Standards for Ethics and Responsibility in Science - an Empirical Study

The Standing Committee for Responsibility and Ethics in Science (SCRES)

Introduction

This study grew out of early consultations concerning the preparations for the World Science Conference (Budapest, Hungary 26 June – 1 July 1999), arranged jointly by UNESCO and ICSU. The conference document "Science Agenda – A Framework for Action" states under 3.2 Ethical Issues, point 71: "The ethics and responsibility of science should be an integral part of the education and training of all scientists. It is important to instil in students a positive attitude towards reflection, alertness and awareness of the ethical dilemmas they may encounter in their professional life. Young scientists should be appropriately encouraged to respect and adhere to the basic ethical principles and responsibilities of science. UNESCO's World Commission on the Ethics of Scientific Knowledge and technology (COMEST), in co-operation with ICSU's Standing Committee on responsibility and Ethics in Science (SCRES), have a special responsibility to follow up on this issue."

The present document analysing a number of existing standards for ethics and responsibility in science is SCRES' contribution to this task, supplemented by a background document produced by the Executive Director, Kathinka Evers (2001) entitled "Standards for Ethics and Responsibility in Science: An analysis and evaluation of their content, background and function" (hereafter abbreviated as BD). These documents are intended as starting point for further discussions in the scientific community. The aim is to lay a useful ground for further inquiries and normative discussions, and help organisations like ICSU and UNESCO to identify possible needs for action.

Material

SCRES has collected 115 ethical standards for science, listed in BD Appendix (i). The collection includes 39 international standards and 76 national standards, representing 23 countries on 6 continents. The standards are of different types that are specified further down in the report and in BD Appendix (ii-iii).

It must be made quite clear, though, that the collection of standards analysed in this study cannot be understood as a representative sample of all existing standards in science. There is currently no way to assess the total number of standards worldwide. In this study we therefore approached ICSU member organisations for their standards, we conducted internet-searches for standards published on the internet, and we followed specific suggestions of individuals. Particularly helpful was the collaboration of the Centre for the Study of Ethics in the Professions (CSEP) at the Illinois Institute of Technology, Chicago, with its director Vivian Weil who is also a member of SCRES. CSEP has a large database on existing standards in various professions. Another particularly useful website was the recently established CODEX (www.codex.uu.se) maintained by the Department of Bioethics, Uppsala University. Also the other members of SCRES contributed standards from within their fields or countries.

The way the material was collected suggests that the sample included in this study is biased in several respects. Only some few standards in other languages than English are included. Material that is not published in English or English translations had thus a small chance of being included. Also material that is not readily available on the internet had a lesser chance of being included in the study. Therefore one must be careful in interpreting the results of the study, and resist the temptation to read more out of it than is justified in a statistical sense.

However, the material does represent a broad and interesting section of existing standards. As such it provides a rich basis for further analysis. Furthermore, as far as we know, there does not currently exist a comparable empirical study of standards of ethics in science. Given this background, SCRES feels that the present analysis, even if empirically deficient in several ways, rests on sufficient material to make it interesting, and it does make a contribution to further analysis of standards of ethics in science both descriptively and normatively.

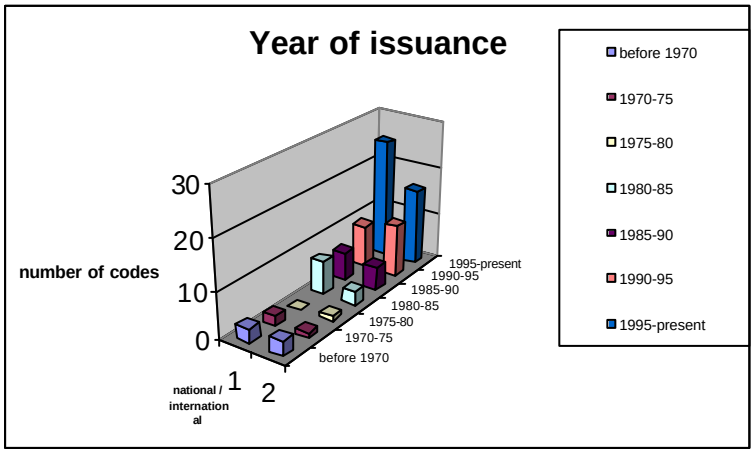
We also want to point out that the material presented below does not always add up to the total number of standards included in the study. This is a reflection of the fact that some standards were difficult to classify under certain parameters, sometimes a unit was not applicable at all.

Presentation of major findings

a) Organisational information contained in the material

Before looking at what different standards have to say on the ethics of science, it is important to have a clear idea about who actually have taken initiatives on these issues, whom they have addressed with these standards, and what format they have chosen to do this. Furthermore, it is also quite interesting to see in more detail when the organisations found it important to take action and to issue these standards. This information provides a background for discussing the topic of ethical standards in a dynamical perspective, and to identify types of organisations that have taken visible initiatives.

