

Science, Policy and Society in an Era of Transformation

by

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I. Introduction: Welcome to Egypt

Ladies and gentlemen,

It is an honor to be invited to address you today, this special day, when the Academies of the world gather for their triennial meeting...

What **a place** to have our meeting – here in Egypt

What **a time** to have our meeting – more on that in a moment...

Welcome to Egypt—where Imhotep almost 5000 years ago, was the first human being whose name was recorded not as a ruler but for the power of his intellectual pursuits. He built the stepped pyramid of Saqqara for his pharaoh Djoser, the precursor of all the pyramids to follow, and some 300 years later the pyramid of Khufu with all its complexities would become the tallest structure on Earth for forty-five centuries, until the Eiffel tower in the late 19th century.

Welcome to Egypt, where Medicine was invented and the brain was given a name. It was also that same Imhotep who proclaimed that illness was neither curse nor magic, and that it could be treated with surgery and herbs.

Welcome to Egypt, where, the first woman scientist found her immortality: Peseshet, "Overseer of Women Physicians," ca. 2400 BCE. And, 100 years later, in nearby Mesopotamia, En Hedû'Anna (ca. 2300 BCE), priestess of Ur, gazed at the heavens and became the first astronomer whose name we know.

Welcome to Egypt, cradle of the written word alongside Mesopotamia with hieroglyphics and cuneiform writing appearing in both places some 6000 years

ago. Then in Egypt, in the turquoise mines of Sinai, the earliest alphabet took form some 3600-3900 years ago. The proto-Sinaitic script whose descendants—Phoenician, Greek, and beyond—would bring alphabets to the languages of the world.

Welcome to Egypt, home of the Ancient Library of Alexandria, that luminous precursor to all houses of knowledge, the first academy, for it gathered the greatest minds of the ancient world in all fields and within its space of freedom, they met, experimented, debated and advanced science as never before...

Welcome to Egypt, the heartland of the vast Muslim world that stretched from Spain to India and that, for a millennium – during the European dark ages – ensured that science was open, debate was tolerated and the empirical method was valued over the opinions of the ancients, and where the Indian numerals and the zero were adopted, and algebra was added and all found their way to Europe as the Arabic numerals that mark our days.

Welcome to Egypt where the great Ibn Al-Nafis in the 13th century called for openness to the contrarian view and asked that we engage with that view, for it could be bringing a new insight, a new truth. Listen to his powerful voice:

“When hearing something unusual, do not preemptively reject it, for that would be folly. Indeed, horrible things may be true, and familiar and praised things may prove to be lies. Truth is truth unto itself, not because [many] people say it is.”

--- Ibn Al-Nafis, (1213-1288 A.D.) Sharh' Ma'na Al Qanun.

He went on to say that the views of the young and contemporary are bound to be more important than those of their elders for science and knowledge are built cumulatively. So, the elders should listen to the young and know when to defer to the new generation.

To those among the youth of my part of the Muslim and Arab worlds, who seek to restore some sort of **identity** by violence and rejection, I say : Open your eyes and look at the greatness of these forebears who promoted tolerance and openness and who advanced science and knowledge, for a thousand years until the torch would pass back to Europe in the 17th century.

There is the great legacy waiting to be revived, so that new generations of our people will take their place at the forefront of the global scientific enterprise, by dint of hard work, openness and collaboration with the other, not by rejection and violence. So that our youth will be the producers of science and innovation, not just the consumers of technology and applications. That is how your contemporary identity can be constructed.

What a place Egypt is for the academies of science to meet, to draw strength from our numbers in this gathering even as we draw inspiration from our forebears on this land and that long legacy that stretches back into the mists of time...

II. Turbulent Times

And what a time for us to meet...

We inhabit an age of breathtaking scientific and technological advance, even as societies are shaken by hyper-connectivity, disinformation, and mounting global instability. At the very moment when humanity confronts existential threats—from climate change and pandemics to food insecurity—the international order is fraying, and collective action grows more elusive.

Technology accelerates discovery at unprecedented speed, transforming fields from protein folding to genomics. Yet each breakthrough carries risks as well as promise, and it falls to scientists—through academies and universities—to ensure that innovation is governed by ethical, evidence-based constraints that safeguard humanity.

Meanwhile, inequalities deepen, discrimination persists, and gains against poverty and hunger have begun to reverse.

