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ACADEMIES OF SCIENCES IN THE CONTEMPORARY WORLD

Jüri Engelbrecht[1] and Ivo Šlaus[2]

[1]Estonian Academy of Sciences and [2]Croatian Academy of Sciences and Arts

Abstract. Academies of sciences have a long history starting in ancient Greece and later in Italy during the Renaissance. Over the centuries, the tasks of academies have been developed according to societal changes. In this paper, the roles of academies of sciences in the contemporary world are briefly analysed. The members of national or international academies are the best scientists and scholars and their responsibility is to promote knowledge. The basic principles of action in academies include independence of thought, excellence, and authority. The advisory role of academies is growing. The complexity of the world needs cooperation that strengthens the production and dissemination of knowledge. The way forward is briefly envisaged.

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The Temple of Science is a multi-faceted building.
Albert Einstein

1. Introduction

The history of academies is usually traced back to Plato's *Akademeia,* established in 387 B.C. Modern history starts with the launching of *Accademia dei Lincei* in Rome in 1603 followed by other academies in France, Germany, England, et al. We refer here to several overviews (Lincei 2003, Engelbrecht, Mann 2011, Engdall 2015, Šlaus 2020). Throughout all history, academies have united the best brains in society – scientists and scholars – and acted as strongholds of knowledge. They are serving society by generating, preserving, and using knowledge and like in ancient Greece, advising society on many issues.

The modern world is information-rich and changing fast. The question of how we could develop and use knowledge concerns also the activities of academies. Two ideas should be recalled (remind needs a preposition) in this context. First, the Nobel laureate Joseph Rotblat has said that more knowledge means also more responsibility. Second, the International Science Council (ISC) has stressed science as a global public good, and Boulton (2019) asks: "How science can be a transformative power for peace and development during times of complexity and rapid change?"

What is described below, are the basic concepts of how academies of science are organized and what are the principles followed by academies in their activities.

2. Basic principles of activities

The activities of academies of science are characterized by the basic principles of science itself. Only scientific research based on transparent methodologies, and scientific arguments based on empirical facts and logical analysis bring us closer to the truth, while reflection, imagination, and creativity tell us where and how to explore further. However, in authoritarian societies that still exist in the world, political rules might be used that could create difficulties for most scientists and scholars. Despite such imposed rules, the defenders of freedom and dignity have used the platform of academies for their messages (like Nobel Prize winner Andrei Sakharov). The nature of scientific discourse means that the aim is to achieve truth based on consensus (critical peer review). In policy, political choices and joint visions are decided by voting and often compromises are needed, which is something that cannot happen in science. Without judgement (what is good and what is not), this is the difference between a scientist and a policy-maker, and it explains why the special advisory status of science depends on the commitment of society to impartial expertise. The strength of research relies on peer-review – all statements, advice, and ideas should be scientifically proved and widely accepted in the scientific community. This does not mean that everything in research goes smoothly – the discussions about new ideas and possible changes in paradigms can be taken as driving forces for new knowledge. Academic knowledge cannot be separated or divorced from the social responsibility of how the knowledge is used.

Two sides of the same coin are: first – the mission of an Academy and second –

its members (Fellows). These sides or lines of action are responsive. Every Fellow should have his/her place and appropriate opportunities for participation in the Academy, and the Academy, in turn, should be able to rely on every Fellow to help fulfil its mission.

The mission of an Academy is usually described in its Statutes or By-laws. The main assets of academies in all their activities are independence, excellence, and authority.

The advisory role of academies is always mentioned in their mission besides fostering research. Quite typical is the description of the mission of the Royal Swedish Academy of Sciences: "to promote the sciences and strengthen their influence in society drawing attention to key social issues examining them in scientific terms" (see <www.kva.se>). And Leopoldina stresses that the academy "scientifically reviews and addresses key issues that are crucial for the future of society" (see <www.leopoldina.org>).