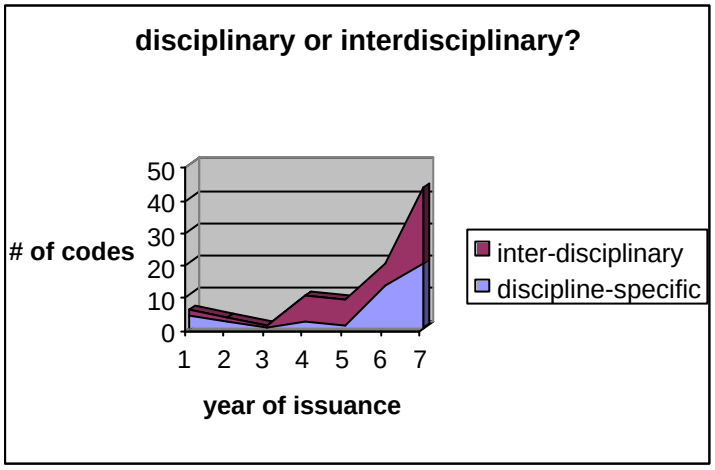
A striking feature of the standards contained in the study is their growth in number with time. If one orders the material according to their year of issuance, in 5-year periods starting with the period 1970 and before, and then in 5 year periods up to the present, it is indicative of the growing interest in ethics that there is clear accumulation of activities from the 1990's onwards. Thus, the period of before 1970 has only 3 national and 3 international standards in the material, while 1990-95 has 9 national and 11 international standards, and the period 1996-present contains 25 national and 16 international standards. The material is ordered according to the year of first issuance.



As an important footnote one should also note that only 10 standards contain information about up-dates or revisions made at a later time. While it may be natural that the youngest standards have not yet undergone any revisions, it may be a bit astonishing that standards that are, say, 10 years old or older are not regularly updated. One reading of this

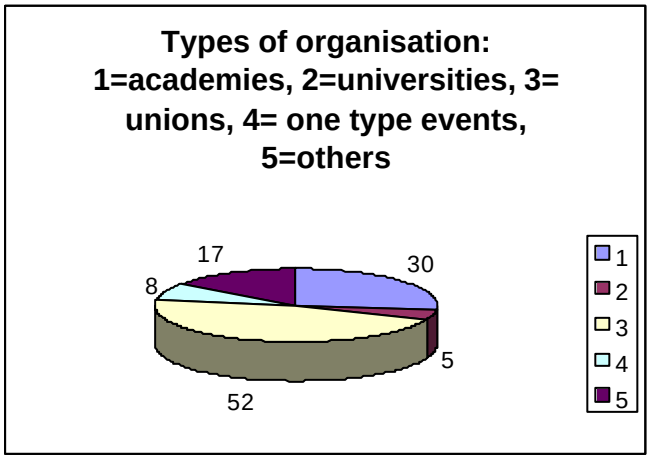
can be that organisations issuing these standards easily fall to rest once they have engaged in the effort to formulate ethical standards.

It does normally make a difference whether the standards are supposed to aim at one discipline alone or whether they are aimed to reach an interdisciplinary community. From an intuitive standpoint and from knowledge about the training of scientists one may be inclined to expect that the disciplinary ones will make up a clear majority of the standards since they may be supposed to address problems of a more concrete nature. However, the material contained in the study shows a rough balance of disciplinary and interdisciplinary standards, with a slight dominance of the interdisciplinary ones[1].



We may take this as some first evidence that the move from a disciplinary to a more general level, i.e. the interdisciplinary level, is not generally experienced as a major hindrance for formulating ethical standards. It may indicate that ethical issues are perceived as more encompassing than specific disciplinary problems. But there is also a clear tendency to growth of discipline-specific standards.

Of course, whether the standards are of a disciplinary kind or of an interdisciplinary kind is directly linked to the question of who the issuer of the standards is. While a scientific union typically will aim at formulating disciplinary standards, an academy of science or a university will want to formulate standards that cross disciplinary boundaries. The material of this study classified the type of organisation that issued the standards along five categories: scientific academy/ research council, universities, scientific union or association, one type events (like symposia, conferences etc.), and other. Dominating among those are academies / research councils and scientific unions / associations:



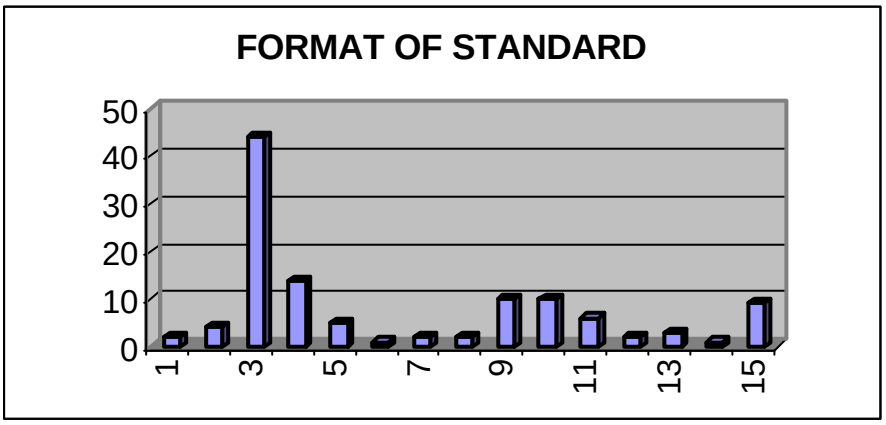
The relatively high number of scientific unions and associations included in the material is certainly also a reflexion of the way the material was collected, with an emphasis on the members of ICSU. However, the number itself (52) – regardless its representativeness - seems to indicate that a significant number of scientific unions and associations regard it as one of their central tasks to formulate ethical standards of the kind studied here. These will then typically be international in their scope, and disciplinary in kind. Similarly for scientific academies and research councils. Even though their number is not as

