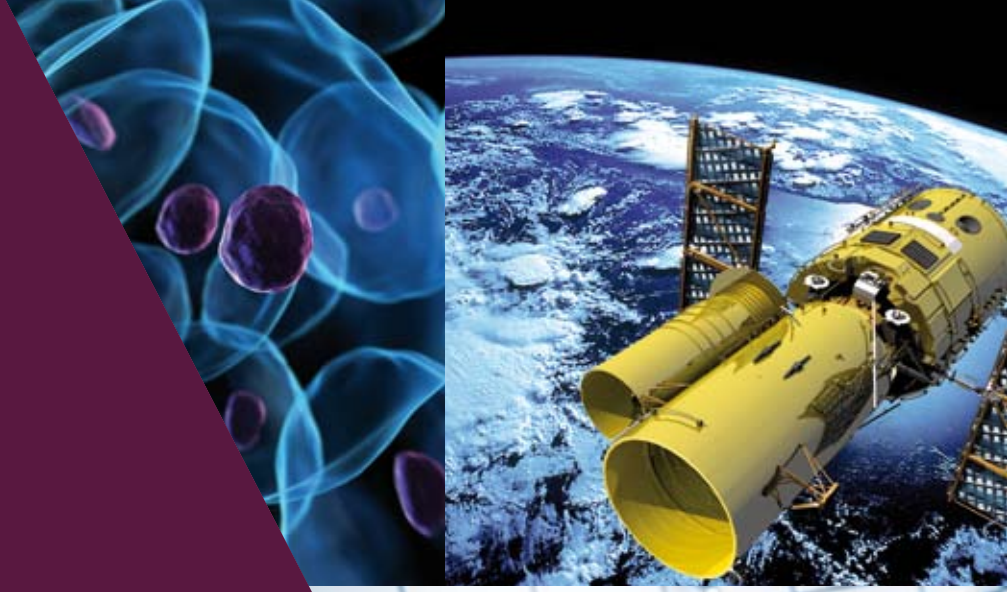

Freedom, Responsibility and Universality of Science

ICSU
International Council for Science

About ICSU

Founded in 1931, the International Council for Science (ICSU) is a non-governmental organization with a global membership of national scientific bodies (114 Members, representing 134 countries) and international Scientific Unions (29 Members). The Council is frequently called upon to speak on behalf of the global scientific community and to act as an advisor in matters ranging from scientific conduct to the environment. ICSU's activities focus on three areas: planning and coordinating research; science for policy; and strengthening the Universality of Science.

ICSU's mission is to strengthen international science for the benefit of society. To do this, ICSU mobilizes the knowledge and resources of the international science community to:

- **Identify** and address major issues of importance to science and society
- **Facilitate** interaction amongst scientists across all disciplines and from all countries
- **Promote** the participation of all scientists—regardless of race, citizenship, language, political stance, or gender—in the international scientific endeavour
- **Provide** independent, authoritative advice to stimulate constructive dialogue between the scientific community and governments, civil society and the private sector.

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Freedom, Responsibility and Universality of Science

Committee on Freedom and Responsibility in the Conduct of Science
of the International Council for Science (ICSU)

Preface

This booklet explains the Principle of Universality of Science[1] and provides a brief overview of issues relating to the freedom to conduct science and responsibilities of scientists. It also includes some illustrative examples of the role that the International Council for Science (ICSU) and its Members have played in defending the freedom of scientists. It should be of interest to everyone involved with science—students, scientists themselves, science managers and policy makers, and also the broader community. While, primarily, the focus is on science in academia, it is also relevant to individuals in many different settings practicing or concerned with science.

The Committee on Freedom and Responsibility in the conduct of Science[2] (CFRS), which has produced this booklet, was established by ICSU in 2006. It is the latest in a series of policy committees that have been responsible for promoting and safeguarding the freedoms of scientists as described in the Principle of Universality (ICSU Statute 5). The new Committee differs significantly from its predecessors in that it has been explicitly charged with also considering the responsibilities of scientists. The impetus for this change came from a strategic review of Science and Society: Rights and Responsibilities (ICSU, 2005) that analysed the changing context for scientific practice and its relationship with, and influence on, other sectors of society.

This booklet does not attempt to dictate new universal norms and codes. ICSU's role is rather to provide an overall framework for reflection and debate. The booklet deliberately raises many unanswered questions and might best be considered as a stimulus to future thinking. We hope you enjoy it, learn something from it and are motivated to discuss the issues it raises with colleagues and friends.