The role of academies in the modern globalizing world was analysed in detail at a conference organized by the Academy of Sciences in Turin (2020). Loprieno (2020) stresses that Academies besides fostering research should be involved more in society at large. Stock (2020) says that "if we want to be heard, ..., we have to be very conscious of the quality of our processes and our work, and the seriousness of the scientific advice". Engelbrecht (2020) lists several roles of academies in the modern world: besides promoting science and scholarship, attention is paid to an advisory role, communication and explanatory role (i.e. promoting scientific understanding), ethical aspects of scientific research, and also science education. Whatever the activities are, all are based on the results of scientific research. Many academies (Leopoldina, Royal Society London, the Royal Academy of Arts and Sciences in the Netherlands, etc.) have formulated the guidelines on scientific advice to policy and society. InterAcademy Partnership has formulated the ideas of merit-based academies in the 21st century (IAP 2019): act collectively at a regional and global scale on issues of shared concern; maintain quality while increasing inclusivity; encourage disciplinary interaction; revitalise the service mission of academies (based on the independence of thought and accumulated experience); advocate rationality in the post-truth world.

The fellows of national academies are elected from the best brains of the country or in the case of international academies – worldwide. The conditions for election are based on the scientific excellence and the activity of candidates (see the corresponding web pages). For example, the US National Academy of Sciences defines the fellows as distinguished scholars engaged in scientific and engineering research dedicated to the furtherance of science and technology and their use for the general welfare. The Austrian Academy of Sciences states that members are dedicated to innovative basic research, interdisciplinary exchange of knowledge, and the dissemination of new insights with the aim of contributing to progress in science and society as a whole. The Royal Society of Edinburgh is proud of having fellows from a wide range of disciplines – science and technology, arts, humanities, social science, business, and public service. It is well-known and accepted in academia that the title of Fellow or Academician does not come simply by inviting to join the academy but goes through

a strict evaluation procedure and a contested election where not all candidates reach the acceptance. The credibility of every academy is based on the quality of its fellows. Scientists and scholars are trained to follow the scientific (evidence-based) arguments in generating and communicating new knowledge and this makes them valuable members of society. That is why academies of science have credibility and authority while members get a reputation by being elected into the academy (Engdall 2015).

3. Cooperation

Academies are acting along the lines mentioned above but the general understanding is that the forces must be united to tackle the global problems and learn from each other how to act in confronting local problems. The aims of national academies are related to the particular situation of their respective countries but not only. Usually, the mission of an academy is described in its Founding Act. For example, the Act of the US National Academy of Sciences states: "The Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art …". On the other hand: "Science has always been, to an increasing extent, international in its need for shared thought and for joint action" – so starts the history of the International Council of Scientific Unions – ICSU (Greenaway 1966). Many academies have strongly supported international cooperation, like the Royal Society in London (or the Royal Society, London), Académie des Sciences in France, and Leopoldina in Germany. In contemporary science policy, the Hungarian Academy of Sciences (HAS) has an important role: in 1999 the HAS together with UNESCO and ICSU hosted the first World Conference on Science, and from 2003 on – the biannual World Science Fora (like Davos of Science).

Nowadays academies are united in several international organizations. The global umbrella organizations of academies thus have a history of more than a century: ICSU was founded in 1899, International Social Sciences Council (ISSC) in 1952, and their merged successor organization, the International Science Council (ISC) was launched in 2018. It is nowadays the world's premier representative scientific organization. The ISC unites more than 140 national and regional academies together with research councils and 40 international scientific unions and associations. The ISC stresses that the individual members are elected based on scientific, engineering, or medical merit. InterAcademy Panel was launched in 1993 and its successor InterAcademy Partnership (IAP) in 2016. The IAP includes also the former InterAcademy Medical Panel, InterAcademy Council, and regional networks in Asia/Pacific, Europe, Americas, and Africa. The IAP brings together more than 140 national and regional academies. The International Union of Academies (UAI) founded in 1919 created the possibilities for the cooperation of academies in philology, history, moral sciences, and political sciences. It unites more than a hundred academies from 63 countries on all continents.