[1] BD Appendix (i) Section 3 contains an alphabetic lisiting by discipline.

high as the number of unions and associations (our earlier remarks of in-built bias of selection apply again here), a remarkable number of them (30) have formulated such standards. These will then be national in scope and interdisciplinary in kind. There are also a number of one type events included (8) in the material, and the data indicate that they mostly refer to relatively recent events . This may be a first indication of a growing tendency among scientists to take the initiative with regard to ethical issues. A number of standards could not be classified among the categories used here, and could be read as a kind of reminder not to limit the number of potential actors in this field too severely, lest one risks overlooking other important bodies.

It is quite interesting to note what format the different standards have taken. To this end, the material was classified into 15 categories. They were: 1) oath, 2) pledge, 3) code, 4) guidelines, 5) principles, 6) appeal, 7) recommendation, 8) manifesto, 9) statement, 10) declaration, 11) resolution, 12) convention, 13) charter, 14) law, 15) other. The format of the standard is typically identified in the heading or the first introductory sentences of the standards. We have made no effort to further analyse the extent to which these characterisations are in fact adequate for the standards that follow, and it cannot be assumed that these characterisations all express a coherent semantics. There may indeed be significant differences in how each category is understood by the issuing body. However, there is also no reason to believe that the understandings differ to such an extent that a rough comparison is made impossible. Obviously, the boundaries between some categories (e.g. oath and pledge, or code and guideline) may be unclear to a certain extent, but the spread of diversity can be assumed to come out in spite of this.

We have the following distribution among the standards:



1=oath, 2=pledge, 3=code, 4=guideline, 5=principle, 6=appeal, 7=recommendation, 8=manifesto, 9=statement, 10=declaration, 11=resolution, 12=convention, 13=charter, 14=law, 15=other.

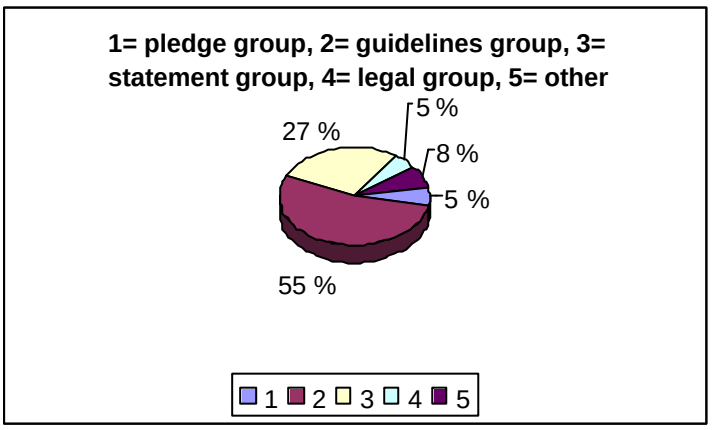
What this diagram seems to indicate is that there is clear preference for formulating either codes (44) or guidelines (14). Also statements or declarations enjoy a certain popularity (with 20 together in both categories). Codes and guidelines are clearly the preferred format when academies or scientific unions issue ethical standards, and for one-type events like conferences or symposia, the obvious choice is to issue a statement or a declaration. In the context of our study it may be worthwhile to note that the number of oaths and pledges in the material is altogether 6. While the number in itself may not seem very impressive when compared to the number of codes and guidelines, one should keep in mind that an oath or a pledge is perceived to be of a more binding nature than mere guidelines. One should also be aware that the number of oaths and pledges in our material reflect only the number of suggestions for such oaths and pledges. It does not provide any indication that any of these

oaths and pledges is actually ever taken by any one individual scientist. They may perhaps best be seen as suggestions to scientific organisations to make such oaths and pledges binding in the routines of their membership admission or similar institutions.

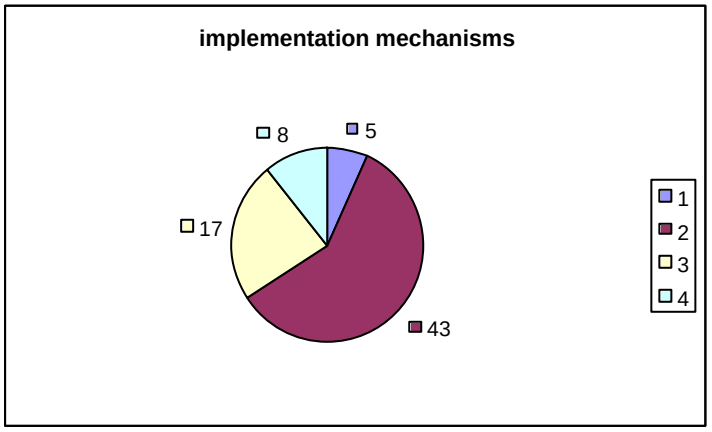
We do not want to enter the specific semantics of the various types of standards[2]. From an intuitive standpoint there is, however, a certain family resemblance between some of them. One may want to group them e.g. in the following manner:

Oath and pledge -> Pledge group
Code, guidelines and principle -> Guidelines group
Appeal, recommendation, manifesto, statement, declaration and resolution -> Statement group
Convention, charter and law -> Law group
Others.

