SUMMARY

Background and scope

The Royal Academy is issuing the report *Trust in Science*[1] in response to a request for advice by the Dutch State Secretary for Education, Culture and Science. The State Secretary asked the Academy to recommend ways to improve public trust in science and to encourage scientists to act with greater integrity, and to suggest policy measures for pursuing these aims. The Academy explored how trust in science is created and the role of scientific integrity and other factors within that context. In addition, it considered the current state of public trust in science and what policy recommendations follow from this analysis. The scope of this advisory report is accordingly much broader than the question of scientific integrity alone, and it does not address specific cases of fraud as such. Such topics have been discussed at length in other recent Academy reports.

This summary outlines the Academy's findings, in the same order as they are dealt with in the advisory report. Chapters 2 and 3 of the report are reflective in nature and explore the notion of trust in science and a number of relevant recent developments in the formal organisation and context of science. Chapters 4 and 5 are more practical and consider, respectively, questions of integrity in relation to trust, and the role of external parties such as government, the business community, the media, and education. The final chapter of the report responds to the State Secretary's individual questions and makes policy recommendations aimed at specific organisations.

1 In this summary, 'science' includes the liberal arts

Public trust in science is very important precisely because science is playing a prominent role in our modern knowledge society. Science offers benchmarks for public debate, delivers building blocks for political decision-making, and acts as an impetus for social progress and economic growth. The Academy therefore believes it is important for this report to survey the situation in the Netherlands and to analyse the threats to public trust in science. The debate concerning the level of trust in science should be conducted with a certain amount of subtlety, however. There is no need for blind trust, and a certain measure of well-grounded scepticism is inherent to the pursuit of science. In addition, the level of public trust in science appears to be relatively high in the Netherlands: science is still a 'strong brand', to put it in advertising terms. What is needed is sensible policy, not radical recommendations.

Trust and science

When the public trusts science, it regards it as reliable. In order to regard science as reliable, the public must believe that (1) science is doing the right things, and (2) doing them the right way. When we ask whether science is doing the right things, we consider the way it sets its agenda, the choices that it makes, how autonomously it makes those choices, and the value of its results. When we ask whether science is also doing things right, we look at whether it operates skilfully, whether it is properly organised, and whether it observes certain standards of integrity. These observations alone show that trust in science is a multidimensional phenomenon. Integrity is only one dimension, albeit a very important one. Others include success, autonomy, and the value of results.

An individual can assign different values to these various dimensions. In effect, the question concerning 'trust in science' should be broken down into various components. In practical terms, trusting 'science' may mean trusting it as a system, as a total sum of activities, or as a professional group, but it can also mean trusting individual scientists or certain areas of science. Public surveys concerning 'trust in science' as a rule fail to explore these various dimensions in enough detail, and the conclusions are often too easily generalised and based on responses that only consider a single dimension. Given the importance of the topic, a more specific study, repeated at regular intervals, would be preferable. The ideal institute to conduct such a study is the Netherlands Institute for Social Research (SCP).

If the aim is to design a policy that promotes trust in science and combats mistrust, it is also important to take another complicating factor into account: mistrust can arise for many different reasons. Healthy scepticism does not require corrective policy, and it would be difficult to change the minds of confirmed cynics, or those who mistrust science for ideological or religious reasons. But when the factual organisation of science or the methods it employs threaten to tarnish its reliable image, it is worth developing a policy to contain these risks. Such risks may arise in science's relationship

with other parties in civil society, or where public perceptions and expectations are mistaken.

Against the background of these considerations, this report addresses two questions related to public trust in science: how do things stand, and what needs to be done. Based on the empirical material available at the present time, the answer to the first question breaks down into two parts. First: we cannot draw any reliable conclusions about *trends*, for example what is sometimes assumed to be a decline in public trust in science. Second: non-longitudinal studies reveal that science still enjoys a large measure of public trust *relatively speaking* – in other words when compared with other institutions. Although the problem does not appear to be urgent, then, that does not mean that the answer to the second question is 'nothing'. After all, science and society are changing constantly.

Trust in a changing system of science

We cannot assume that the current situation is a given; there are various risk factors at play, closely tied to far-reaching changes in science and its increasingly high-profile positioning over the past fifty years. One of those risks is that the public has inflated expectations of science, the result of the prominent position that science occupies in the modern knowledge society. Although such expectations may themselves be a sign of trust, they can easily lead to scientists making lofty claims that they cannot live up to in the end, or to disappointment in scientific uncertainty or preliminary results. Inflated public expectations therefore require expectation management and 'new virtues' such as transparency and accountability for choices made. Another risk factor is the increasingly close relationship between science on the one hand and government, politics and business on the other. This close relationship demands careful monitoring of the autonomy and objectivity of science. Finally, the speed and omnipresence of the media make it possible not only to communicate scientific knowledge (and a knowledge of science) among a broad audience, but also offer plenty of risks in spreading disinformation and generating a hype. What we need is to ensure satisfactory science communication and level-headed journalism, and to project an honest and all-inclusive image of science and its opportunities and limitations. Due in part to the power of the media, violations of scientific integrity can have an enormous impact. They are quickly regarded as representative and the damage they do is difficult to repair. Scientific integrity therefore remains a matter of great importance.