Bengt Gustafsson
Chair of the ICSU Committee on Freedom
and Responsibility in the conduct of Science

Carthage Smith
Deputy Executive Director
ICSU

[1] More information on the background and operational implications of some aspects of the Principle of Universality of Science are available at www.icsu.org. This website includes, for example, regularly updated guidelines on the organization of international scientific meetings

[2] see www.icsu.org/5_abouticsu/STRUCT_Comm_Poli.html#CFRS for Terms of Reference and membership

Executive summary

Implementation of the Principle of the Universality of Science is fundamental to scientific progress. This Principle embodies freedom of movement, association, expression and communication for scientists, as well as equitable access to data, information and research materials. These freedoms are highly valued by the scientific community and generally well accepted by governments and policy makers. Hence, scientists are normally able to travel to international meetings, associate with colleagues and freely express their opinions regardless of factors such as ethnic origin, religion, citizenship, language, political stance, gender, sex or age. However, this is not always the case and so it is important to have mechanisms in place at the local, national and international levels to monitor compliance with this principle and intervene when breaches occur. The International Council for Science (ICSU) and its global network of Members provide one such mechanism to which individual scientists can turn for assistance.

The Principle of the Universality of Science focuses on scientific rights and freedoms but implicit in these are a number of responsibilities. Individual scientists have a responsibility to conduct their work with honesty, integrity, openness and respect, and a collective responsibility to maximize the benefit and minimize the misuse of science for society as a whole.

Balancing freedoms and responsibilities is not always a straightforward process. For example, openness and sharing of data and materials may be in conflict with a scientist's desire to maintain a competitive edge or an employer's requirements for protecting intellectual property. In some situations, for example during wars, or in specific areas of research, such as development of global surveillance technologies, the appropriate balance between freedoms and responsibilities can be extremely difficult to define and maintain.

The benefits of science for human well-being and development are widely accepted. The increased average human lifespan in most parts of the world over the past century can be attributed, more or less directly, to scientific progress. At the same time, it has to be acknowledged that technologies arising from science can inadvertently have adverse effects on people and the environment. Moreover, the deliberate misuse of science can potentially have catastrophic effects. There is an increasing recognition by the scientific community that it needs to more fully engage societal stakeholders in explaining, developing and implementing research agendas.

A central aspect of ensuring the freedoms of scientists and the longer term future of science is not only conducting science responsibly but being able to publicly demonstrate that science is being conducted responsibly. Individual scientists, their associated institutions, employers, funders and representative bodies, such as ICSU, have a shared role in both protecting the freedoms and propagating the responsibilities of scientists. This is a role that needs to be explicitly acknowledged and embraced. It is likely to be an increasingly demanding role in the future.

The nature of science

Science is the attainment of knowledge through research—the systematic exploration and explanation of the unknown. The scientific process is based on the formulation and testing of hypotheses by the generation of verifiable evidence from observations and experiments[3]. As such, science has an inherent and very important cultural value; satisfying human curiosity, enriching the human spirit and changing human perceptions and understanding. In parallel, scientific research provides the basis for the development of the technologies and policies that are shaping the future of Planet Earth. Science and technology are major drivers of innovation, social welfare, increased productivity and wealth-creation.

For science to progress efficiently and its benefits to be shared fairly, scientists must be allowed to communicate, travel, associate and to have access to information and materials. For the privilege of being able to freely perform research, scientists have a duty to act honestly and ethically with respect to the environment, animals, humans and society, as well as each other. Because not all the applications of science are beneficial and the misuse of scientific knowledge can present serious threats, scientists also have a shared responsibility with other members of society, to do their utmost to prevent misuse of their discoveries.

The desire to maximize the use of science for the universal good of society is encapsulated in the vision of the International Council for Science (ICSU):

> The long-term ICSU vision is for a world where science is used for the benefit of all, excellence in science is valued and scientific knowledge is effectively linked to policy-making. In such a world universal and equitable access to high quality scientific data and information is a reality and all countries have the scientific capacity to use these and contribute to generating the new knowledge that is necessary to establish their own development pathways in a sustainable manner.
> *ICSU Strategic Plan 2006-2011*

[3]For a more detailed discussion on the nature of science and its distinction from traditional knowledge and pseudo-science, see 'Science and Traditional Knowledge: Report from the ICSU Study Group' (ICSU, 2002) at www.icsu.org/Gestion/img/ICSU_DOC_DOWNLOAD/220_DD_FILE_Traitional_Knowledge_report.pdf

The Principle of Universality

ICSU was created in 1931, essentially to promote scientific exchange and interaction across national borders and among scientific disciplines; in other words to help build a truly international science community. This was not just an idealistic aim but was based on the very practical realization that science is inherently a global enterprise. From the outset it was recognized that effective exchange and collaboration across borders requires shared understanding and acceptance of the freedoms of scientists to circulate, associate and pursue their science. These freedoms are embodied in the Principle of the Universality of Science, which has provided the basis for free scientific exchange over the past 75 years.