Following this rough categorisation we can visualise their relative occurrence as characterisations of the analysed standards in a pie-chart:



It is furthermore worthwhile to investigate to what extent the standards mention any mechanisms for implementation[3]. Here we think about mechanisms for enforcement (e.g. sanctions) (#1), mechanisms for communication (e.g. newsletter, website) (#2), mechanisms for monitoring (#3), and mechanisms for addressing complaints (#4). The data provide the following picture:



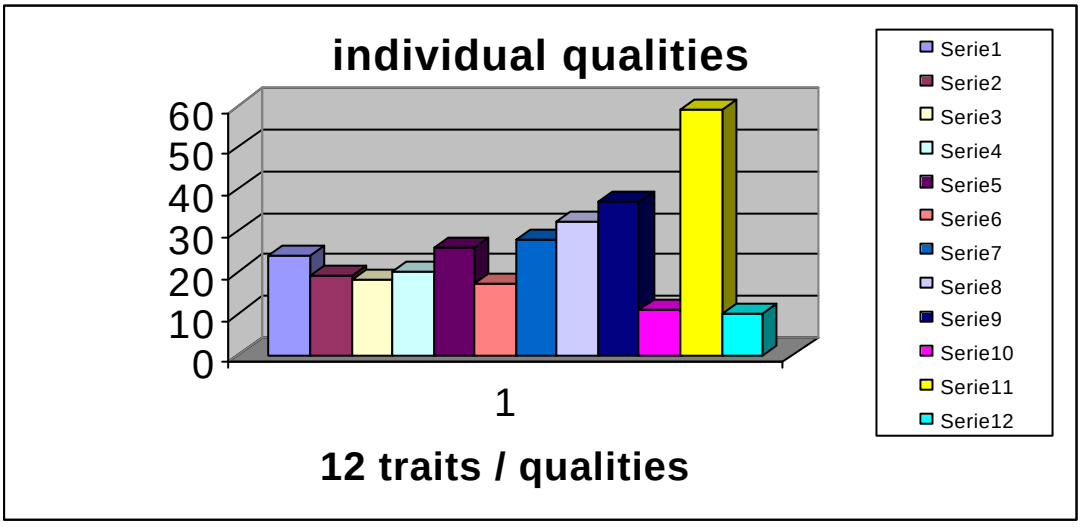
We have also tried to elucidate some background information on the codes concerning their origin and their authors. Only 2 of the standards were originally drafted by individuals, while 101 were written by a committee (the rest unknown). As far we could find out, only 1 of the standards had its immediate origin in a specific scandal that called for clarifying the ethics in

[2] These distinctions are discussed and clarified in BD Appendix (ii).
[3] Cf. BD 1.4.

science. 28 were related to specific problems that scientists felt needed to be handled, and 28 came out of a general interest.

b) Information pertaining to the core ethical responsibilities of individual scientists

If one turns from the more formal information to the content of the standards, one gets a first glimpse of a more substantive discussion about ethics in science. Obviously, there is wide scope of possible positive traits or virtues that may figure in such standards, and their wording may somewhat differ without any substantial difference in implied behaviour. We have tentatively tried to identify some of the core traits or virtues that we expect to find in the standards. We have then scanned the material for occurrences of these key-terms or closely related ones. Again, we want to warn against various kinds of pitfalls in this analysis, as e.g. the fact that occurrence of identical terms does not necessarily imply a homogenous interpretation of their content. However, the total picture that emerges from the material may still provide a first indication of what kind of individual responsibilities the bodies that issued ethical standards actually have in mind. Unfortunately, the way the material was presented to us did not allow us to make a more detailed analysis of possibly interesting co-variances among the categories.



1=honesty, 2=openness, 3=fairness, 4=thruthfulness, 5=accuracy, 6=conscientiousness, 7=giving due credit, 8=respect, 9=collaboration, 10=loyalty, 11=professional quality, 12=whistle-blowing.

As one can see in the above diagram, the most outstanding feature of this assembly is that professional quality occurs nearly three times as often as the average number of all other traits. It is clear that the precise content of this trait can at times be problematic to specify or be subject to conflicting interpretations. However, guidelines or codes of ethics are certainly not the place to expect an operationalisation of terms and goals of this kind. Rather, it may be a common feature of guidelines that they are built around overall norms, principles or goals that exhibit a certain vagueness. The striving for professional quality as an attempt to realise objectivity is apparently seen by many of those who issue ethical standards as the primary ethical obligation of any individual scientist or engineer.

The traits “collaboration”, “respect”, “giving due credit”, “honesty” and “fairness” refer relationships among scientists that are usually deemed essential to the workings of the scientific community. Together they make up a substantial number of occurrences in the standards (37+32+28+24+18). “Fairness” is a trait that may also be understood to refer to dealings with the world outside science.

"Truthfulness" and "accuracy", and perhaps also "conscientiousness" seem first of all to relate to the content of the scientific production and the way a scientist is expected to handle the empirical material. Though these features do not figure most prominently among the occurrences of central traits (20+26+17), it can be safely assumed that the term "professional quality" normally is understood as comprising these aspects as sub-categories.

