective" with collective and distributive responsibility of scientists; nevertheless, "universities, faculties, institutes, large research units etc. may be viewed as bearers of institutional, corporate (moral) responsibility; they dispose of statutes and articles of association, decision-making structures, self-governing bodies etc.; through their organs they can act (secundarily)."[93] This can occur at given moments; an example is the Technical University of Berlin's refusal to participate in research on weapons of war.[94]

Unfortunately, Maring remains vague as to the further consequences of this approach and closes by saying: "Scientific corporations and institutions have a specific form of moral responsibility, or responsibility analogous to moral responsibility. Such a corporate/institutional responsibility is incurred not only by universities, faculties etc., but also, in specific cases, by such institutions as technologists' and scientists' associations. This responsibility exists (in certain circumstances) alongside the responsibility of the corporation's members. Models of the distribution of responsibility must be developed according to forms and degrees of organisation and according to hierarchical and system levels."[95]

The practical consequences of the two models presented above remain somewhat vague; rather, the proposals indicate simply the direction a future debate should take. The following, on the other hand, is a very specific proposal.

4.3. Science courts

MacCormac's[96] starting point is the observation that more and more, decisions on whether to permit the application of scientific-technological developments are being taken by the courts

91 Quoted in Maring, M., "Institutionelle und korporative Verantwortung", p. 139

92 Maring, M., "Institutionelle und korporative Verantwortung", p. 142

93 Maring, M., "Institutionelle und korporative Verantwortung", p. 142

94 See appendix

95 Maring, M., "Institutionelle und korporative Verantwortung", p. 146

96 MacCormac, E.R., "Die Wissenschaft und die Gerichte", in: Lenk, H. (ed.), *Wissenschaft und Ethik*, pp. 175-192

(examples: nuclear power plants, the release of genetically-manipulated plants). Moreover, according to his figures, 73% of engineers work in private industry.[97] As a suitable means of reaching decisions in controversial cases and in order to better protect engineers from dismissal in such cases, he proposes that science courts be established. In his view, a specialised jurisdiction is necessary since the standards of proof and the fact-finding methods of "normal" courts are different from the procedures for finding the truth applied in science and technology.[98] Moreover, the normal courts are largely staffed by judges whose scientific training is insufficient when it comes to deciding such cases, aided by juries similarly lacking the necessary expertise.[99]

To avoid these problems the creation of science courts was proposed in the USA as early as the mid-1970s. Specialised courts such as the National Labor Relations Board and military courts may be seen as forerunners of such science courts.[100] The ground for establishing these special courts was that the decisions they had to reach presupposed specific knowledge. In analogy to these cases, it was argued that science and technology also required special courts, if an adequate procedure was to be found for dealing with their problems. For opinion polls had revealed that in 1979 only 7% of the population of the USA could claim to have a general education in the natural sciences; by 1985, this had fallen to 5%.[101] Recognition of this deficiency was a reason for proposing the establishment of scientific courts.

Arthur Kantrowitz has made specific proposals for how such a court could be organised. A public hearing should take place before scientifically-trained judges selected from neighbouring disciplines. The hearing should be presided over by an impartial, scientifically-trained arbitrator. All parties involved in the conflict should be represented by a lawyer selected for his expertise and as the representative of a legitimate constituency. The institution should be financed by a government agency not directly involved in the case so as to ensure equality of opportunity. The procedure itself should be carried out according to the rules used to establish scientific truth, not those applied in normal legal procedures. The reason for this was the assumption that in the case of scientific knowledge a clear distinction is possible between facts and value judgements. "The wish to reach decisions on the basis of scientific data instead of legal rules of evidence was a decisive motive for this proposal for a scientific court."[102]

The judgement itself is not to have a legally-binding character, but should merely exercise a convincing effect on normal courts and government agencies as well as on the public. Controversial in this proposal was above all its assumption that facts and value-judgements could be treated separately. "In larger public-political controversial issues with technical aspects, the political and social value-judgements are almost inevitably far more significant than the questions related to science and technology. If the scientific and technological questions are treated separately for special consideration by a scientific court, it is probable that they will exercise

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97 MacCormac, E.R., "Das Dilemma der Ingenieursethik", in: Lenk/Ropohl (eds.) *Technik und Ethik*, p. 229

98 MacCormac, E.R., "Die Wissenschaft und die Gerichte", p. 175

99 MacCormac, E.R., "Die Wissenschaft und die Gerichte", p. 177

100 MacCormac, E.R., "Die Wissenschaft und die Gerichte", p. 177

101 MacCormac, E.R., "Die Wissenschaft und die Gerichte", p. 183

102 MacCormac, E.R., "Die Wissenschaft und die Gerichte", p. 179

greater political influence than they actually merit."[103] A further aspect must also be mentioned: "Scientific facts and values are not only inextricably linked in the public-political discussion; they cannot even be separated in the formulation of scientific theories themselves."[104] Thus, a precondition for the successful domination of biological phenomena is the deliberate practical and theoretical *simplification* of reality. As the recent debate on scientific theory and sociology of science has shown, the formation of scientific knowledge is a constructivistic enterprise that presupposes a reduction of complexity and always leads to *reductionist* interpretations in the sense that reality is reduced to certain theoretical models.[105]

MacCormac believes that to accept that values and facts intermesh does not mean that one would have to abandon the idea of scientific courts. He regards it as a cause for concern that nowadays decisions on whether to permit scientific experiments and technological processes are increasingly being taken by judges who have not been specially trained in the natural sciences. "How are judges to decide a case about the effects of chemicals if they do not even understand relatively simple concepts such as "toxicity" and "concentration"?[106] And even if the court does have a basic knowledge of science, it can still be confused by the contradictory statements of apparently competent and legitimised witnesses.[107] MacCormac therefore proposes the creation of a system of science and technology courts that could be empowered by Congress through a law on science and technology policy. The judges who would preside over these courts and the lawyers appearing before them would have to be trained not only in law but also in a natural or engineering science. The decisions of these courts would be legally binding. In accordance with Kantrowitz' proposal, the rules of evidence would be based on the principles applied in the natural sciences and the procedure would follow that of a scientific dispute. Nevertheless, the deliberations leading to the court's decision would not be limited to "scientific facts", but would include values and would be integrated into the appropriate cultural and political contexts.