The regional associations of academies are also important actors in formulating science policy. In Europe, the European Federation of Academies of Sciences and Humanities (ALLEA) has 57 member academies from 41 countries (as of 2019), while European Academies' Science Advisory Council (EASAC) has member academies from all the EU countries together with Norway, Switzerland, and Academia Europaea. There are regional associations of academies in Asia, the Americas, and Africa. More about the history and activities of these international organisations – see, for example, Engelbrecht and Mann (2011), Šlaus (2020), and Engelbrecht et al. (2020).

4. The way forward

The research is always looking forward and is not only a vital part of the social tapestry of a modern state as it is sometimes said. In principle, research not only contributes to innovation and economic development, but it is also about man, society, and the world, about culture and human perception, about inquiry into phenomena; it is a response to societal problems, natural hazards, and climate change; a way to improving health and education – the list is long (more in Engelbrecht and Mann 2011).

Centuries ago, academies were the places where the new scientific results were presented. From this period, the publishing in academic journals started and several top scientific journals are still published by academies. The communication process is important and still developing while the debates about open access are going on. Nowadays much has been changed, the advisory role of academies is growing, and much attention is paid to challenges in the society. Many academies and their meta-organizations (ISC, IAP, ALLEA, et al.) consider the UN's 17 SDGs with their targets and indicators (Agenda 2015) as strategic goals for research and educational institutions. The ideas of contemporary science policy are best characterized by the ISC (2019): "… a fundamental challenge to contemporary science is to identify manageable pathways to global sustainability through the complex web of cause and effect connecting planetary, social and economic processes, and to assist in the creation and promotion of policies and public action that can move societies along them". A recent document of the ISC (2021) explains clearly why science matters: "Science is indispensable to the human endeavour as a fundamental part of its intellectual infrastructure. Its distinctive value derives from open scrutiny of concepts based on evidence and tested against reality, logic, and the scepticism of peers. The knowledge that has been accumulated since the earliest days of scientific practice is continually refreshed, renewed, and re-evaluated by new experiments, new observations, and new theoretical insights …". This is actually a basis for all academies in their actions. The ISC also stresses the need to increase evidence-informed understanding and decision-making at all levels of public policy, discourse, and action. It means that international research on global challenges must be intensified.

A brief analysis of the current tasks of academies and academia, in general, is

given by Engelbrecht et al. (2020). The keywords, in general, are excellence and responsibility, looking for new knowledge, and communicating results to society. The COVID-19 crisis has demonstrated the vulnerability of world society. It is obvious that the future is not just 'back to normal' and needs fresh ideas not only in SDGs but in many areas of human activities. The ALLEA General Assembly in 2021 has stressed that science is at the centre of society. This understanding is not just wishful thinking but is based on a summary of the actions of European academies.

In a nutshell, these actions may be called 'modern enlightenment' contributing to global challenges. In this context, more attention is paid to integrating knowledge and transdisciplinarity. By the definition, the transdisciplinarity means (Stolz and Steiner 2015): "… a facilitated process of mutual learning between science and society that relates a targeted multidisciplinary or interdisciplinary research process and a multi-stakeholder discourse for developing socially robust orientations about a specific real-world issue." Consequently, the stakeholders from practice should be engaged in transdisciplinary processes. One should point out that many social problems are so-called 'wicked problems', be it the climate change, pandemics, social inequalities, etc. Note that 'wicked' denotes here the resistance to solving and not being evil. Wicked problems are difficult or even impossible to solve because they are characterised by incompleteness and contradictory requirements of solving that may be changing in time.

The main aim of the research is to obtain new knowledge, but the crucial problem is how this knowledge will reach society and policymakers to be used for the general benefit. The European Commission has created a Group of Scientific Advisors that work closely with SAPEA (the Scientific Advice for Policy by European Academies). SAPEA is the consortium of ALLEA, EASAC, Euro-CASE, FEAM, and Academia Europaea and unites so the potential of about 100 national academies across Europe including Academia Europaea. The guidelines of scientific advice are described in the EC Report (2019). This report stresses the need to understand the complexity of natural and social systems including policymaking. In complex systems the interactions between the elements may lead to the emergence of effects that are not predictable and the behaviour of the system is path-dependent – i.e. depends on initial decisions and conditions. It means that the advice should take a 'systems perspective'" by thinking broadly about the large picture rather than studying the single components of a system. This understanding is widely supported by various actors in academia. For example, LERU has in its recent Statement (LERU 2021) stressed that the relevant research areas should include "1) identifying enablers of resilience in society, 2) improving our understanding of policy and mitigation measures, 3) understanding how society can sustainably adapt to complex challenges and, 4) studying obstacles to international collaboration, and the role of science in and for diplomacy."