The term "openness" occurs 19 times in the material. What is implied by this term may be a bit unclear, and is certainly dependent on the context of its occurrence within a given standard. A first and perhaps natural interpretation would be to expect that it comprises openness about the data-material, including e.g. the free exchange of data or research material (like cell-lines etc.). But there may also be more far-reaching interpretations, like e.g. the way the study was performed, sources of funding for the study, or even the disclosure of other conflicting interests (like outside contracts with industry etc.). One interesting ethical feature of this quality is perhaps that it usually must be triggered by requests. Unless e.g. scientific journals do demand or ask for that kind of information, or unless a scientific colleague asks for the data-material, an individual scientist may not have the chance to show this quality in practice. Thus, openness may be an individual ethical quality, given that the scientific community has established routines for the standard exchange of this kind of information. Probably the clearest feature of this quality is that it is supposed to be the opposite of secrecy. Standards of ethical behaviour of individual scientists that underscore the value of openness therefore exclude secrecy among the features that may be tolerated in science.

The qualities "loyalty" and "whistle-blowing" invite perhaps the most problematic interpretations. Loyalty of course may have a double meaning. It can be a quality of behaviour that characterises the scientists' relationship to his or her peers, or the scientific community in general. This would be an "internal" interpretation of the term. But it may also characterise the scientists' relationship to the general public or to outside parties that have a special interest in the study (e.g. those that fund the study or those that are affected by it). One may expect that the context of the standard will provide hints of which interpretation is intended in the specific case. If taken in the narrow "internal" meaning, the term lines up well with the qualities mentioned above, like "respect", "collaboration" and so on. If, however, taken in the wider sense, comprising loyalty to external parties of various scope (from funder to general public, or country and religious groups etc.), it may run counter to what many scientists intuitively regard as an ethical duty. First of all, many people will hold that loyalty at best is a conditioned ethical quality. This would mean that loyalty (as e.g. political loyalty) applies only when e.g. professional quality is not compromised by it. Secondly, many people will perhaps hold the deep-felt conviction that one of the main functions of science is to realise its critical potential, i.e. that science needs to counteract by objective contributions those distortions of reality that are wide-spread but due to a clear interest-bias. If that is the case, than loyalty cannot be expected towards these interests. Again, this could be remedied by making loyalty a conditioned quality, subsumed under e.g. a greater common good. This then is also the link to the other quality, "whistle-blowing".

Whistle-blowing refers normally to unauthorised disclosure by a member of an organisation of information held within the organisation. Setting aside loyalties to the organisation or colleagues within the organisation for a common good, the whistleblower risks sanctions from peers in hopes that the larger audience will appreciate the information conveyed to it.

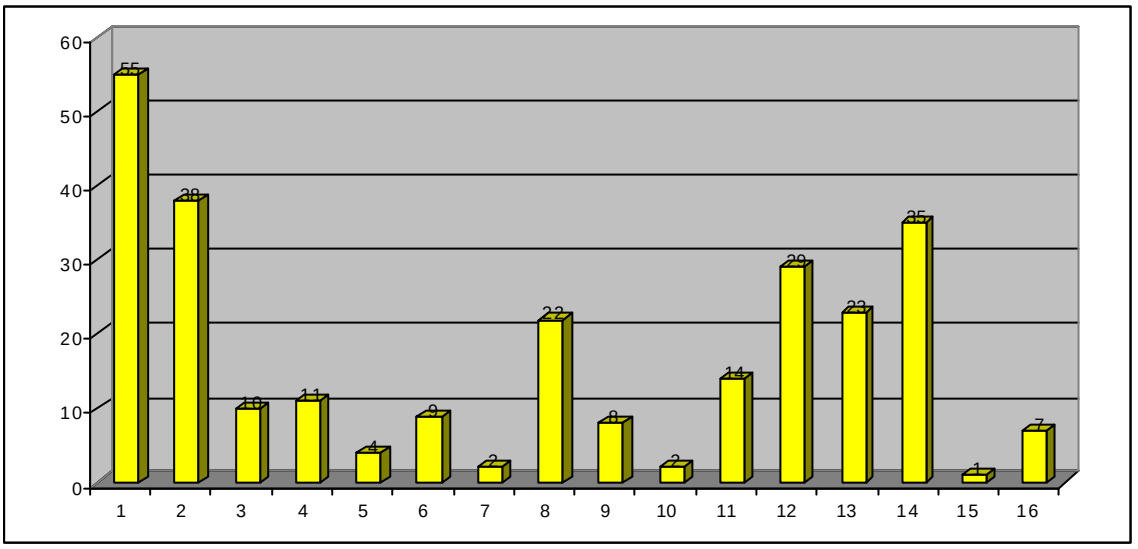
Both loyalty and whistle-blowing may thus be understood as qualities that link the individual scientist with external groups or with society at large. The fact that they appear relatively seldom (11+10) in the material may be taken as an indication that the scientific community

has not yet come to a definite conclusion concerning how individual scientists are expected to handle their responsibilities towards external parties.

c) Positive values for science as a communal activity

Ethics consists not only of a micro-level comprising the behaviour of individuals, but also of a macro-level that set standards and goals for the combined efforts of the scientific community. They specify what the sum of the individual contributions should add up to.