The essential elements of this Principle, as defined in ICSU's Statute 5, are non-discrimination and equity. In accordance with this principle, all scientists should have the possibility to participate, without discrimination and on an equitable basis in legitimate scientific activities, whether they are conducted in a national or international context. In asserting this, it is implicit that scientists themselves must accept certain responsibilities both in relation to the conduct of their science and to society.

The Principle of the Universality of Science (ICSU Statute 5)

The Principle of the Universality of Science is fundamental to scientific progress. This Principle embodies freedom of movement, association, expression and communication for scientists as well as equitable access to data, information and research materials. In pursuing its objectives in respect of the rights and responsibilities of scientists, the International Council for Science (ICSU) actively upholds this principle, and, in so doing, opposes any discrimination on the basis of such factors as ethnic origin, religion, citizenship, language, political stance, gender, sex or age. ICSU shall not accept disruption of its own activities by statements or actions that intentionally or otherwise prevent the application of this principle.

Freedoms of scientists

Included in the Principle of Universality above are four specific freedoms for scientists—freedom of movement, association, expression and communication. Defence of these freedoms is grounded in the Universal Declaration of Human Rights, particularly Articles 13, 19, and 20. Access to data, information and research materials for science is also supported by article 27.

Freedom of movement

Article 13 of the Universal Declaration of Human Rights concerns the right to freedom of movement and residence within the borders of each nation and the right to leave any country, including one's own, and to return to that country.

Problems in obtaining national entry visas are a relatively common obstacle to the freedom of movement of scientists in various parts of the world. These entry visa issues are most frequently associated with either security and/or politics and tend to be targeted at particular population groups. There is also the problem of scientists who are not permitted by their national authorities to travel outside their own countries—generally out of fear that they will reveal embarrassing information about their country or that they might not return. Without careful monitoring and attention, there is a real danger that certain members of the global scientific community will become isolated.

ICSU and visas for scientists

ICSU and its Members have acted when scientists wishing to attend scientific meetings outside their countries of citizenship have been denied visas for political reasons. For example, in the 1970s and 1980s, ICSU actively defended 'refusenik' scientists who were denied exit visas from the former Soviet Union (and other Eastern bloc countries) to attend international scientific meetings with their colleagues in the West. During the 1980s ICSU intervened on behalf of about 20–30 scientists per year. Examples of difficulties encountered include scientists in Taiwan who were denied visas by mainland China and vice-versa, Chinese scientists who had difficulties obtaining visas to Israel, Iraqis who were denied visas to Sweden and South Korea, Cuban scientists who were denied visas to the US and Australia, and scientists in Israel and South Africa who had difficulties obtaining visas from a number of countries. ICSU, working with its Members, frequently intervened vis-à-vis the countries refusing visas and, in the majority of cases, it was successful in reversing the initial refusal.

In some instances, ICSU has called for the relocation or cancellation of scientific conferences when visas have been denied for political reasons. One notable case occurred in 1988 when the ICSU General Assembly was held in China rather than Japan because the Japanese government advised ICSU that South African scientists would not be granted visas.

Freedom of association

Freedom of association relates to the right of individuals to peaceably and voluntarily associate with other people without interference. Scientific progress depends on contact between scientists in different nations. Many areas of scientific study, particularly in medical or social sciences, depend on close contact with and/or investigation of specific societal groups.

Boycotts, whether they are targeted at scientists or not, can, by their very design, present a major obstacle to the freedom of association. Another challenge arises because of the interest and involvement of many scientists in improving society. Good scientists seek and speak the truth, regardless of whether the subject is scientific and/or political. In most societies this is considered to be a normal, and healthy, part of democratic discourse. However, in some circumstances, for example in the face of unjust government behaviour and repression of human rights, scientists may become active proponents for change. In associating with others who share their views, they can make themselves vulnerable to accusations of associating with terrorists or treason. In some countries, individual scientists who have contact with foreign colleagues risk similar charges of treason or espionage.