Here lies the real problem with MacCormac's proposal. It is already the case today that more and more controversial societal and political issues are decided by the courts. The chances for those who are actually affected to participate in these legal cases is on the whole low; the decisions are binding. Such a legalistic approach to the decision-making process is probably counterproductive if a truly comprehensive debate on modern science and technology is to take place. Judges, after all, are also appointed by political bodies; thereafter they are no longer accessible to democratic control, e.g. through de-selection.[108]

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103 Casper, B., "Technology, Policy and Democracy", *Science* 194 (1976), p. 30, quoted in: MacCormac, "Die Wissenschaft und die Gerichte", p. 180 passim

104 MacCormac, E.R., "Die Wissenschaft und die Gerichte", p. 181

105 Cf. Bonβ, W. et al., "Risiko und Kontext. Zur Unsicherheit in der Gentechnologie", MS p. 4; to be published in: Bechmann, G./Rammert, W. (eds.), *Jahrbuch Technik und Gesellschaft* (Frankfurt, 1991)

106 MacCormac, E.R., "Die Wissenschaft und die Gerichte", p. 183

107 In this connection it must be pointed out that the state of science in the relevant research fields, e.g. genetic technology, is in itself controversial; see on the risk discussion Rother, V., *Ethische Aspekte der Gen- und Reproduktionstechnologie*, Master's thesis, Free University Berlin, 1990 (unpublished MS)

108 A similar criticism may be made of the recent proposal of Otfried Höffe, that has had some influence in German-speaking countries, for an abrogation of scientific ethics through a judicative critique; Höffe, O., "Wann ist eine

Finally, a proposal will be presented that takes the legal aspects into consideration but at the same time explicitly envisages the participation of those affected and that therefore appears particularly noteworthy.

4.4. Excursus: The discourse ethic and the assumption of responsibility; the case of genetic engineering

Dietrich Böhler has sketched the form a discourse should in principle take if it is adequately to consider the consequences of scientific and technological developments. His proposal is made from the viewpoint of the ethics of discourse.[109] It includes some important aspects for the discussion on the assumption of responsibility by scientists and technologists.

Böhler distinguishes the following steps:

I. Proposal for a research goal/idea for a project

II. Validation of the goal/project idea

II.1. Presentation of alternatives

II.2. Analysis of their consequences

II.2.a) Intended consequences that form part of the goal

II.2.b) Possible side effects that are unintentional, harmful, to be excluded where possible

II.3. Assessment: Cost-benefit-analysis

II.4. Decision in favour of a goal or project

The starting point is the proposal for a research goal. Thereafter the question must be asked how this project idea can be examined, validated, and rendered specific. In the next step, alternatives are to be proposed and examined with respect to their consequences. This step was unfortunately omitted in the development of genetic engineering. The Investigative Commission of the German Bundestag merely looked at the possibilities and risks inherent in this particular technology; it did not consider possible alternative technologies. The discussion of the consequences must consider

Forschungsethik kritisch?", in: Wills, J.-P./Mieth, D. (eds.), *Ethik ohne Chance? Erkundungen im technologischen Zeitalter* (Tübingen, 1989), pp. 109-129. Since Höffe proposes an institutionalisation merely in the "well-tried form" of a "scientific periodical", which would ultimately remain without consequences, his arguments will not be presented in detail here.

109 See Böhler, D., *Der öffentliche Diskurs über die Folgenverantwortung des wissenschaftlich-technischen Fortschritts.* (Lecture given at the interdisciplinary seminar of the Free University Berlin on Experimental biology as the originator of ethical and ecological problems, unpublished MS, Berlin, 1989)

not only the intended effects, but also possible unintentional side-effects. The third step is the evaluation of the alternatives in a cost-benefit analysis. The decision would then be made in favour of a project that produced the best results at this stage. The problems of safety so much in the public eye at present would be taken into consideration; this would include looking at both safety within the laboratory and - in the case of experiments in genetic engineering - in the possible release of manipulated genes. This issue is a matter of controversy among scientists; therefore, a debate on safety cannot be left to the researchers involved.

The public discourse is to be bear in mind a) accepted norms such as the right to life and physical non-injury and b) the accumulated experience gathered in the course of public debate.[110]

With respect to a) accepted norms :

In a thirteen-page judgement on the running of facilities for genetical engineering, the Administrative Court of the land of Hesse comes to the conclusion that these may only be set up and operated with the explicit consent of the legislature. "Where (...) life and physical non-injury are at stake, the legislature is not only entitled and obliged to pass protective laws to limit the basic rights at hand to users of a technology in a way that is constitutionally unobjectionable; rather, this duty arises objectively, i.e. quite independently from the assertion of subjective claims (...)"[111]

It is, however, a controversial issue whether this constitutional right is adequately guaranteed in the draft law on regulating genetic engineering recently passed by the German government. Gerhard Winter of the Centre for European Legal Policy at the University of Bremen has criticised the fact that, even in the final version of the draft, the notion of prevention is far from adequately treated.[112] In particular, Winter criticises the lack of an independent risk evaluation.

The public debate on the draft legislation must be oriented towards the basic rights guaranteed in the constitution.