Academies pay more and more attention to societal problems. An excellent example is the recent ALLEA Symposium "Across Boundaries of Science" (May 5, 2021, Helsinki). The talks analysed how to increase the impact of science in society, how the boundaries between science and politics are changing, and how to tackle

science disinformation (ALLEA Report 2021). Given the recent COVID crisis that shattered the world, many academies and their metaorganizations (ISC, IAP, etc.) formulate a vision for the future.

Šlaus et al. (2020) have also stressed the general aims of academic research in the context of crisis: "Academia should analyze the risks and formulate paths to innovation and cooperation combined with personal responsibility. Attention should be based on decision theory, rational choice, and values in framing solutions that take into account the complex relations, interactions, and reciprocal immediate and long-term influences involved. … Lessons concerning the weaknesses of social systems must be studied in-depth and analyzed to understand why and how conventional thinking has led to global crises, the vulnerabilities generated by globalization and networking, and the ideas needed to foster effective social innovation. It calls for changes from a technology-driven society to human and humanity-oriented technology utilizing opportunities generated by the digital revolution…". A similar ideology is supported by SAPEA asking how the EU can improve its strategic crisis management.

The cooperation of academies strengthens global science and science diplomacy. The benefits of cooperation are explained in a report by the Australian Academy of Sciences (2019). This report demonstrates clearly how useful is such cooperation for developing science in Australia (up to economic values) and what is the role of Australian scientists in meeting the global challenges. The future goal is to maximise Australian engagement with the ISC and scientific unions.

5. Final remarks

The activities of academies or, in other words, activities of top scientists, can be characterised twofold: policy for science and science for policy. Academies as institutions have a long and successful history and the cornerstone of their success has always been related to the scientific mindset. The activities of contemporary academies reflect the diversity and complexity of the world (Engelbrecht 2021). There is much that unites academies: excellence in scholarship and scientific research, expertise that is independent of political and commercial interests, experience, and authority in academia and society. They are fostering critical thinking in society and promoting independence and freedom of science. As institutions, the academies present a fundamental part of the human intellectual infrastructure (ISC 2021). Being aware of the responsibility, academies pay a lot of attention to challenges to mankind and communication of scientific results to society. The visibility of academies and trust in them are based on permanent activities and not on single projects. Clearly, the success of academies is based only on uniting the efforts of top scientists and scholars – the members of academies. In the context of society, academies ensure that the most widely trusted knowledge informs policymakers in their decisions.

The diversity of the world is also reflected by the diversity of academia and the variety of academic institutions. In this context, besides the national academies and

their metaorganizations, the international science academies have an important role. These academies unite top scientists over all the world in their efforts in building up modern global society. The criteria of activities and memberships described above for national academies are certainly the same in the case of international academies that keep an eye on global challenges. One cannot forget the words of Lord Boyd-Orr (1961): "Our earth has grown so small. And man so great. The earth knows nothing of its smallness – nor does man of his greatness". The responsibility of scientists is to develop scientific knowledge about the 'small' earth, 'great' man, and complex society into sustainable co-existence. A similar idea is stressed in a recent statement of the ISC (2021).

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Addresses:
Jüri Engelbrecht
Estonian Academy of Sciences
Kohtu 6
Tallinn 10130, Estonia
E-mail: je@ioc.ee

Ivo Šlaus
Croatian Academy of Sciences and Arts
Zrinski trg 11
Zagreb 10 000, Republic of Croatia
E-mail: slaus@irb.hr

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