ICSU and boycotts

On behalf of the global scientific community, ICSU actively defends freedom of association by opposing proposed or actual politically-inspired boycotts against scientists and academic/scientific institutions based on nationality or geographic location. Specific cases have involved South Africa, Israel and Serbia. For example, ICSU spoke out in 2002 when some academics in the United Kingdom promoted a boycott of Israeli scientists and academic institutions, and when two Israeli scholars were dismissed from their positions on the editorial boards of two scientific journals published in the United Kingdom. Although the proposers behind the boycott wished to draw attention to restrictions on freedom of association imposed by Israel on Palestinian students and academics, ICSU considered that action targeted at the Israeli academic community was seriously misplaced and issued a public statement. This statement called for academic cooperation rather than boycotts. When a similar issue arose again in 2007, a public letter was submitted to the journal *Nature*[4]. At the same time, concern has been expressed to the Israeli authorities that the rights of bona fide Palestinian students and academics to associate, communicate and leave their territories for academic purposes are being denied.

[4] *Nature*, **447**: 908, 'Scientists should promote cooperation, not boycott'

Freedom of expression and communication

As mentioned above, good scientists seek and speak the truth. They, like everyone else, have the right to freely express their ideas and opinions, be it by writing, speaking, or other means of communication.

In a number of countries, when individuals criticize government policies—be they about environmental issues, health, education, or scientific practices—they risk severe repercussions. Extreme cases involve repression of individuals, including harassment, detention, arrest, torture, and denial of medical treatment and access to family and lawyers.

ICSU and persecution of scientists

In association with other scientific and human rights organizations, ICSU supported the physicist Andrei Sakharov in the 1980s when he was persecuted by the former Soviet Union for speaking out against uncontrolled progress, unregulated industrial development, and dangerous or irresponsible military applications of scientific achievements. A similar group of concerned organizations, acted on behalf of environmentalist Wangeri Maathai in the 1990s when she was imprisoned after speaking out against Kenyan government environmental practices, particularly deforestation; and, in more recent years, they intervened on behalf of Russian environmental engineer Alexander Nikitin, who wrote with a Norwegian environmental organization about the dangers posed by nuclear dump sites and nuclear-powered submarines of the Russian Northern Fleet. ICSU also intervened in the case of Belarusian scientist Yuri Bandazhevsky, who was imprisoned after researching and voicing strong criticism of Belarusian government policies regarding the health effects of the Chernobyl disaster on the local population.

Access to data, information and research materials

Article 27 of the Universal Declaration of Human Rights states that, 'everyone has the right to...share in scientific advancement and its benefits.' Access to scientific data, information and research materials is essential for scientists and for those wishing to benefit from the products of science. This is acknowledged in recent UNESCO and OECD guidelines on access to information and data[5].

In practice, there are many obstacles to providing universal and equitable access to these fundamental building blocks of science. These may be technical, such as poor internet access for on-line resources; financial, such as charges for scientific journals; or security-related, such as access to certain categories of equipment or materials. In some instances the obstacles are the result of the behaviour

[5] See Policy guidelines for the development and promotion of public domain information (UNESCO, 2004) at http://unesdoc.unesco.org/images/0013/001373/137363eo.pdf , and OECD principles and Guidelines for access to Research Data form Public Funding (OECD, 2007) at www.oecd.org/dataoecd/9/61/38500813.pdf

of the scientific community itself and its reluctance to share data and materials. Comprehensive solutions are needed to address all these issues, and developing such solutions is a long term process involving many stakeholders and interests.

At the level of individual scientists, when discrimination is preventing access, it is a clear breach of the Principle of Universality and appropriate interventions, on a case-by-case basis, can be effective.

ICSU and data and information access

ICSU has established several Interdisciplinary Bodies, including the World Data Centre system, whose specific aim is to provide full and open access to data and data products for the global science community. The ICSU Committee on Data for Science and Technology (CODATA) is very active at the international policy level in developing guidelines for data access. The International Network for the Availability of Scientific Publications, and several similar initiatives sponsored by the United Nations, help provide universal and equitable access to scientific information in least developed countries. These activities are a practical and important mechanism for promoting the universality of science.

As well as addressing infringements to freedoms, ICSU is one of a small number of global scientific bodies that actively support exchange and cooperation between scientists from all countries, including those that are in military or political conflict.