On b):

"As a background for the orientation of the public discourse, there exists a critical accumulated experience:

(b1) knowledge of the imperfection and riskiness of high technologies,

(b2) knowledge of the lack of consensus among researchers as to what constitutes normal phenomena, and

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110 Böhler, D., *Der öffentliche Diskurs*, p. 14

111 *Frankfurter Rundschau*, 11.11.1989

112 Cf. *Frankfurter Rundschau*, 17.3.1990. Winter criticised the fact that essentially the draft was concerned only with risk avoidance and that, in the final analysis, it offloaded the responsibility for safety onto the authorities whose function it was to grant permits for genetic engineering, without, however, allowing these authorities to judge the risks for themselves.

(b3) knowledge that we have a non-knowledge with respect to the forecasting of ecological effects."[113]

From the knowledge (b1) of the imperfection and riskiness of high technologies the conclusion must be drawn that they can no longer be accepted as an internal affair of researchers, as a matter for the experts.

The lack of consensus among researchers (b2) has led to the state of science and technology itself becoming the subject of public debate. The fact that the public debate on safety in research relates the issue to basic constitutional norms such as the right to life and physical non-injury "is in itself sufficient to say that technological rationality (...) has been given over to a normative-practical rationality, that it in a certain sense is treading the level of practical reason that argues according to basic principles of moral obligations."[114]

This development is further strengthened by the non-knowledge with respect to the forecasting of the ecological consequences of the new technologies (b3).[115] From this results the proposal, made by Hans Jonas, that the onus of proof be reversed. This would justify a kind of general reservation towards all high-technology projects. The participatioon of the public in the decision-making process is especially important, since such a discussion cannot meaningfully take place without the participation of those potentially affected. The law on genetic engineering passed by the Bundestag (the lower house of the German parliament) is utterly inadequate in this respect, for it largely excludes the public from participating in the procedures for granting permits while conversely the scientists who participate are strongly represented in the commission responsible for issuing permits.[116]

The scientists justify this state of affairs by pointing to the public's lack of expertise and to an irrational fear of non-existent dangers. Thus the presidents of some of the most reputable research institutions in Germany, among them the Max-Planck-Gesellschaft and the Fraunhofergesellschaft, have declared in a common statement on the uses and dangers of genetic engineering: "Fear and emotion are understandable reactions that must be taken into consideration in politics and legislation and that may not be ignored by a humane society. But science must (...) attempt on the basis of its expertise to bring these emotions into a proportion appropriate to the matter (...) In this sense we regard it as our duty to point out that the dangerousness of genetic engineering is greatly over-exaggerated in the Federal Republic of Germany. The tasks of science for the formation of a humane future are too great for us to be

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113 Böhler, D., *Der öffentliche Diskurs*, p. 16

114 Böhler, D., *Der öffentliche Diskurs*, p. 17

115 Cf. Rother, V., *Ethische Aspekte der Gen- und Reproduktionstechnologie*, p. 43 passim

116 According to Professor Jürgen Hahn, Departmental Head in the Federal Health Bureau (Bundesgesundheitsamt), ten out of the twelve members of the commission which in future is to be heard before decisions on the issue are made, are active in research on genetic engineering. *Der Spiegel*, Nr. 16/1989, p. 56

able to afford to build up irreversible legislative and administrative structures because of a false estimation of possible risks, that would hinder the use of trend-setting technology."[117]

The representatives of the scientific organisations are here committing a double error. First: what we conceive as a humane future is not exclusively a question of developing scientific-technological instruments. Secondly: in a society governed by the rule of law, legislative and administrative structures are not irreversible. On the contrary, the risk is rather that certain consequences and side-effects of genetic engineering could prove to be irreversible. The attempt to declare the public incompetent to participate in a debate on structuring the future is unjustified. One suspects that it is simply the expression of a marketing rationality that sees a broad public debate on the dangers of new technologies as disruptive of research possibilities. Yet it is precisely the reflection on societal consequences of technological developments that calls for such a discussion. "Because that is a matter of reflection it does not belong to specialists' competence."[118]

The need to cope with a colllective mortal risk rather demands a general non-hierarchical discourse on the planned projects. But what is the situation with regard to the legitimacy of this ethics, an ethics that regards itself as communicative? The ethics of discourse attempts to answer this question "by calling on all those who bring forward anything at all, especially a project, grounded on reasons - and among these people may be counted self-evidently and above all the representatives of technological rationality - to reflect on what they actually claim in their arguments."[119] At this level of the foundation of the moral principle, an answer can be given to the question: what obligations do we assume when we enter into a debate and argue our case by giving the grounds for our position? At the least it can be said that in making an assertion we necessarily claim that it is valid, for the assertive act implies that a claim of truth-capability is made for what is said. The assertion is thus that good reasons (in the final analysis compulsive reasons) can be asserted for what is said vis-à-vis someone who does not agree to the assertion, so that ultimately all could agree to it. When someone makes an assertion, he enters an obligation to defend the assertion argumentatively, i.e. by adducing his reasons, and at the same time to be receptive to the argumentation of others. From this we may extract a procedural moral principle that runs thus: "Attempt to find an argumentative consensus, i.e. arguments that under the best possible conditions of dispute such as time, information etc. would find the agreement of those informed and willing to enter into a dispute".[120] Besides the recognition of the other participants in the dispute, this would also imply the effort to create the societal conditions necessary for free dispute.

117 *Frankfurter Rundschau*, 24.3.90. The statement was signed by the following: for the Max-Planck-Gesellschaft Professor Dr. Heinz A. Staub, for the Deutsche Forschungsgemeinschaft Professor Dr. Hubert Markl, for the Westdeutsche Rektorenkonferenz Professor Dr. Heinrich Seidel, for the Fraunhofergesellschaft Professor Dr. Max Syrbe and for the Arbeitsgemeinschaft der Großforschungseinrichtungen Professor Dr. Harald zur Hausen.

