The Role of Science Philanthropy in the USA and Canada

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Preface

Science philanthropy is crucial in supporting scientific endeavors that may not receive sufficient funding from traditional sources like government grants or industry investments. It allows donors to directly support areas of scientific research and initiatives that align with their interests and priorities. By providing financial resources, science philanthropy aims to accelerate the pace of scientific discovery, foster innovation, and create a positive societal impact.

Key findings indicate that philanthropic funding in the U.S. for basic research via higher education and nonprofits has grown to US$24.7 billion in 2021. In comparison, Canada's Philanthropic Foundations report highlights a diverse range of charitable giving by foundations, accounting for around CA$ 2.2 billion. Overall, these findings underscore the substantial impact of science philanthropy in shaping the research landscape, particularly in the US.

This report, “The Role of Science Philanthropy in USA and Canada,” draws on recent examples to highlight the importance of science philanthropy to basic and applied research funding in North America and how it is driving scientific progress and addressing pressing global challenges, such as climate change, healthcare, energy, and environmental sustainability. The reader obtains insight into what science philanthropy is, how it compares with government funding, and recent trends in philanthropy.

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Executive Summary

This report highlights the significant role of science philanthropy in supporting scientific research in Canada and the USA, with their more substantial and sophisticated ecosystems. The report focuses on contemporary science philanthropy, including new philanthropists like Bill Gates and Mark Zuckerberg, as well as innovations by legacy foundations like the Sloan Foundation. The report acknowledges challenges in gathering comprehensive data due to the low profile of many philanthropists. Interviews and secondary sources were used, thus providing a qualitative interpretation rather than a complete summary of all major philanthropists. The report aims to offer insight to Swedish readers interested in collaborating with researchers in the USA and Canada. It encourages consideration of the role of science philanthropy in the Swedish system.

What is science philanthropy?

Science philanthropy involves donating money, resources, or time to support scientific research, innovation, and education. This form of philanthropy encompasses various activities, including funding research projects, supporting science education initiatives, and encouraging collaboration among scientists and institutions. Additionally, science philanthropists may engage in advocacy and policy efforts to create a favorable environment for scientific research. The report emphasizes the diverse forms that science philanthropy can take, including collaborative research projects, interdisciplinary efforts, and initiatives that bridge the gap between research and real-world impact.

Tradition established in the First Gilded Age of science philanthropy in North America

During the First Gilded Age of Philanthropy in the USA and Canada, influential industrialists such as Andrew Carnegie, John D. Rockefeller, and J. P. Morgan made substantial donations, shaping the science and discovery ecosystem with endowments to universities and private research institutions. This philanthropic model, established in the late 19th and early 20th centuries, resulted in a unique landscape of private institutions in the USA, distinct from many other wealthy countries. US and Canadian foundations have shared roots in the British Charitable Trust Act of 1853, but despite parallel developments, Canadian foundations generally remained less influential than their US counterparts.

Lack of aggregate data on the scale of science philanthropy in the USA and Canada

Assessing the scale of science philanthropy in the USA and Canada is challenging, partly due to the inherently private nature of philanthropic activities. Sources, if they exist, neither distinguish science philanthropy from other charitable giving nor report donations to basic and applied research separately. Private initiatives in both countries have recognized the need for more data-driven insight into philanthropy and are actively developing data strategies for the sector. The report primarily relies on data from organizations dedicated explicitly to foundations interested in science philanthropy to provide a more focused understanding of this philanthropic sector.

Surprisingly large relative contributions according to emerging indicators for science philanthropy

The Science Philanthropy Alliance (SPA) recently published its inaugural Science Philanthropy Indicators Report, offering insight into the scale and impact of science philanthropy in the USA. Key findings indicate that philanthropic sources funded nearly 40% (US$24.7 billion) of basic research via higher education and nonprofit organizations in 2021, marking a significant increase since the 1960s. Philanthropic support for basic and applied research has seen a 40% and 100% increase, respectively, from 2006 to 2021. Notably, philanthropy predominantly favors biological, biomedical, and health sciences, constituting over 70% of nonprofit funding for science research and development (R&D) at universities. Figures presented by the SPA illustrate the increasing significance of philanthropy in supporting basic research, challenging the traditional dominance of federal funding. In comparison, a report from Canada's Philanthropic Foundations highlights a diverse range of charitable giving by foundations, including 32% directed towards education and research, accounting for around CA$2.2 billion. Overall, these findings underscore the substantial impact of science philanthropy in shaping the research landscape, particularly in the USA.