ICSU and strengthening scientific cooperation

A major role of ICSU is to plan and coordinate global interdisciplinary research programmes, for example in the area of global environmental change. All ICSU Committees and programmes are open to scientists from any country in the world and it is often the case that the 'neutral platform' of ICSU enables scientists who normally would be prohibited from meeting and communicating for political reasons, to work together.

The Principle of Universality is as relevant today as it has been in the past. Upholding this Principle and the freedoms that it embodies is critical to the practice of science and hence to optimizing the benefits of science for society. However, in today's complex world, there are a significant number of circumstances in which the uncritical applications of science may be considered to be undesirable and where the unethical or dishonest practice of science has the potential to cause harm. In this context, ICSU fully recognizes that it has a duty not only to promote and protect the freedoms of scientists but also a moral obligation to examine, recognize, and embrace the responsibilities inherent in these freedoms.

Responsibilities of scientists

There are many scholarly works that analyse and define the responsibilities of scientists and attempt to distil out the universal norms that underpin the practice of science. In recent years, a wealth of information has also been produced regarding the ethical responsibilities of scientific practice and the 'external' responsibilities of scientists to society. One conclusion from these studies is that universal norms that encompass all areas of science, and are applicable to all areas of the world, are difficult to define (and even more difficult to implement). Notable in this regard has been the response from the scientific community to a call for a 'Hippocratic oath' made at the World Conference on Science in 1999. Many scientific organizations, including national academies and disciplinary unions that are Members of ICSU, have opposed such an oath, arguing primarily that the responsibilities of scientists can only be properly and effectively agreed at the local level, the national level, or at the level of the scientific discipline.

On the conduct of science

The starting point for considering the conduct of science is that all work should be of the highest quality and, in so far as is possible, reported in a way that makes it reproducible and/or verifiable. Poor quality science—no matter how important the field—should not be tolerated and all efforts should be made to ensure the robustness of any information or data that are produced. In the 1940s the American sociologist Robert Merton formulated four principles, which he believed constituted a 'moral consensus' in science. The, so called, CUDOS norms (Communalism, Universalism, Disinterestedness and Organized Scepticism[6]) may no longer be sufficient to fully accommodate the changes that have taken place in science and society since that time. Nevertheless, they remain an important foundation on which to build.

[6] Merton, RK. (1942) 'The Normative Structure of Science' in Storer, N.W. (1973) *The Sociology of Science*. University of Chicago Press, Chicago, pp267–78. See also, for example, www.geocities.com/we_evolve/Basic_Sci/merton.html

All scientists have a responsibility to ensure that they conduct their work with **honesty** and **integrity**; to ensure that methods and results are reported in an **accurate, orderly, timely** and **open** fashion. Further to this, scientists are expected to be **impartial** and **fair** in assessing both their own work and that of their colleagues; and, to be **respectful** and **considerate**, particularly where human subjects or animals are involved or where work can have an adverse impact on the environment. While these general attributes, which largely mirror the CUDOS norms, may appear self-evident, their relative importance is not, least of all when conflicts arise between them. For example, some trade-off between consideration and openness may be required when dealing with human genetic data or reporting of geographical data on rare species. Nevertheless, an awareness and respect for each of these values is important for the individual scientist in making his or her own decisions on what is responsible scientific practice in specific situations.

Acceptance of these values also leads inevitably to another important but controversial issue—**whistle-blowing**[7]. This normally refers to unauthorized disclosure by a member of an organization of information held within the organization; in the context of scientific practice it can mean exposing fraud or malpractice but at the risk of isolating oneself from colleagues and peers and/or an employer. Whistle-blowing is often associated with, and in conflict with, another highly esteemed value—**loyalty**. The dilemma of the potential whistle-blower—to tell all and risk being ostracized or to turn a blind eye, is not made any easier in most cases by the lack of institutional support for whistle-blowers. Yet, self-surveillance of the scientific peer community is a crucial guard against scientific malpractice. Indeed it can be argued that all scientists have a duty to expose fraudulent information and/or misconduct and that whistle-blowing will sometimes be necessary.

[7] A whistle-blower is an employee, former employee, or member of an organization, especially a business or government agency, who reports misconduct to people or entities that have the power and presumed willingness to take corrective action.