Science itself is under pressure. Institutions of knowledge struggle to maintain authority amid political polarization and resurgent bigotry... It is a moment where as Yeats observed: ...Things fall apart, the center cannot hold [...] and The best lack all conviction, while the worst Are full of passionate intensity.... A global disinformation ecosystem that erodes public trust in expertise. Social media, once heralded as a tool for enlightenment, has instead amplified division and undermined rational debate.

These challenges unfold in a period of extraordinary global turbulence. The MDGs and SDGs reflected moments of rare consensus, yet today the rules-based multilateral system born after World War II is being weakened by the very powers meant to uphold it. At a time when planetary crises—from climate and biodiversity loss to water scarcity—demand coordinated responses, cooperation falters.

The scientific frontier itself is both exhilarating and unsettling. ICT, AI, and the new biology are transforming our understanding of life and matter, yet our regulatory frameworks lag behind. The institutions meant to guide responsible innovation struggle to keep pace with technologies that diffuse globally at unprecedented speed.

At the same time, societies face rising inequality, renewed hunger, mass displacement approaching 125 million people, and the destructive return of war. The promise that knowledge and connectivity would foster informed, harmonious communities has instead given way to polarization and anti-scientific rhetoric. The custodians of science now find themselves defending not only truth but the very idea of shared reality.

Viewed across science, education, technology, society, and international relations, we unmistakably inhabit turbulent times—times that echo Dickens's paradox: an age of wisdom and folly, hope and despair, with everything before us and nothing assured.

III. What Next?

Against that background, and in this place and at this time my remarks shall focus on three broad topics:

First.

Why do we have academies of science? I will argue that their work is **a global social public good**—one that deserves greater recognition and stronger support than ever before.

Second.

How are their traditional roles reshaped by our turbulent age? We stand amid revolutionary advances in science and technology, yet societies are ensnared in hyper-connectivity, social media, and rampant disinformation, even as faith in education and research erodes. At the same time, humanity confronts existential challenges—climate change, pandemics, food insecurity—while the international order undergoes tectonic shifts and the commitment to multilateral action is being torn asunder..

Third.

Based on these reflections I will advance **five specific recommendations for the academies** to better meet the demands of the present and the future, honoring their obligations to society while engaging young scientists who must help build today and imagine tomorrow. We can—and we will—rise to the challenges of our time.

IV. The Pursuit of Science as a Global Social Public Good

Economists classify goods by whether they are excludable or rivalrous. By this measure, basic scientific knowledge—mathematical truths, physical laws, biological principles—clearly bears the marks of a public good.

It is non-rivalrous: one scientist's use of relativity or CRISPR diminishes no one else's. And it is, in principle, non-excludable: once published, knowledge cannot easily be withheld from others.

Thus science occupies several categories at once. Basic research is a public good; science literacy a merit good; applied science may become private or club-like; and knowledge vital to resilience—climate, health, water—emerges as a public social good.

Except for those areas that are truly private (patents, proprietary research, confidential data) or partially club-based (paywalled journals, membership databases, restricted laboratories), the scientific enterprise must be sustained by public investment. Few undertakings repay society so richly.

And what is more, it has enormous “positive externalities” for the pursuit of science requires the promotion of what I have called **the values of science**.

V. On the Values of Science

Along with Bronowski, I believe that the scientific enterprise—its spirit of exploration and problem-solving—rests on a set of essential values without which scientific research cannot endure. These are:

1. Truth.

Fabricating data is the unforgivable sin of science. Even the most celebrated researcher is cast out when falsehood is uncovered.

2. Honor.

Giving each their due is a core ethic. Plagiarism is the second gravest offense. Citations, footnotes, and references safeguard credit. Newton captured this obligation towards the preceding scientist’s contributions in his famous remark: “If I have seen farther, it is by standing on the shoulders of giants.”

3. Teamwork.

Today’s advances arise from teams more than lone geniuses. Laboratories, not isolated desks, produce most breakthroughs. We must teach young scientists the ethics of collaboration and the fair sharing of recognition.

4. Constructive Subversiveness.

Science advances by challenging existing paradigms. Each generation reshapes understanding, yet reverence for earlier giants remains undiminished—Einstein did not erase Newton. Renewal is built into the scientific endeavor.

5. Transparency and Openness.

Progress requires open data, clear methods, and disclosure of conflicts of interest. Only with such transparency can peers replicate, critique, and refine results—sustaining the ceaseless dialogue at the heart of science.

6. Engaging the Contrarian view.

Science grows by confronting opposing ideas—even those from the youngest or most unlikely voices. Only the idea matters. The nationality, race, religion,

gender or age of the scientist advancing the idea does not. Ad-hominem attacks are banned.