Integrity

Scientific integrity is not just a condition for generating trust in science – it is intrinsically important. It is an issue that has long attracted considerable attention the world over. In the Netherlands, that discussion led to an updated version of the *Netherlands Code of Conduct for Scientific Practice* (VSNU, 2012) and to a detailed advisory report on *Responsible Data Management and the Prevention of Science Fraud* (KNAW, 2012). Existing codes and advisory reports on integrity provide a firm basis for policymaking, but the codes will need to be updated every once in a while. The present advisory report also makes recommendations in that respect. It identifies a number of additional virtues that should be inserted into the *Netherlands Code of Conduct for Scientific Practice*, and adds provisions for dealing with violations of scientific integrity. But a policy that addresses integrity should go beyond establishing rules and issuing advice. Everyone, from students to professors, must internalise the codes of conduct and guidelines, a process that can be facilitated in the communication between colleagues and in courses and workshops. Empirical surveys conducted at regular intervals should establish whether this is effective.

Science bears primary responsibility for its own integrity. Universities and research institutes have a duty to establish the right conditions and circumstances. That goes beyond codes of conduct to include the structure of research programmes and the internal organisation of knowledge institutions. The latter includes encouraging a sufficient level of internal discussion and checks on sound scientific practice (peer pressure). In addition, room should be created to conduct peer reviews with the necessary scrupulousness. All this should be designed to support the self-refining and self-correcting ability of science.

External factors

External parties – and chief among them, the funding bodies – also play a role in preserving and promoting trust in science, however. The pressure inherent to the funding system poses a number of risks: the risk of inflated claims and expectations, the risk that the image of autonomy will be undermined, and the risk that the self-refining and self-correcting ability of science will be eroded. What we need is to strike a better balance between emphasising knowledge valorisation and offering the scope required for unfettered science, and between emphasising innovation and offering sufficient leeway for a system of scientific checks and balances, for example duplication, verification and peer review. The funding policy pursued by government and the Netherlands Organisation for Scientific Research (NWO) and the universities' internal funding system should make it possible to achieve that balance.

As a commissioner of contract research and requests for scientific advice, government must allow science to act autonomously and to remain objective. Science must consistently be assigned the role of an 'honest broker', offering alternative scenarios where possible and indicating the limits to certainty and predictability. Government should resist the temptation to install heavyweight advisory committees when contracting research and requesting scientific advice. Government officials and politicians must take their own decisions, without compromising science by involving it in the process. Government-wide agreements are needed about the best way to deal with scientific advice. Such agreements could stipulate the methods used to select advisers, set out how to deal with recommendations that are not adopted (in their entirety), and establish guidelines for determining the need for peer review. All these issues should be addressed in the procedural sense, without attempting to fill the shoes of existing advisory bodies. The Academy thinks it would be worth experimenting with the position of a Government Chief Scientific Adviser. Canada and the United Kingdom can serve as examples.

Businesses should also respect and support the autonomy and objectivity of science, both in their own R&D and in public-private partnerships. Many large enterprises already have relatively detailed codes of conduct. It is the duty of the business sector to introduce sector-wide good practices. Like publicly funded science, public-private partnerships should be guided by the *Netherlands Code of Conduct for Scientific Practice*.

Trust in science also depends on the image of science portrayed in science communication and the media. Knowledge institutions can provide their scientists with the tools they need to communicate adequately, for example by developing media guides, and they should themselves put greater emphasis on a well-rounded image in their external communication. Besides results, they should also highlight their working methods and the uncertainties and limitations involved. Unrealistic claims and a one-dimensional image will eventually erode trust in science. If knowledge institutions were to cluster their science communication more, they might be able to structure their contact with the media and generate publicity that transcends the daily headlines.

Dutch science journalism is generally of good quality and offers a nuanced portrait of science. There is no urgent reason for regulation in this area. If the editorial boards of science news outlets were to draw on one another's expertise more, however, the reporting would gain greater depth and scope.

Education – from primary school to PhD programmes – can also play an important role in disseminating a more accurate picture of science. Education can raise awareness of the potential of science, but also of its limitations and uncertainties. In that sense, it can help foster informed trust in science. Policymakers should start by focusing on

higher education, specifically the Bachelor's and Master's phase at university level. Instruction in science practice should be a standard component of Bachelor's programmes. Research Master's and PhD programmes should offer students and candidates systematic but customised instruction in the sociology, philosophy and ethics of scientific research. These should include discussion of the *Netherlands Code of Conduct for Scientific Practice*, as well as the relevant examples and dilemmas.

In primary and secondary schools, the emphasis should be on getting pupils interested in and enthusiastic about science. Knowledge institutions and secondary schools should be encouraged to arrange guest instructors; platforms such as the Broad Regional Support Desks set up by the National Platform Science & Technology must be supported, as well as informal science education through a variety of channels (Internet and other online media, television, science museums , science café's, and so on). New initiatives should be rewarded, for example with prizes. Finally, given the importance of public trust in science, it bears repeating that we need more academically trained teachers working in secondary education.