118 Habermas, J., "Technischer Fortschritt und soziale Lebenswelt", in: Habermas, J.: *Technik und Wissenschaft als 'Ideologie'* (Frankfurt, 1979), p. 119

119 Böhler, D., *Der öffentliche Diskurs*, p. 23

120 Böhler, D., *Der öffentliche Diskurs*, p. 24 passim

From this it follows that in principle all claims of the participants in communication that can be brought into harmony with the argumentatively-grounded claims of other communication partners must be mutually respected. Thus only that is recognised as a valid claim which in discourse can be defended against the grounded criticisms of all participants in the dispute.

The task of discourse ethics is not to propose material norms related to specific situations; rather, its task is to analyse the normative conditions under which collective responsibility is organised at the various levels of practical discourse.

In summary it may be said that a responsible discussion on the direction of scientific-technological progress calls for a broad public participation. The debate must be comprehensive and it must take place in good time, since certain developments can have catastrophic and irreversible consequences for humanity. Efforts to limit or hinder such a free and equal debate must be a matter for concern. The German government's draft law on genetic engineering, for example, does not envisage measures that would adequately cope with the risks since it attempts to limit public participation in decision-making processes.

An interesting counter-proposal is contained in the "Memorandum on the law on genetic engineering" drawn up by an environmental protection organisation, the German Ring for the Protection of Nature.[121] There, the proposal is made that an body be established to evaluate and assess the consequences of genetic engineering and to advise the Bundestag on the matter. The advisory body would consist of members of the following groups:

- natural and engineering sciences;

- the humanities and social sciences;

- industry;

- the trade unions;

- agriculture;

- representatives of health organisations, industrial safety, consumer protection, animal protection;

- environmental protection;

- churches;

- the federal Länder;

- government agencies such as the Federal Health Bureau and the Federal Environmental Agency.

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121 Deutscher Naturschutzring (ed.), *Memorandum zum Gentechnikgesetz* (Bonn, 1989)

The signatories to the memorandum represent a broad spectrum of various groups that have reached agreement on the issue of genetic engineering; they include representatives of forty environmental and consumer organisations, scientific institutions and religious and political groups; altogether, they claim to represent 2.5 million citizens.[122]

A further proposal is the creation of a parliament of scientists and a public control of science in analogy to the division of state power between legislature, executive and judiciary.[123] The creation of such a "science parliament" could be constitutionally guaranteed; it should enjoy parliamentary prerogatives and would offer a suitable framework within which to hold the necessary debate on the ethics of scientific responsibility. It would ensure that openness and the public character of scientists' deliberations were guaranteed and at the same time would tend to overcome or counteract the hierarchical elemts in the organisation of science and technology. Such a body would be legitimised to establish norms and would have the advantage over other proposals (such as the legalistic solution of science and technology courts) of being permanently open, able to amend earlier norms in the light of new information.

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122 See *Frankfurter Rundschau*, 31.10.1989

123 See Böhler, D., *Mensch und Natur: Verstehen, Konstruieren, Verantworten. In dubio contra projektum.* (Lecture held at the 15th German Philosophy Congress, Hamburg, 25.9.1990, unpublished MS)

5. Conclusions

5.1. Summary theses

1. The concepts "ethos" and "ethics" must be distinguished: "ethos" refers to an internal normative code of the "guild"; "ethics" to the assumption of responsibility in the sense of universal morality.

2. The distinction between basic research and its industrial application is disappearing; civil research and development increasingly finds military application.

3. Given the power they wield through their role in the research and development process, technologists and natural scientists cannot refuse to accept the co-responsibility for the consequences of their discoveries and developments.

4. It is thus not sufficient for natural scientists and engineers to rely exclusively on their traditional professional ethos - iin itself debatable - as a guideline.

5. This paper has thus presented different proposals for an assumption of responsibility in the sense of universal morality. The concept of an individual ethics of responsibility is reflected in various proposals for hippocratic oaths for natural scientists and engineers.

Given the civil-military ambivalence of research and development, such oaths will be too restricted if they are limited to the military sphere. Nevertheless, it must be emphasised that an individual ethic of responsibility in the form of voluntarily-assumed obligations can encourage the necessary debate on the issues involved.

6. The same applies to the concepts presented here for a "concerted technology evaluation" and for the "institutional and corporate assumption of responsibility". These concepts, however, indicate merely the direction a future debate should take; their practical consequences still remain undefined.

7. So far as the proposal for science and technology courts is concerned, the criticism must be made that, apart from the bureaucracy to be expected, these courts would only deal with actual, but not with potential damage. One could, however, envisage a prosecution in the form of an ombudsman or woman.

8. A further proposal is the creation of a scientists' parliament and a public control of science to be organised analogously to the division of state power.

5.2. Prospects

As elements for the future debate we propose the following practical measures:

A. Progress could be achieved in the sphere of military research and development by creating the institution of an ombudsman or women, to be enshrined in the constitution.

Such a "parliamentary commissioner for technology consequences" would then, like the "parliamentary commissioner for the armed forces"[124] in the FRG, be appointed by Parliament and would investigate matters at the instance of the Parliament or upon request of technologists or scientists. The function of such a commissioner would be, like that of the armed forces commissioner, to protect the basic rights of scientists and technologists and to assist the Bundestag in the task of parliamentary control.

Information provided to ombudsmen and women by technologists and engineers would be subject to confidentiality and the provision of such information should remain without legal consequences of any sort.

B. Technologists and scientists who refuse on ethical grounds to carry out certain tasks must be given legal and financial security. With respect to their legal position, one could envisage an appropriate amendment to the Basic Law and, as proposed by Rotblat, the inclusion in the UN Charta of a similar provision.[125]

The "Scientists' Initiative Responsibility for Peace" has recognised the need for financial provision and envisages the setting up of a fund to help "colleagues who in exercising their responsibility have encountered professional difficulties."