Decentralized science philanthropy adds dimensions other than financial support and "supercharging" systems from the bottom up

Science philanthropy, with its decentralized nature, plays other crucial roles in basic and applied research systems, particularly in universities and nonprofit organizations. This impact is noteworthy because, compared to many other countries, US and Canadian research institutions operate under more decentralized control, allowing philanthropic spending to incentivize behaviors that enhance

the productivity and creativity of the research system. Science philanthropy is seen as a pivotal contributor to making the overall research enterprise more risk-tolerant and creative than it would be when solely relying on government or business funding. Combining philanthropy with other institutional funds allows for flexibility in research strategies, thereby supporting basic and applied research agendas.

Some distinct advantages of science philanthropy over public research funding

Science philanthropy brings several valuable features beyond capital, impacting the research community significantly. First, it offers flexibility by allowing donors to target specific research areas, support innovative projects, and fund emerging fields, thus fostering greater risk-taking. Second, the diversity of science philanthropists, both in interests and backgrounds, results in a broad research agenda that supports a more diverse research community. Third, philanthropic organizations typically have expedited decision-making processes compared to government agencies, enabling faster funding decisions and project initiation. Lastly, philanthropy acts as a gap-bridging and buffering mechanism by supporting underfunded or overlooked areas in scientific research and providing stability when public funding is insufficient or fluctuating. Overall, philanthropic funding introduces flexibility, diversity, expedited decision-making, and gap-bridging to the research landscape, encouraging risk-taking, innovation, and the exploration of new strategies, thereby contributing significantly to the advancement of scientific research, innovation, and education in both the USA and Canada.

Potential inherent weaknesses of science philanthropy

Although philanthropic funding provides flexibility, it is more vulnerable to accusations of subjectivity and bias based on donors' priorities. The main drawback of science philanthropy is, however, its limited resources compared to government funding, limiting the number and scale of research projects it can support. Government funding offers more significant financial resources derived from taxpayers, allowing support for a broader range of research projects, and is often aligned with national priorities. Philanthropy tends to be hesitant to fund large-scale infrastructure projects, leaving them instead to the government. Both philanthropic and government research funding have strengths and limitations, and collaborations between these funders can maximize support for scientific research, foster innovation, and effectively address diverse societal challenges.

Diverse approaches and common traits in science philanthropy

Science philanthropists operate with distinct styles and missions to advance research, education, and innovation. While each foundation has unique organizational structures, governance, and decision-making processes, their operations often resemble those of larger public funding agencies. Private foundations, typically governed by a board of directors or trustees, prioritize specific areas of interest that align with their missions, such as health, education, or scientific research. Founders, whether individuals or corporations, contribute significantly to science philanthropy. Providing financial support through grants and endowments is their core activity, while some adopt a venture philanthropy approach, treating contributions as investments. Recipients include research institutions and universities actively engaging with science philanthropy to secure funding. Philanthropists may also be involved in advocacy, policy efforts, and collaborations to amplify their impact, foster interdisciplinary research, and address grand challenges. Overall, partnerships and collaborations between philanthropists, research institutions, and government agencies play a vital role in advancing scientific research and public engagement.

Increased scale and experimentation in science philanthropy

Emerging trends reflect the dynamic landscape of science philanthropy. The impact of venture capital in recent decades has fueled the growing influence of philanthropy in the USA and Canada. The aftermath of the COVID-19 pandemic and the intensified climate emergency have lately accelerated a surge in philanthropic experimentation. Another interrelated trend is that philanthropic megagifts are increasingly prevalent, affecting universities and large-scale research infrastructures.

Introduction

Science philanthropy is crucial in supporting scientific endeavors that may not receive sufficient funding from traditional sources like government grants or industry investments. It allows donors to directly support areas of scientific research and initiatives that align with their interests and priorities. By providing financial resources, science philanthropy aims to accelerate the pace of scientific discovery, foster innovation, and create a positive societal impact. Science philanthropy has the potential to help drive scientific progress and address pressing global challenges, such as climate change, healthcare, energy, and environmental sustainability. It complements public funding and private sector investments by providing additional resources and flexibility to tackle complex scientific problems and explore new frontiers of knowledge.

The USA and Canada have long traditions of large-scale philanthropy, and industrial magnates such as John D. Rockefeller, Andrew Carnegie, and J. P. Morgan are well-known to Swedish readers. This report, however, primarily focuses on contemporary philanthropy. A new wave of philanthropists, such as Bill Gates and Mark Zuckerberg, are using wealth created in new industries, while legacy foundations, such as the Sloan Foundation, have innovated and changed their philanthropic work.