The following diagrams exhibit the occurrence of the 16 traits / qualities that we have used as basic categories.



1= social responsibility, 2=environmental responsibility, 3= sustainable development, 4= socio-economic development, 5=social welfare, 6= socio-economic equity, 7= gender equality, 8= scientific freedom, 9= peace, 10= democratic development, 11= human rights, 12= welfare of human subjects, 13= animal rights, 14=scientists acting in different roles, 15=internet, 16= whistle-blowing & institutional responsibility.

Again, we do not want to enter a detailed analysis of the semantics of the categories used here. We have taken a descriptive standpoint and investigated the occurrences of these terms (or very similar terms) in the standards. Double or multiple occurrences within a single standard are counted as a single occurrence, but occurrences of several different terms within a standard are counted separately. Thus there is an overlap between the categories.

The great number of standards that mention “social responsibility” (55) is perhaps surprising to some. However, given the academic traditions from the Enlightenment onwards and given the implicit social contract on which science has been built since then, the inclusion of social responsibility among the scientific virtues seems a consequent. More surprising to our mind is the fact that 38 standards explicitly mention environmental responsibility, and 35 discuss the issue of scientists acting in different roles (carrying various “hats”)[4].

With regard to environmental responsibility, this quality could perhaps be seen in conjunction with “sustainable development” (10 occurrences). The prevalence of these terms in the analysed material may be an indication that science does indeed pick up some political signals and adjusts its internal expectations correspondingly. It would certainly be a false rhetoric to claim that science is totally irresponsive to the environmental predicament of our planet.

[4] Cf. BD, p. 8. The concept of social responsibility is discussed in BD 2.2.

Perhaps one may even want to make the case that it is science that puts the environment on the agenda, for politics to pick it up.

Things are a bit different with regard to gender equity (2 occurrences) or peace (8 occurrences). While science seems ready to take its share of responsibility when it comes to the environment, it seems more reluctant to do the same with regard to gender issues or peace. This can certainly be interpreted in several ways. At worst it may be an indication that science is indifferent with regard to these values. At best it may be an indication that science simply assumes it endorses these values anyway, without the need of explicit mention. Or it may be seen as an expression of the belief that science under no circumstance is in a position to affect policies in these fields. It may express the belief of a strict demarcation between the political and the scientific. This could also explain the low occurrence of "democratic development" (2). "Human rights" on the other hand does not occur too infrequently (14 times) in the material. Some aspects of human rights may also relate to the mention of the "welfare of human subjects" (29), though a standard interpretation of the latter would limit the scope of human subjects to those that are actually studied by science.

In regard to gender equity it may be worthwhile noting that this quality appears in one international statement on ethics, issued in 1989 by a union / association of science, and in another international declaration, issued in 1999 by a one-type event. Gender issues may perhaps have come to the awareness of people more recently than e.g. environmental issues.

"Animal welfare" occurs altogether 23 times in the material. We have no way to judge whether this figure should be seen as relatively high or relatively low. Obviously, animal welfare does not play a role in many physical sciences, like physics or astronomy, or other disciplines without application to the living world. But it certainly does enter the picture in the life-sciences or many applied branches like toxicology etc. One would hope that mention of animal welfare occurs in *precisely* those cases where it is relevant. While we see from the list of standards that mention of animal welfare is made by unions or other bodies where it certainly is relevant, we have no basis to claim the opposite, i.e. that animal welfare is not relevant where it is not mentioned[5].

We also want to point to the fact that the internet is mentioned only once in the material. Since there always is a certain time-lag between the rise of a new technology and the ethical awareness around its use, one may see this as the expression of such a time-lag. Attempts to include "computer-ethics" or the internet in standards of ethics are in any case of a recent time[6].

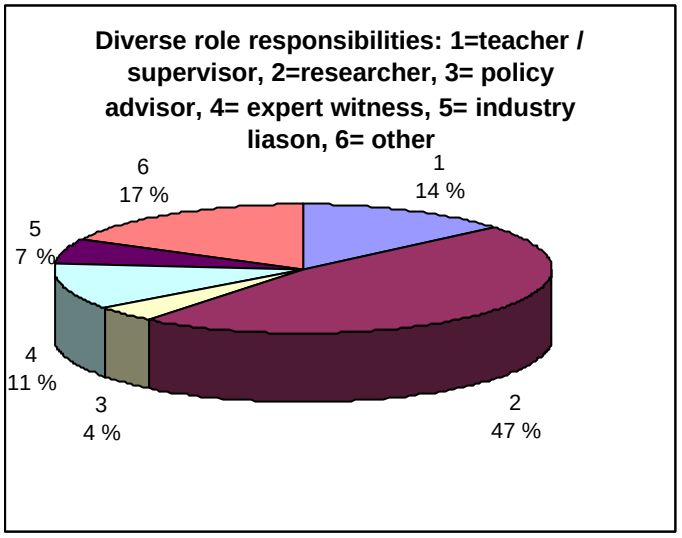
The occurrence of "scientists acting in different roles" (29) suggests an awareness of problems where scientists easily end up in conflicting role-models or interests. The more applied the science, the greater the chance that scientists actually will wear various hats at the same time. The underlying theme seems again to be the concern for the larger common good, which we already mentioned with regard to whistle blowing. Some of the roles or some of the interests that scientists may pursue can easily come into conflict with this greater common good (i.e. social responsibility).