C. The problem of limited expertise in inter-disciplinary analyses of technology has been discussed in this paper. A possible means to counteract this would be through special seminars, which would also offer an appropriate context in which to debate e.g. the dual use of research and development for civil and military purposes. Appropriate labour law provisions should guarantee that scientists and technologists are able to attend such seminars, and the trade unions should develop a heightened awareness of the significance of the issue.

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124 Art. 45 b Basic Law (constitution) of the FRG. The specifics are set forth in the Law on the Parliamentary Commissioner for the Armed Forces of 26.6.1957

125 See Rotblat, J., *Societal Verification* (unpublished MS of a paper presented to the Pugwash Symposium held in Turin in March 1991, reproduced here in the appendix)

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Appendix 1)

Pugwash Study Group
"Desirability and Feasibility of a Nuclear-Weapon-Free World"

SOCIETAL VERIFICATION Topic 5

Joseph Rotblat

Introduction

This paper is based on the premise that there has been a general recognition of the need to eliminate all nuclear weapons; that a treaty with this objective is being contemplated by the community of nations; and that the chief obstacle to such a treaty is the worry whether it would be effective enough to prevent cheating, by the concealment of a clandestine nuclear arsenal, or by undetected production of weapons later on.

The chief protection against possible violation of the treaty is a regime of verification of compliance with the terms of the treaty, forming an integral part of it. The main component of this regime, technological verification, is discussed in other chapters. This chapter deals with another component, societal verification. It is argued here that the employment of both components would satisfy the legitimate concern about the effectiveness of the treaty.

Role of societal verification

Societal verification is here defined as the system of monitoring compliance with treaties, and detecting attempts to violate them, by means other than technological verification, the latter using methods such as physical inspection, instrumental detection, ground surveillance or aerial reconnaissance. The two systems are intended to be complementary to each other. As the name implies, societal verification is based on the involvement of the whole community, or broad groups of it, in contrast to the employment of highly specialized teams of experts required for technological verification. In that sense societal verification can be viewed as being part of the political requirements for the disarmament process.

Even at the present state of the art, technical verification is sufficiently developed to serve - by itself - treaties aiming at reducing nuclear arms down to very low levels, of the order of a few per cent of the present arsenals. But it is often asserted that technology alone would not be an adequate safeguard for treaties aiming at zero, the complete elimination of nuclear weapons. The effectiveness of verification techniques is likely to be greatly improved in the future, if more research effort is put into it, particularly if the weapon designers themselves were charged with this task, as part of the process of conversion of military research establishments to peaceful applications.

However, it can never become 100 per cent effective, nor is it likely to come near enough to this figure to satisfy legitimate concerns. For non-nuclear weapons, a 90-95 per cent effectiveness is generally acceptable, but the enormous destructive power of nuclear weapons makes it necessary to reduce the error to very nearly zero, if a treaty to eliminate these weapons completely is to have a chance of being accepted universally. In a nuclear-weapon-free world, the illegal retention of even a few nuclear weapons, or their clandestine production after the treaty has come into force, might give the transgressing state overwhelming power and the capability to exert political blackmail.

Like the technological element, societal verification will have to be an integral part of the step-by-step disarmament process. As will be shown, its implementation entails an educational effort, a change in certain attitudes of the general public, and this makes it a long-term undertaking. On the other hand, the technological element, even the mere physical destruction of nuclear armaments, will also take years to be accomplished. As has been pointed out elsewhere [1], the two aspects of the disarmament process, the technological and the political, are both not only necessary but reinforce each other in a process of positive feed-back. The side-by-side implementation of both aspects will significantly accelerate the achievement of a nuclear-weapon-free world.

Citizen's reporting

The main form of societal verification is by inducing the citizens of the countries signing the treaty to report to an appropriate international authority any information about attempted violation going on in their country. For this system of verification to be effective it is vital that all such reporting becomes the right and the civic duty of the citizen. This right and duty will have to be written in the national codes of law in the countries party to the treaty. The passing of such laws would be demanded in a specific clause in the treaty on the elimination of nuclear weapons.

The concept of citizen's reporting has been discussed in the literature for many years, under different names, including such as "inspection by the people", or "knowledge detection". The idea was introduced in the late 1950's by Lewis Bohn [2] and Seymour Melman [3] and incorporated in the classic *"World Peace through World Law"* by Grenville Clark and Louis Sohn [4]. Leo Szilard, in his quixotic *"The Voice of the Dolphins"* [5] also considered it an important part of the disarmament process.

The early 1960's were the period of intense debate on 'general and complete disarmament', when many detailed studies, including concrete proposals for the implementation of G.C.D., were very much on the agenda. After it became obvious that the political climate was not ripe for such a radical remodelling of the world's security system, and with the intensification of the cold war and declining stature of the United Nations, the subject of citizen's reporting ceased to be a topic of interest, although papers elaborating certain aspects of the concept appeared in various journals from time to time [6].

The momentous events that have occurred at the end of the 1980s have made it possible to bring back from the cold many ideals and aspirations; objectives that were previously dismissed as utopian, can now be brought to the fore. Among these is citizen's reporting. This appears to be an idea whose time has come. The recent dramatic changes in the political arena, especially the restoration of the United Nations to its primary role of maintaining global peace and security, justify a re-examination of the concept of citizen's reporting, at least as applied to the more restricted aim of nuclear disarmament.