On responsibilities to society[8]

Getting scientists to agree on their shared 'internal' responsibilities, relative to the scientific community, can be relatively straightforward if, in principle, we accept some derivation of Merton's norms. However, defining the 'external' responsibilities of science and scientists relative to society as a whole is more challenging. Fortunately, there is again much material to refer to and many groups have attempted, from their own particular perspectives, to define the ideal standards and goals for the scientific community as a whole[9]. The ICSU vision (see page 4) also helps define the responsibilities of the global scientific community. Extrapolating from these, one can list various central aspects of the social responsibility of the scientific community as a whole, including:

- **Responsibility to contribute to the wealth of shared human knowledge and experience**
- **Responsibility to generate, and promote the use of, relevant science to improve human welfare and sustainable development**
- **Responsibility to try to ensure the benefits and minimize the potential dangers of applications of science**
- **Responsibility to support good, evidence based, policy-making**
- **Responsibility to promote public engagement in science**
- **Concern for the greater common good**

At the level of the individual scientist these communal responsibilities imply:

- **Upholding the Principle of Universality and its inherent values of openness, equity and non-discrimination**
- **Respect for human rights, animals and the environment**
- **Acknowledging scientific risk and uncertainty**
- **Being accountable in any advisory capacity**
- **Communicating responsibly and honestly**
- **Placing societal benefits before the pursuit of personal profit**

[8] Society is used in a broad sense to include not only human beings but also the Earth and all its life support systems on which human society ultimately depends.

[9] See, for example, SCRES report, 'Standards for Ethics and Responsibility in Science' (ICSU, 2003), www.icsu.org/2_resourcecentre/RESOURCE_list_base.php4?rub=7

This may, at first reading, appear to be a fairly mundane list of responsibilities or ideals, many of which could be applied to other professions or trades. What makes it unique is the nature of science itself. Scientists are the gatekeepers of new knowledge and as such they have a special responsibility to the rest of society. In the ideal world, scientists would indeed be able to pledge to 'do no harm', but such a bold declaration would contradict what we know only too well from past experience. Scientific knowledge, if misappropriated or misused, can do considerable harm. On the other hand, when properly nurtured and managed by scientists and society, it provides enormous benefits. Given this 'dual use' potential, the demands on scientists to pay careful attention to their individual and communal responsibilities are higher than in most other areas of work.

Defining the responsibilities of scientists is further complicated by the multiple roles that scientists may play in differing circumstances, roles often related to parties or interests outside of science. The specific responsibilities associated with being a researcher, a teacher/supervisor, a policy advisor, an expert witness, or an industrial consultant can be very different. Nevertheless, as an individual scientist and member of the scientific community, it can be argued that the generic responsibilities to society remain, regardless of what role a scientist may be performing at any particular juncture.

Balancing freedoms and responsibilities

As the world continues to change, with science as a main driver, there are new challenges to the freedoms of scientists and an increased onus on the scientific community to articulate and embrace its responsibilities. But what does this mean in practice? There are many areas of science where the tensions between freedom and responsibilities are evident. The answers for resolving these tensions are invariably less evident and require much more debate and discussion both between scientists and, in many cases, with society more broadly.

A few illustrative examples[10] are given below. Each of the chosen topics is complex and in itself merits much longer discussion than can be afforded here. A number of specific questions are included but the corresponding answers are still missing. The challenge for the scientific community is to refine these questions and develop its own answers. In some instances, reaching consensus may be straightforward; on other issues, opinions may diverge sharply, but being aware of different perspectives should, at least, help in developing feasible solutions.

Armed conflicts

The development of the Principle of Universality of Science was to a great extent a reaction to restrictions imposed by governments involved in international conflicts that lead to World War II and the Cold War. Over time, a common understanding emerged as to the freedom of science and its boundaries in these conflicts between nation states and superpowers. So called 'fourth generation' armed conflicts—decentralized, chronic, low-intensity or episodic conflicts involving groupings outside of nation states—are now the prevalent type of conflict in many parts of the world. While the defence of some fundamental elements of the Principle of the Universality of Science is quite straightforward, the freedoms and responsibilities of scientists in such conflicts are not always clear-cut. Notions such as non-discrimination and equity can be subject to different interpretations in such conflict situations, raising several issues that merit further exploration, including:

[10] These examples were selected as topics that CFRS plans to explore further via workshops and/or academic reviews in 2009–11.

1. What actually happens to scientists in 'fourth generation' conflict situations: what are the real problems, pressures and influences?
2. To what extent can scientists, universities and research institutes really disassociate themselves from armed conflict involving their countries or regions?
3. What might scientists volunteer or be forced to do in such conflict situations?
4. What areas should scientists not work in, e.g. nuclear or chemical weapons, cluster bombs, bio-weapons, interrogation procedures? Can prohibitions be applied to scientists working in military research establishments and/or armaments companies?
5. How could scientists and scientific facilities be supported and protected in armed conflict situations?