The report further focuses on science philanthropy, i.e., how private foundations and individuals fund basic and applied science. Today, the main goal of most foundations mentioned in this report is the funding of science. Yet, distinctions between, for example, funding aid in developing countries and medical science are diffuse. Some foundations, such as the Bill & Melinda Gates Foundation and MasterCard Foundation, fund both.

The report also aims to include as much insight as possible into the Canadian system. Nevertheless, the US system of science philanthropy dwarfs the Canadian in sheer magnitude, access to reliable data sources, level of coordination, and overall sophistication. No other country comes close to matching the US level of philanthropic funding for science, technology, engineering, and innovation, either absolutely or as a share of their total national investment.

The importance of science philanthropy, especially in the US ecosystem, both in numbers and agility, came as a surprise to me and will perhaps surprise some of the readers of this report. Overall, philanthropy is a significant and distinctive feature of the US research ecosystem for both basic and applied research. I hope that this report will give Swedish readers involved in, or planning, collaboration

with researchers in the USA and Canada some insight and understanding, and perhaps also thoughts on how science philanthropy could play a more prominent role in the Swedish system.

I want to clearly acknoweldge that there is little new analysis on the subject in this report, but rather a light curation of existing thinking and analysis by scholars as well as my interviewees, the real subject matter experts. I urge the reader to dwelve deeper into the sources, and especially the work of Robert W. Conn, Peter F. Cowhey, Joshua Graff Zivin, and Christopher L. Martin in 2023 published by IGCC in the report chapter "Science, Technology, Engineering, Medicine, and the Role of Philanthropy in the American Discovery and Innovation Ecosystem", as well as Eden Stiffman's article on how "Quick Grants from Tech Billionaires Aim to Speed Up Science Research". Staff from the Science Philanthropy Alliance have given invaluable input as well have provided the most up-to-date view on status in the U.S. in their recent "Science Philanthropy Indicators Report".On the Canadian side, the work from 2020 by Peter R Elson et al on Philanthropic Foundations in Canada walks us through the past and present with many rich examples and comparisons with the U.S.

A note on delimitations and methodology. Many science philanthropists keep a low profile, often per instruction from the founding donors. One interviewee claimed that a large majority, perhaps as high as 90% of all philanthropists, do not even have websites. Due to time and resource constraints, most examples are drawn from the larger science philanthropists organized under the umbrella of a coordinating body or from those with a high media profile. Even well-funded and active philanthropic foundations have asked not to be mentioned in any report. The philanthropic foundations' staff and representatives are generally somewhat guarded – perhaps because of the high demands from the research community seeking funding.

The primary method has been a series of interviews, where one interviewee introduced me to another, plus consulting some secondary aggregate sources when available. Therefore, this report should not be mistaken for a comprehensive summary of all major philanthropists and their activities; it is a qualitative interpretation of the foundations' sentiments. As several interviewees explained, getting to know one foundation is only getting to know one foundation because they are all unique.

What Is Science Philanthropy?

Philanthropy, in a general sense, refers to the act of donating money, resources, or time to promote the wellbeing of others or to support charitable causes. It is a broad term encompassing various charitable activities to address societal issues, provide aid, and improve the overall quality of life for individuals or communities.

On the other hand, science philanthropy focuses explicitly on supporting scientific research, innovation, and education. Science philanthropy involves individuals, foundations, corporations, and other organizations that provide financial backing to scientific endeavors through charitable donations or grants. Science philanthropy may include advancing scientific knowledge and funding research projects, supporting educational programs in the sciences, contributing to innovation and technology development in various scientific fields, promoting such technological advancements, and addressing multiple societal challenges.

The best-known, most visible type of science philanthropy is tangible financial research funding, where donors provide grants to research institutions, universities, and individual scientists to support their investigations across various scientific disciplines. All foundations mentioned in this report have this as their core raison d'être. Donors may specifically contribute to establishing or improving research facilities, laboratories, and scientific infrastructure, enabling scientists to conduct their work more effectively.

More broadly, science philanthropy can take various forms. Philanthropists often support science education initiatives, such as scholarships, fellowships, and outreach programs to promote Science, Technology, Engineering, and Mathematics (STEM) education and inspire the next generation of scientists. Several philanthropists have created fellowship programs that recognize and reward outstanding achievements in STEM fields, thus encouraging students to excel academically and pursue advanced degrees. Endowment of chairs or professorships within universities, thereby providing financial support for distinguished faculty members, ensures the availability of experienced educators who can guide and inspire students in STEM disciplines. Some philanthropists also support initiatives that integrate cutting-edge technologies into STEM education. This involves funding the development of educational apps, virtual laboratories, or online courses to enhance the learning experience.