In relation to general disarmament, Clark and Sohn proposed a revision of the UN Charter that envisaged a UN Inspection Service with direct responsibility for supervision over the fulfillment of obligations by nations and individuals in respect of all phases of disarmament. Two sections of the relevant Article deal with citizen's reporting:

> "5. *Any person having any information concerning any violation of this Annex or of any law or regulation exacted thereunder shall immediately report all such information to the United Nations Inspection Service. The General Assembly shall enact regulations governing the granting of rewards to persons supplying the Inspection Service with such information, and the provision of asylum to them and their families.*
>
> 6. *No nation shall penalize directly or indirectly any person or public or private organization supplying information to the United Nations with respect to any violation of the Annex".*

The granting of rewards for supplying information - as an encouragement to fulfil this duty - was also recommended by Szilard; writing in 1960, he suggested an award of one million dollars, free of tax, to be paid by the government accused of a violation, but returnable if the information later turned out to be invalid. Lewis Bohn[7] also approves of financial and other rewards, but goes further than this: he calls specifically for

> *"..a provision in the original arms-control agreement requiring all participating governments to pass laws making it a crime, punishable by domestic law, to violate the provisions of the arms-control agreement or to keep secret from the agency for international control any information of such a violation. Moreover, these provisions of the law of the land should be publicized by each government and failure to support them by such publicity (or by other ways) should be declared to be a major violation of the control treaty"*

As already mentioned, these proposals were put forward in the context of general and complete disarmament, but they can also be applied - even with a better chance of success - to the treaty on the elimination of nuclear weapons (though without the stipulated revision of the UN Charter, which could delay the treaty indefinitely, and is not really necessary). The fundamental point is that the duty of the citizen to supply information about any violations should be an integral part of the treaty on the elimination of nuclear weapons, and be spelled out clearly in the terms of the treaty. Thus, disclosing to an outside - albeit international - body information about sensitive security matters inside one's country, would not only cease to be considered as a crime, an act of treason, but would in fact become part of the law of one's country.

The inclusion of a clause in an international treaty demanding the enactment of new national laws is likely to be seen by many as an intrusion into sovereignty and therefore would be resisted. In order to test the readiness of at least the two superpowers to take such a step, it is suggested that such a clause be incorporated in the treaties on partial nuclear disarmament currently on the agenda, such as START and its successors, even though for these disarmament proposals it is not an indispensable measure as it is for a treaty of complete nuclear disarmament.

Even if governments were persuaded to pass laws to make reporting legitimate, this goes so much against traditional loyalties that it would require a considerable educational effort to induce people to act on it voluntarily. This raises the question: how effective would citizen's reporting be, if it were legitimized and safeguarded by a clause as discussed above? In considering the answer to this question one needs to be reminded of the premise of this paper, namely that a political climate has been generated in which the elimination of nuclear weapons is being considered as a realistic and desirable goal for world security. During the cold war era, with all the mistrust, fear and hostile propaganda that it engendered, it would have been stretching credibility to the limit that a treaty to eliminate nuclear weapons would be put on the official agenda. An atmosphere of trust, and willingness to elaborate and collaborate on a global security system, are essential conditions for starting negotiations on such a treaty (the start of such negotiations would in itself reinforce that atmosphere). But the changed political situation has brought us a long way towards meeting this condition. Another essential condition is the existence of an international authority capable of ensuring compliance with the terms of the treaty. In this respect too, the recent events augur well. The greatly enhanced stature of the United Nations makes it likely that an agency under its aegis would command the necessary degree of confidence about its effectiveness.

There are good reasons for expecting that citizen's reporting would be more effective in relation to nuclear than other types of weapons. By the very nature of its technology, the maintenance of a concealed nuclear arsenal, or the preparation for making such weapons, requires the involvement of many people with specialized skill, and more complex facilities than say for a chemical or biological weapon. A government intending a violation would thus face a very considerable risk that the attempt will be detected at an early stage and reported to the international authority by its own citizens, thus incurring the reprisals provided in the treaty, well before being in a position to reap the fruit of the contemplated violation. Another reason why the probability of exposure of such attempts is greater in relation to nuclear weapons is because in the mind of the public a nuclear war carries with it the threat of global destruction, possibly the end of civilization, and people are likely to do their utmost to prevent anything that may lead to such an outcome. I am convinced that, if properly operated, citizen's reporting would provide the necessary supplement to technological verification, and thus allay the fears that a violation of the treaty on the elimination of nuclear weapons would be undetected.

There are data in the literature to justify the belief that there will be enough people willing to overcome the taboo on reporting on its own government.

In 1958, a public opinion poll was carried out in six countries to determine the attitude of citizens towards disarmament and inspection by the public [8]. The poll was conducted by the American Institute of Public Opinion and its affiliates in other countries.

Table 1 contains the text of the three questions posed in the poll and the replies in terms of percentages. The sizes of the samples (shown in the Table) were sufficiently large (especially in the UK and USA) to give statistically meaningful answers. They matched, by sex and age, the total populations in the countries.

As is seen, in all six countries the opinion was decisively in favour of making it a citizens duty to report attempts to make nuclear weapons secretly. Similarly, at least half of those interviewed expressed willingness to report knowledge of such attempts.

A breakdown by sex showed no difference in the response by males and females, but there was a significant difference between professions. Scientists and engineers (about 1.5 per cent of the samples) showed a greater willingness to report violations (84 per cent in the total survey) than the other groups (69 per cent).

A later survey [9], in Norway, showed an even higher proportion, nearly 100 per cent, of willingness to report.

It would be of interest to repeat the survey at the present time, and to include, in particular, countries with non-democratic regimes, and/or those with ambitions to become nuclear powers. In such countries, the expressed willingness of reporting is likely to be much lower, but one needs only a few reports of genuine attempts at transgression to initiate an investigation and thwart the attempt.