In this context it is also interesting to note the sparse occurrences of whistle blowing and the corresponding institutional responsibility (7 times). While blowing the whistle in a given case is in the last instance an ethical decision of the individual, scientific institutions may have a communal responsibility to provide an institutional framework where this kind of decision is

[5] Animal welfare is discussed in BD 2.3.
[6] The internet is discussed in BD 2.4.

not made too difficult for the individual. It is a well-known fact that whistle-blowers often experience tremendous pressure from the mother institution for the breach of loyalty. In some cases this can lead to the stigmatising of the individual, with job-loss and severe hardships following.

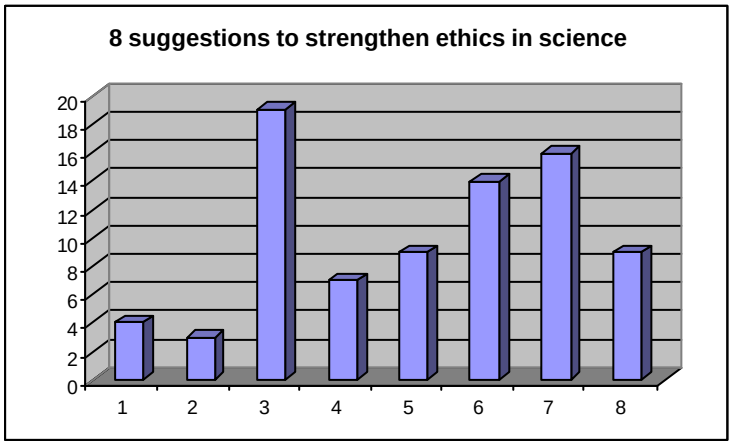
Many standards address the different roles that scientists may take in different circumstances, often related to parties or interests outside science. The following diagram depicts the relative occurrence of these roles in the standards:



The total numbers for these occurrences are: 1=17, 2=57, 3=5, 4=14, 5=8, and 6=21 with the total exceeding the number of standards due to double occurrences.

What is interesting about this diagram is the general awareness that scientists do occupy roles that are external to science. With the exception of teacher / supervisor and researcher, all other roles may be perceived as service to non-scientific interests. With 39% mention of these external roles, one may conclude that the interface between science and societal roles is recognised as a field that calls for ethical guidance. This compliments our earlier remarks on whistle blowing.

An interesting question is whether the ethical standards have something to say about the integration of ethics in science. Does one find indications that the ethical standards are perceived as a first attempt to the firmer integration of ethical awareness into science, and if so, are any specific mechanisms suggested in the codes? This kind of question is probably the least specific among the questions we have asked, since it is difficult to specify how the wish to integrate ethics into science would be worded in the standards. One could imagine cases where a specific standard represents a very strong call for more ethics in science, but this is more implicitly than explicitly expressed. But some standards do mention specific measures that should or could be taken in order to strengthen ethics in science. These are depicted in the next diagram:



1= ethics as a guide to prioritise research topics and make choices among them, 2= increase the allocation of funding for this purpose, 3=ethics as a guide to improve research practices, 4= ethics linking up to scientific applications, 5= more ethically reflected transmission of scientific results, 6=more ethics in education and training, 7=establishing ethics committees, 8= others.

The number of individual suggestions is relatively low, but it is still noteworthy that 19 standards suggest improvement in research practices by better ethics, that 14 call for more ethics in education and training, and that 16 ask for the establishment of ethics committees.

Conclusions of the data

The analysis of the 115 standards of ethics in science shows a wide variety of concerns that are expressed in the standards. They also show that many actors have taken an initiative in this field, most of them preferring to convey codes of ethics or ethical guidelines.

A very clear tendency in the material is the near exponential growth of such standards with time. A very natural interpretation of this is that ethical issues are felt to become more and more important, and science cannot be unaffected by this but must take action. This trend merely confirms what any informed person would have suspected anyway, namely that the times when science could stay clear of complicated ethical issues are over, and that ethical issues arise already within the core of the sciences, and in the interface between science and the public.

- The activity of explicitly formulating codes of ethics or ethical standards is increasing with the advances of the sciences and the changing conditions of the outside world.

The wide occurrence of both disciplinary and interdisciplinary standards seems to disprove the suspicion that ethics needs to stay within the disciplinary boundaries of the special sciences if scientists are to make sense of it. Thus there obviously is a good case for arguing that inter- or trans-disciplinary ethical guidelines of a wide scope do indeed serve an important function in science:

- Inter- or trans-disciplinary ethical guidelines or codes of ethics are perceived as serving an important function in science, alongside the disciplinary ones.

More substantial results concern the qualities that the standards deem important enough to deserve explicit mention in the guidelines / codes etc. With regard to the individual qualities the striving for objectivity or, more generally, the upholding of professional quality is widely perceived as the primary ethical obligation of the individual scientist. In itself, this may again not be very surprising, since it seems to reflect what many people regard as the traditional ethos of science. However, when seen against the background of current discussions about the alleged deep structural changes that science has undergone since WW II, with the increased pressures on relevancy and problem-based research in new institutional settings, this insistence on "traditional" values is indeed noteworthy, if not reassuring. Its explicit mention may, however, also reflect that one perceives that this professional quality has come under increased attack from other forces.