The experiences of scientists in 'classical wars' cannot necessarily be directly extrapolated to 'fourth generation' wars. Without discarding established rules, new thinking and debates are needed to establish realistic expectations for the freedoms and responsibilities of scientists in chronic armed conflict situations.

Global health and emerging diseases

There are few areas where the interactions between science, society and policy are as obviously important as in the domain of public health and emerging infectious diseases[11]. There have been a number of recent global alerts for diseases such as SARS and avian influenza. The response of the global community and the scientific community, in particular, to these alerts raises fundamental issues about the rights and responsibilities of scientists. At the macro level these include the level and nature of response and investment in both basic and public health research on these diseases. At the level of working scientists there are important issues relating to bio-safety and access to, or sharing of, materials and information. Super-imposed on these issues is the national and regional versus the global perspective, as well as issues of equity and openness, including the tensions between scientific collaboration and competition. For example, tissue samples and scientific data may variously be considered as essential public health tools, dangerous precursors of bio-weapons, demonstrations of scientific prowess and levers for political influence. What is the scientist's role as the person who generates the tissue sample or data in the first instance? What is the role of the institutions that sponsor,

[11] CFRS, in partnership with the Academy of Sciences located in Taipei, held a workshop on Emerging Diseases: Rights and Responsibilities of Scientists in Taipei in October 2007. See http://iao.sinica.edu.tw/globalhealth

manage and fund research? What are the most effective mechanisms to link science and policy in crisis situations?

Public-private interface

The conditions of scientific practice in the 21st century include an increasing presence of the private sector, as well as increased collaboration, sometimes mandated by law and policy, among universities, industry and government. Indeed, measures of innovation and commercialisation have become critical performance indicators in many areas of science. While this development has generated more resources for science and strengthened ties between research and the exploitation of science, it can also carry risks to academic freedom and research conduct. Closer relationships between academia and industry can necessitate re-evaluation of the rights and responsibilities of scientists. Contractual agreements, collaborative arrangements and intellectual property protection procedures may be in direct conflict with Merton's norms for scientific practice, creating a challenge for the individual scientist to either reconcile or choose between them. Whistle-blowing and the responsibility to expose malpractice while working for the greater good can take on a whole new dimension when commercial concerns are involved. How does a scientist balance all these conflicting pressures? How involved should he or she become when confronted with questionable actions of colleagues or employers? And, how can any concerns be dealt with? What institutional measures should be taken to regulate the relations between academic scientists and commercial companies?

Science for policy: the climate change example

Over the past decade, the scientific evidence that deleterious environmental change is occurring, has become irrefutable. The most recent report from the Intergovernmental Panel on Climate Change (IPCC) concludes that it is 'very likely' that much of this change is human-induced. Scientists have played a major part in producing this IPCC report and the very large majority of scientists with expertise in these areas concur with its conclusions. At the same time, one of the obstacles to effective policy responses has been the vocal denial of anthropogenic effects by a small number of scientists. This scientific 'opposition' has found strong support from some private companies with commercial interests and has also been publicized in the mainstream media. This has been coupled to government interference with, or suppression of, unwelcome scientific views in some countries. There can be a fine line between providing scientific evidence for policy formulation and lobbying for a particular course of action; the freedoms and responsibilities of scientists on both sides of the climate change debate are not always

clear-cut. How can scientists communicate most effectively with the media and decision-makers, whilst being transparent about the degrees of scientific consensus and scientific uncertainty? Are there any situations where individual academic freedom should be tempered in the interests of scientific consensus or political imperatives?

II Global surveillance and use of information and communications technologies (ICTs)

The second half of the 20th century witnessed the development of global networks of surveillance of telecommunication traffic as part of military systems. More recently, these systems have been given legitimacy and developed further as 'security measures' in the fight against international terrorism and other criminal activity. New international conventions and modified national laws have criminalized certain on-line activities in networks, and instituted more detailed surveillance of network traffic. These developments involve scientists in several respects: the advanced technology needed is based on relatively recent scientific progress and scientists contribute to the systems. At the same time, the systems themselves—not the least when applied by repressive regimes—may threaten civil rights in general and the freedoms of scientists in particular, inhibiting the free exchange of views and results within the international scientific community. Establishing an international consensus on the responsible use and control of these surveillance systems is an important issue for the scientific community. What is the responsibility of a scientist who develops new technologies that can be used to abuse human rights? What are the relative roles and responsibilities of a scientist, both as a researcher and/or a citizen, working in this field? Are there any circumstances in which it is legitimate to inhibit scientific communication?