Various ways have been suggested to encourage and remind people of their duty, such as frequent advertisements on television and in newspapers; or the provision of detailed information how to get in touch with the relevant UN authority. The suggestion to offer financial rewards (except for expenses incurred) seems to me questionable:

TABLE I

Opinions about Disarmament Inspection in Six Selected Nations

	USA	*UK*	*France*	*India*	*FRG*	*Japan*
(size of sample)	(1610)	(1000)	(287)	(250)	(282)	(200)
	%	%	%	%	%	%
Would you favour or oppose setting up a world-wide organization which would make sure - by *regular inspections* - that *no* nation, including Russia and the United States, makes atom bombs, hydrogen bombs, and missiles?						
Favour	70	72	85	78	92	91
Oppose	16	10	6	1	1	8
No Opinion and No Answer	14	18	9	21	7	1
If this inspections organization were set up, would you favour or oppose making it each person's *duty* to report any attempt to secretly make bombs, hydrogen bombs, and missiles?						
Favour	73	54	74	71	86	80
Oppose	11	15	13	2	4	16
No Opinion and No Answer	16	31	13	27	10	4
If you, yourself, knew that someone in (name of country) was attempting to secretly make forbidden weapons, would you report this to the office of the world-wide inspection organization in this country?						
Yes	80	50	63	63	73	83
No	6	17	18	6	11	5
No Opinion and No Answer	14	33	19	31	16	12

reporting should be a response to one's deeply felt moral obligation. Financial rewards might indeed be counter-productive, by encouraging false reporting.

This leads to another more difficult problem, how to prevent trivial reports or deliberate hoaxes. A continuous flood of alleged violations would not only saturate the system but could lead to embarrassing situations and even international crises. Indeed, discrediting the reporting regime by such action could be the deliberate aim of a government (or group of terrorists) intending to violate the treaty. This is the kind of problem facing members of the public all the time in many countries, where hoax calls of bombs hidden on aircraft or other public places, often result in the disruption of the normal way of life. But just as the community is learning to deal with these nuisances, it should be possible to devise a system of scrutinizing reports to distinguish between genuine and bogus information. For example, any anonymous report would be disregarded; the *bona fides* of the "reporter" would be investigated before any action is taken; penalties may be imposed for deliberately false information. There is a need for more study on this problem, as well as on the detailed procedure for checking and verifying reports of attempted violation of a treaty; when and how a government should be confronted with the evidence; and the type of sanction to be applied.

Other types of societal verification

Apart from citizen's reporting, which relies upon members of the general public finding out, in one way or another, about attempts to rebuild nuclear weapons in a nuclear-weapon-free world, the preparation for such actions could also be monitored systematically by workers in the relevant disciplines or industries. Any serious attempt to violate the treaty would require the involvement of highly specialized scientists and technologists. Monitoring the movement and change of employment of such experts, would provide an important clue and lead to early detection. For this purpose the community of scientists and technologists would need to be alerted and their help enlisted.

It should be pointed out that one of the requirements in the agreement to abolish nuclear weapons is the closure - or conversion - of research establishments, such as Livermore or Chelabinsk, whose main task is the design and development of nuclear weapons and the means of their delivery. The closure - or conversion - of these establishments will remove the existing legitimized secrecy of scientific research, a pernicious practice that goes against the very basis of science, openness. Openness in science means that the outcome of research work is published in journals or books, and is available to anyone interested. It also means that projected and ongoing research is widely known. Under openness in science there would be much more communication among scientists, and therefore greater awareness in the scientific community about the whereabouts, and the type and scope of the work carried out by their colleagues. This would make it particularly difficult for key people, those who would have to be in charge of a break-out attempt, to carry out such attempts undetected.

Apart from relying on sporadic observations, organizations of scientists and technologists could be set up for the specific purpose of acting as a watchdog of compliance with treaties, by monitoring the activities of individuals likely to become involved in illegal projects. Such monitoring can be done, without spying on one's colleagues, by keeping a register of scientists and technologists, and by noting changes of place of work or pattern of publications (or their absence). Other 'give aways' of attempted clandestine activities include the start of new projects at academic institutions without proper justification; the recruitment of young scientists and engineers in numbers not warranted by the declared purpose of the project; or the large scale procurement of certain types of apparatus and equipment.

Special attention would have to be paid to institutions with nuclear facilities, such as processing of spent fuel elements from nuclear reactors, storage of such elements, plants for enrichment of isotopes, or management of intense radioactive sources. With the halt of military uses, all the establishments dealing with the above will have to be opened and made subject not only to monitoring by (strengthened) IAEA safeguards, but also to the scrutiny of the watchdog organizations.

In countries with an open democratic regime, the measures described above could ensure that no clandestine activities would go on undetected, thus easing the task of the inspectorate supervising the compliance with the terms of the treaty. In countries with non-democratic regimes much more vigilance by the inspectorate would be necessary. But even in these countries there are bound to be many scientists with a social conscience ready to carry out the task of monitoring and whistle-blowing.

A loyalty to mankind

One of the most difficult aspects of societal verification is that it carries with it the taint of disloyalty, the stigma of spying on one's colleagues or fellow-citizens; this would make it distasteful to many well-meaning people.

Loyalty to one's group is a natural condition for the stability of the group, it is essential to ensure its continuity. For this reason it has, over the years, become enshrined with codes and taboos. Disloyalty is equated with dishonour and, in addition, may carry penalties of various kinds. The more aggressive, or less scrupulous, members of the group often exploit this for their own gains; weaker members are bullied and subjected to other mistreatments, and the codes ensure that this will not be disclosed by the victims. This happens in the family where children will not squeal on their siblings; in schools, where 'telling tales' is not done on the penalty of being ostracized; it extends to trade unions, where disclosure of unfair practices carries with it the threat of being 'sent to Coventry', and to other fraternities and associations.

The increasing interdependence of everybody on each other in modern society - mainly resulting from ever increasing specialization - inevitably leads to new, larger groups coming into being, and demanding new loyalties. These new loyalties are usually an extension, not a replacement, of the loyalties to the smaller communities. We still have our loyalty to our family, to our local community, to our professional group, on top of the loyalty to our nation. The necessity for larger groups is unquestioned, since they are able to provide greater security to all their members, and therefore loyalty to them takes precedence over those to the smaller groups.