7. A Method for Settling Disputes.

Science's authority lies not in any individual but in its method. Evidence and rational argument alone decide.

These values serve not only science but society. They nurture openness, tolerance, civility, and reason—qualities urgently needed in an age of polarization and misinformation.

VI. Looking to the Future

Academies must now consider how to meet the demands of a rapidly changing world—fulfilling their obligations to society while inspiring younger scientists to help build today and imagine tomorrow.

New scientific frontiers, merging disciplines, and emerging risks require academies to assume roles far broader than ever before.

AI, with its vast promise, may also encode racial or social biases; professional societies can drift toward self-interest rather than public service; and universities, reinventing themselves in an age of distance learning, struggle to redefine their purpose. As many leading professors belong to academies, their guidance is essential in shaping new educational models and ensuring that young scientists receive both rigorous training and meaningful career paths.

In the coming decades of automation and AI, academies will almost certainly deepen their influence on education and professional structures.

AI will profoundly reshape education. Attempting to ban it is futile, just as banning calculators once was. Tomorrow's professionals will be judged by how well they use AI. Blue-book written exams and oral assessments can still test comprehension, while students learn to work with AI as a trusted intellectual tool.

This will accompany major transformations in universities, which must renew their commitment to research, nurture the next generation, and rethink their

relationship with society far beyond the old “town and gown” divide. I have much to say about how to transform education in the age of AI, but that is another discussion for another day. Let me stay here with what I recommend that the academies should do to meet the challenges of our turbulent times.

Anti-Science Politics and Disinformation

One of the greatest challenges ahead is confronting the waves of anti-science disinformation now sweeping through social media—undermining trust in vaccines, GMOs, and climate science, and complicating public policy.

Not all scientists can be charismatic communicators, yet the public desperately needs trusted voices. Academies and learned societies can unite professional communicators with scientific experts to explain complex issues clearly and counter the rising tide of misinformation.

But academies must also widen their own internal dialogue—to address ethics, intergenerational equity, inequality, diversity, human and animal rights, and other vital concerns.

The Coming Environment

Our future will unfold simultaneously at global, regional, national, and local levels. The tools at our disposal will dwarf anything known to earlier generations, and scientific and technological change will outpace even our boldest imaginings.

Science is an endless journey of exploration. We are its questers, and—as Boorstin reminded us—**it is the fertility of the questions that matters more than the finality of the answers.**

Yet despite the transformations ahead, the enduring functions and values that have long defined academies will remain. Our guiding star is, and must always be, the pursuit of truth, and every new discovery will be an addition to the reshaping of our scientific consensus, which we will recognize again as the best truth that can be gleaned from the evolving explorations of Science at that moment ...
indeed, as T. S. Eliot wrote...

"We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time" .

VII. Five Recommendations

So what should we do?

I have **five proposals** for what the academies must do to confront the challenge of our turbulent times, and remain true to their core mission that has been honed during the last half century.

First: We must redouble our efforts at protecting these core functions against political, economic and social incursions against it.

Recall that these core functions include:

- Upholding the highest standards of rigor in research;
- Setting ethical principles for inquiry and for the deployment of the technologies it yields;
- Reaching out to institutions of learning around the world;
- Providing governments with the most expert and dispassionate counsel;
- And advancing science-based policies and evidence-grounded regulation.

And to these functions we must increasingly become involved with the social issues of our times, and that means that the academies should become active participants in the debates raging in our societies. And in order to do so well, the academies should build bridges that **complement the knowledge of the natural sciences with the insights of the social sciences and the wisdom of the humanities**. Thus, expanded teams should look at the complex problems of today and tomorrow. This is much more than what was implied in C.P. Snow's dialogue of two cultures.

Second: the governance of the academy must remain in the hands of its members, both in who they accept and what priorities they pursue. The scope of their work and how they choose to execute it must remain the hands of the membership, not subject to the whims of politicians or the pet projects of wealthy donors. This may be difficult in the times of austerity and limited funding, but it is a challenge that has to be met. Here reinforcing the case of science as a social public good that deserves support is important.

This is not to deny that some excellent governmental institutions in a number of countries do undertake a scope of work that overlaps considerably with what we term the functions of the academy. But I am speaking of and to the academies as learned societies, with a long tradition of autonomy and independence.

Third: I believe that the academies and their university partners should recognize a new discipline, that of “Science Communication”.