Concluding comments

Over the past 75 years, the Principle of Universality of Science has developed from a declaration of the rights of scientists to conduct their work freely, in communication and association with colleagues internationally; to the understanding that such rights or even privileges go hand-in-hand with the acceptance of certain responsibilities of the scientific community relative to society. In parallel, the relationship between science and society has changed in many ways, at least partially as a consequence of the increasing recognition of the socio-economic benefits and impact of science. However, there are also certain risks and dangers associated with scientific progress and the potential for its abuse or misuse.

The world today and the major challenges that face humanity are such that science must be a vital element of national, regional and international progress towards sustainable development. Given this situation, the universality of science is not only of interest to the scientific community but to society as a whole. The most important improvements in the human condition during the last century are a result of the constructive and wise application of policies and technologies that were dependent on basic and applied scientific research and discovery. To realize the full potential of science, scientific skills and work must be developed optimally. This, in turn, means that individuals anywhere in the world, who can contribute to science, have to be given adequate training and be supported by society to conduct their profession effectively and responsibly. Furthering the universality of science, and promoting the free and responsible conduct of scientists, are vital elements for the future of science and humanity as a whole. Governmental and non-governmental scientific institutions (see Appendix) have a critical role to play in working together to promote the Principle of Universality of Science.

Appendix:

Suggested roles for key institutions in dealing with issues relating to scientific freedoms and responsibilities

There are many institutions at the local, national and international level with a stake in ensuring the freedoms and responsibilities of scientists. These structures vary enormously and their potential roles overlap. Some examples of how they might contribute are given below.

Non-governmental international science bodies, e.g. ICSU

- Establish universal principles and provide ultimate recourse for individual scientists who cannot get necessary assistance from the relevant national or disciplinary bodies.
- Provide support to those same bodies as necessary, in addressing individual cases.

Intergovernmental science bodies, e.g. UNESCO

- Promote understanding and support at the governmental level for the Principle of Universality.
- Provide mechanisms to deal with individual cases, e.g. petitions to the UNESCO Committee on Conventions.

National Academies and scientific associations

- Potential role in establishing national guidelines for various aspects of scientific practice, e.g. dual use of research, bio safety or research ethics.
- May also provide a monitoring and appeal mechanism for individual cases.
- Assist with entry visas for visiting scientists.

National governments

- Develop and promote good research practice and ethics guidelines for government scientists.
- Where appropriate, establish national mechanisms for supporting and monitoring good research practice e.g. ombudsmen or offices of research integrity.

International Scientific Unions and associations

- Debate, promote and monitor freedom and responsibility issues in the relevant international, disciplinary context.
- Develop relevant codes, guidelines and educational materials. Deal with individual cases, working with ICSU and its National Members as necessary.

Research providers and funders

- Promote and support high-quality science, with no discrimination on the basis of ethnic origin, religion, citizenship, language, political stance, gender, sex or age.
- Develop good research practice and ethics guidelines to be followed as a condition of funding.
- Monitor the implementation of these guidelines and, where appropriate, develop mechanisms for dealing with individual cases.

Universities, research institutes and companies

- Ensure that employees and students are familiar with the Principle of the Universality of Science and that it is upheld.
- Take responsibility for promoting a good in-house research culture, including implementation of effective education and mentoring programmes.
- Ensure that processes are in place for dealing with conflicts relating to freedom and responsibilities at both the Institutional/company and individual level.
- Provide clear and transparent mechanisms for dealing with allegations of scientific misconduct and protecting whistle-blowers.

Photo credits

p.4 Satellite dishes. Photo: Image Bank

p.4 Drop. Photo: Alfred Bondarenko

p.10 Team work. Photo: Image bank

p.10 Team of people working together. Photo: Image bank

p.14 and Front cover: Space telescope over Earth. Photo: Image bank

p.14 Young doctor checking an MR exposure. Photo: Image bank

p.18 Woman working in the laboratory. Photo: Image Bank

p.18 and Front cover: 3D cells. Photo: Image Bank

Front cover: Working in the laboratory. Photo: Image Bank

Back cover: Young woman ready for the work day. Photo: Image bank

Back cover: Business meeting. Photo: Image bank

Back cover: Molecules and DNA compounds. Photo: Image bank

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