At present, loyalty to one's nation is supreme, generally overriding the loyalty to any of the subgroups. Patriotism is the dogma; "my country right or wrong", the motto. But in case these slogans are not obeyed, loyalty is enforced by codes of national criminal laws. Any transgression is punished by the force of the law: attempts by individuals to exercise their conscience by putting humanitarian needs above those dictated by national laws are denounced by labelling those individuals as dissidents, traitors or spies, and are severely punished by exile (e.g. Sakharov), long-term prison (Vanunu), or even execution (the Rosenbergs).

The time has now come to develop, and recognize consciously, loyalty to a much larger group, loyalty to mankind. In this nuclear age the very existence of the human species is no longer assured. It has been put in peril not by the threat of external or natural forces, such as a collision with a large meteorite, or an enormous eruption of a volcano, but by the action of man; the end of civilization can now be brought about either abruptly, in a nuclear war, or slowly, by the continuous erosion of the environment.

Nothing unites people more than the threat from a common enemy. All our national differences would have been forgotten in an instant, if the planet Earth were attacked by 'Martians'. The fact that the threat is man-made, the outcome of our own developments and actions, should not make it less of a common enemy, demanding common efforts. The Russell-Einstein Manifesto, the credo of the Pugwash Movement, recognized this when it said: *"We are speaking on this occasion, not as members of this or that nation, continent, or creed, but as human beings, members of the species Man, whose continued existence is in doubt".*

Among scientists, the group to whom the Manifesto is especially directed, the feeling of belonging to mankind, is already well developed. Science has always been cosmopolitan in nature; its methods and ethics are universal, transcending geographical frontiers and political barriers. Because of this, scientists have developed the sense of belonging to the world community, of being citizens of the world. There are also other groups which 'speak the same language', such as musicians or artists. What is now urgently needed is to develop the same sense of feeling in everybody. We need to foster and nurture in each of us a new loyalty, an extension of the loyalty to our nation, to embrace the whole of mankind.

This new loyalty is necessary for the protection of the human species, whether nuclear weapons are eliminated or not. But the recognition of the necessity of this loyalty, and the education of the general public about this need, would be of momentous importance in ensuring compliance with a treaty to eliminate nuclear weapons. It would contribute towards this by overcoming national taboos, and by making societal verification a natural expression of one's concern for mankind. It would make it an effective instrument for achieving such a treaty, since it would allay the fears, that many of us still have, about the stability of a nuclear-weapon-free world.

Conclusion

The end of the cold war has further reduced the need for arsenals of strategic nuclear weapons. The recent dramatic events in the Middle East have brought home to everybody the grave dangers of the spread of even tactical nuclear weapons. Such proliferation cannot, however, be prevented, if some states consider the retention of nuclear weapons to be necessary for their security. This emphasizes the desirability of the complete elimination of nuclear weapons.

The feasibility of a nuclear-weapon-free world depends largely on the existence of an effective regime of verification. Due to the enormous destructive potential of nuclear weapons, such a regime would have to be nearly one hundred per cent effective. Further intensive research work - involving the designers and makers of nuclear weapons - needs to be carried out urgently, in order to improve the effectiveness of technological verification.

In parallel with this, there is the equally urgent need to evolve a system of societal verification, in which all members of the community, or large groups of it, would have an active role. The main form of such verification is citizen's reporting, in which all citizens will have the right and the duty to provide information to an international authority about attempts to violate the terms of the treaty on the elimination of nuclear weapons. This right and the civic duty of citizens would have to be safeguarded by a clause in the treaty, requiring the passing of relevant national laws in the countries party to the treaty.

In order to test the acceptability of such a clause, it should be introduced into the treaties on partial nuclear disarmament currently being negotiated between the nuclear superpowers.

In addition, organizations of scientists and technologists should be set up with the task of serving as watchdogs and whistle blowers, to monitor the activities of individuals and groups likely to become involved in projects contravening international treaties.

The implementation of societal verification would be greatly facilitated by the development of a new loyalty, a loyalty to mankind. This is in any case essential in the ever increasing interdependence of all peoples on the globe, and the threat to the continued existence of the human species. The fostering and nurturing of this new loyalty should be a specific task for the groups that are already cosmopolitan, because they 'speak' the same language, such as scientists.

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Appendix 2 (inofficial translation)

Technical University Berlin | Berlin, 3rd July 1991

The President | 22501

M i n u t e s

of the 434rd meeting of the Academic Senate of the Technical University Berlin on 29th May 1991

Item 8 on the agenda

<u>Measures to prevent weapons research at the Technical University Berlin</u>

VL AS 2/434

ASt. Frau Rogge and others

<u>Decision of the Academic Senate 3/434-29.5.91</u> unanimous

1. The Academic Senate welcomes the debate within the university aimed at preventing weapons-related research at the Technical University Berlin even after cessation of the Allied regulations.

2. The members of the Academic Senate are in agreement that no weapons research is to be carried at the Technical University Berlin.

3. Furthermore the Academic Senate is also aware that scientific results cannot be protected against misuse for military purposes by third persons.

Therefore no commissions or payments for weapons-related research are to be accepted by the Technical University Berlin or by its research units. In case of doubt the applicant is to prove that the planned research goal does not serve primarily military purposes.

If existing doubts cannot be allayed, administration of the finances of weapons-related research projects will not, contrary to § 25 (4) of the Hochschulrahmengesetz (Framework University Law), be assumed by the Technical University of Berlin. The Technical University Berlin will not conclude contracts of employment with full-time employees in such projects who receive payment from third persons.

Every applicant for a research project is to declare that the project does not serve military purposes. An appropriate modification of the project notification form through the administration of the Technical University of Berlin is to be occasioned by the President.

Furthermore the internal research financing provided by the Technical University Berlin will make no means available for the execution of weapons-related research.