If our message to society and the world is to be heard and accepted, whether it is by written text or audio recordings or movies and videos or the special language of the social media on the internet, effective communication requires the skills of a professional. Let the factual useful knowledge produced by science reach society in a meaningful way. Only thus will the truthful message of science rival in its power and intensity the destructive message of the conspiracy theorists who trade in falsehoods and fake news.

Fourth: I believe that the distinctions between basic and applied research need to be revisited. In my view, with the internationalization of science and the spread of the scope of research and the need for the advanced scientific countries to help the poor and lagging countries in joining in the quest for meaningful science, we can benefit from revisiting the success of the CGIAR, that model of international cooperation in agricultural research that built on the success of the green revolution and brought so many benefits to the world. Indeed, the ISC had advanced a similar idea calling for “Hubs” of international assistance to help the mobilization of the best science to promote sustainable development throughout the world.

The key for such hubs or international institutions of scientific research to work effectively is to recognize that the steps in research really go from **basic to**

strategic to applied to adaptive, with the most advanced institutions in the world pushing the envelope of the basic research, and the international centers or hubs connecting that to the strategic and the applied, and the local institutions – even in the poorest and most lagging places – overlapping with them on the applied and undertaking the adaptive on their own.

Thus for example, looking at genome editing for agriculture: the basic breakthrough was CRISPR/Cas9 , strategic would be to decide what traits you need to develop and how you would use that technique to achieve that, the applied would develop these traits in the most important crops, and the adaptive would take these modified crops with the desirable traits and adapt them to the local agro-ecology of the region.

The academies – in their core function of promoting international science cooperation – can be extremely valuable partners in making such projects happen.

Fifth: the academies should think of creating a category of “associate member” for promising young scientists to help nurture their growth and allow these rising young leaders to interact with the membership of the academy. I believe that this would be beneficial to both the youth and the elders.

VIII. Conclusions:

Ladies and gentlemen,

There is a tide in the affairs of men
Which taken at the flood leads on to fortune
Omitted, all the voyage of their lives
is bound in shallows and in miseries
On such a full sea are we now afloat
And we must take the current when it serves
Or lose our ventures

– William Shakespeare

But we shall not lose our ventures.

We shall bend the future to match our dreams, for we are the practitioners of Science, and science is the culture of living change.

Science is, as Vannevar Bush said, "The Endless Frontier". And science can feed the world, protect the environment, heal the sick, bring dignity to work, and create the space for self-expression.

That negative cultural and social realities can co-exist with, nay even arise from, this exciting reality of a world where all barriers are falling and the unlimited future is within our grasp is nothing new. Indeed, already a century ago, T.S. Eliot presciently asked:

Where is the Life we have lost in living?
Where is the wisdom we have lost in knowledge?
Where is the knowledge we have lost in information?
-T.S. Eliot

And in this headlong rush to embrace the age of big data and endless information, it is pertinent to remember that data when organized becomes information, and information when explained becomes knowledge, but humanity locally, nationally, regionally and globally requires more than knowledge: we need wisdom.

And thus, I ask that the academies recognize that **beyond the knowledge produced by the natural sciences we need the insights of the social sciences and the wisdom of the humanities.** Only thus will the recommendations of the Academies fully resonate with a rapidly changing and increasingly skeptical society.

The academies need to build such bridges to remain true to their mission in these times of rapid change and political turbulence.

Envoi: A call to action:

My friends,

And so, on this day and from this place, I ask that we redouble our commitment to the pursuit of science...

To the youthful members of our academic community, I say:

To the wrongs that need resistance,
To the right that needs assistance,
To the future in the distance,
Give yourselves...

-- Carrie Chapman Catt (1859 – 1947)

To the elders of our academic community, I say you are, and must remain,
young at heart...

Years may wrinkle the skin, but to give up your ideals, loose your curiosity or
forget your commitment to the defense of truth, that wrinkles the soul.
The years may mark our bodies, but we can remain young at heart... for You
are:

As young as your faith, as old as your doubt;
As young as your dreams; as old as your cynicism;
As young as your self-confidence, as old as your fear;
As young as your hope, as old as your despair.

Only if you give in to pessimism, and loose your heart to cynicism, then, and then
only, are you grown old. And then, indeed as Douglas MacArthur said... " you
just fade away."

Together, all armed with the values of science, we must redouble our
commitment to advance the scientific enterprise, and in pursuing our vocation,
we can think of the unborn, remember the forgotten, give hope to the forlorn,
include the excluded, reach out to the unreached, and by our actions from this
day onward lay the foundations for better tomorrows.

Thank you.