- Striving for objectivity and upholding standards of professional quality are perceived as primary ethical obligation of the individual scientist.

The traits "collaboration", "respect", "giving due credit", "honesty", and "fairness" appear relatively frequently in the analysed material, indicating the importance attached to them.

- The traits "collaboration", "respect", "giving due credit", "honesty", and "fairness" refer to relationships among scientists that are deemed essential to the working of the scientific community.

When it comes to the communal qualities it seems noteworthy that most of the standards express social responsibility as well as environmental responsibility (including sustainable

development) as primary goals and values for the scientific enterprise. These values seem to serve as overall ethical values that integrate scientific activity in a larger societal framework, i.e. they provide a basis for the social contract of science. These values are both important and telling, since they seem to extend the realm of ethical responsibilities of the scientists from the mere research process to the integration of the knowledge products in the wider societal and political framework. In other words, the ethics of science, when expressed with these qualities, takes the step from a micro-ethics within the internal bounds of the scientific community to a macro-ethics of an interaction between science and society.

- Social and environmental responsibilities are widely recognised as important values for science in its dealings with societal interests.

Given this recognition of social and environmental responsibility, and given the insistence on professional quality, it is the more surprising that some of the problem areas where these values easily clash are not taken up more often or more explicitly. Here we think about the complex of qualities that deals with the different roles of the scientists, with whistle blowing, loyalty, openness, and the mechanisms for dealing with supposed conflicts of interests etc. While it seems clear to us that modern science and its practitioners are more than ever before subject to pressures and interests that easily may lead to conflicts with expressed norms of science, these conflicts are apparently not widely dealt with in the standards that we have analysed.

- Comparatively few standards of ethics in science are explicit about possible conflicts of roles or interests that individual scientists may be subjected to.

Finally we note that a substantial number of standards call for ethical improvement in research practices, and that they often mention the establishment of ethics committees and the strengthening of ethics in education and training as a remedy.

- Those standards that address the issue of implementation express often a concern regarding the improvement of research practices, and see both ethics committees and better education as a means to this end.

Remarks on the ethical norms of science

Science enters into a number of new dependencies in its effort to fulfil the tasks that are set by society. However, we believe that this need not threaten the basic normative commitments of science. The development toward new institutional settings for science only increases the need to work out good standards of quality and objectivity. Thus it may be re-interpretation rather than radical change that is the challenge for those who want to get clear about the norms and ethics of science.

In this context we also note with interest that many policy makers increasingly stress the triple normative commitment of: **quality**, **transparency** (openness), and **responsibility** (socially and environmentally) with regard to science. In some contexts, also the need of greater **interaction with**, or **participation** of the public is stressed. This is e.g. apparent in the documents from the World Science Conference 1999. In this regard we want to remind scientists of the list of social issues that is explicitly addressed in the final documents of this conference. They are among others: - a reduction of the resources allocated to the development of new weapons (3§), - the (partial) conversion of military production and research facilities to civilian use (3§), - sustainable human development including poverty alleviation (11§), - improved human health and social care (12§), - and respect for human

rights (39§). Ethics can be seen as the arena of dialogue between science and society where clarification on these issues is sought. As far as we understand, this is also reflected in the recent discussions about a new social contract for science.

We believe that ethical standards serve an important function in this context. Though their effect in preventing misconduct may be doubted, they still set a framework or orientation that appears clarifying, in particular for younger scientists. We see standards of this kind in a dynamic perspective: they need to respond to changing societal and institutional conditions and provide goals for the scientific enterprise. Thus they need revisions and continued discussions. To this end it is important that there is institutional ownership of the standards. Ideally such standards should also inspire the education and training of young scientists. Norms such as e.g. professional quality, transparency and responsibility are notoriously vague and need to be discussed on the basis of concrete examples, good and bad, in order to be experienced as meaningful.

The issue of a scientific oath or a scientific pledge ought perhaps best be seen as an extension of these developments. It marks the individual adoption of such norms by a public act, and thus has a function both with respect to the individual taking such an oath, and with respect to the public that conceives such an act as a normative reference point. However, without the lively debate and continued renewal of codes of ethics or ethical guidelines in science such an oath or pledge runs the danger of becoming a pure formality without content. Our study has revealed, among other things, that the scientific community already has started along this route of ethical debate and formulation of guidelines. Ethical standards as they are to be found in the scientific community confront issues of great importance, and they are a good foundation to confront the ethical challenges of the future.

Conclusions and recommendations

SCRES recommends the following actions:

- That following consultation with ICSU members, ICSU take the foregoing conclusions as the basis for a model format of ethical guidelines for the use of ICSU members,
- That ICSU specify mechanisms or platforms for revising guidelines, e.g. in the form of ethics committees,
- That such guidelines be accompanied by teaching activities that are encouraged and supported with teaching materials from ICSU members,
- That ICSU address qualities like social and environmental responsibility. ICSU can begin processes to advance understanding of these terms. In such efforts, ICSU can identify situations that generate conflicts with these goals, e.g. when scientists act in various advisory roles at the interface of science and society.

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