As this report exemplifies, science philanthropy also often encourages collaboration among scientists, institutions, and organizations by funding collaborative research projects and interdisciplinary efforts. As in the case of public funding

agencies, philanthropists often establish grants specifically designed to fund interdisciplinary research projects. These grants encourage scientists from different disciplines to collaborate on projects that address complex scientific challenges by leveraging diverse expertise. Some philanthropic initiatives prioritize funding models that require collaboration. By setting up grants accessible only to research teams involving scientists from multiple disciplines, philanthropists encourage the formation of diverse and collaborative teams. The major science philanthropists in the USA also collaborate and share ideas and often help to sponsor conferences, workshops, and symposiums that bring together researchers from various disciplines. These events provide opportunities for networking, exchanging ideas, and forming collaborative partnerships.

Moreover, several philanthropic foundations included in this report are dedicated to supporting the translation of scientific discoveries into practical applications and fostering entrepreneurship within the scientific community. These foundations recognize the importance of bridging the gap between scientific research and real-world impact. Worth mentioning are the Bill & Melinda Gates Foundation and its Grand Challenges program, which encourages bold ideas and innovations to address global health challenges, as well as the Gordon and Betty Moore Foundation's focus on environmental conservation, patient care, and scientific research while paying particular attention to initiatives that encourage innovation and the translation of discoveries into practical solutions, often with an emphasis on sustainability and conservation.

Philanthropists may themselves be active in advocacy and policy and/or support organizations and initiatives that advocate for evidence-based policymaking and scientific integrity, aiming to create a favorable environment for scientific research and its applications. The Science Philanthropy Alliance is a good example. This is not a traditional foundation but a collaboration of philanthropists dedicated to increasing private funding for basic scientific research. Its primary focus is advising, though it also promotes the importance of basic science research and shares resources about science philanthropy.

Impact of Science Philanthropy in the USA and Canada

This section establishes the relevance of science philanthropy in the first place. Starting from the modern history of science philanthropy, the quantification of initiatives is considered. While the inherently private nature of science philanthropy poses challenges regarding quantifying its scale in the USA and Canada, recent efforts have shed more light on this critical sector. Does science philanthropy make a difference in the US and Canadian systems? If so, how big a difference does it make?

Tradition established in the First Gilded Age of science philanthropy in North America

Science philanthropy in the USA and Canada has its roots in what is known as the First Gilded Age of Philanthropy, when the financial titans of the 1870s to the 1920s left a considerable imprint on the US science and discovery ecosystem (including education) through philanthropic giving. Industrial magnates such as Andrew Carnegie, John D. Rockefeller, and J. P. Morgan donated what would amount to billions of inflation-adjusted US dollars money to public infrastructure such as libraries, research institutions, and museums (Davis 2010).

Robert W. Conn, Peter F. Cowhey, Joshua Graff Zivin, and Christopher L. Martin recently published the report chapter "Science, Technology, Engineering, Medicine, and the Role of Philanthropy in the American Discovery and Innovation Ecosystem" neatly connecting the past and the present. The researchers illustrate how a model was established for US universities. Unlike many other wealthy countries, the USA has a large number of private institutions, all of which are outside direct federal government control (Conn et al. 2023). Examples of such philanthropic ventures abound and include the 1871 founding of Johns Hopkins University with an endowment gift from Johns Hopkins; Leland Stanford's 1885 gift to establish Stanford University; the separately provided megagifts from Andrew Carnegie and Andrew Mellon to found the Carnegie Institute of Technology and Mellon University, now Carnegie Mellon University; Cornelius Vanderbilt's 1872 gift to found Vanderbilt University; and John D. Rockefeller's megagifts to found both the University of Chicago in 1890 and Rockefeller University in 1906. This class of donors established endowments and operating funds for these universities while also seeding the growth of many of the great US private research institutions, now known as nonprofit research institutions or nonprofit organizations (NPOs). These new institutions were secular, based more

on the early-19th century German model, geographically decentralized, and, most importantly, not institutions run by the federal government. Philanthropic giving during the First Gilded Age played a significant role in defining the basic and applied science ecosystem at US universities because government spending was relatively small and funding universities was not a corporate priority. Companies operated industrial research labs focused on applied, invention-oriented work of the Edison or Bell type (Conn et al. 2023).

There are notable similarities in the origins of US and Canadian foundations, often making it challenging to distinguish the influence of one on the other. Peter R Elson et al in the work from 2020 on Philanthropic Foundations in Canada walks us through the past and present with many rich examples and comparisons with the U.S. Both countries emerged from similar structural and economic conditions and established their foundations using a trust structure due to limited state interference, with the British Charitable Trust Act (1853) serving as the initial legal guideline (Elson et al. 2020). Wealthy entrepreneurs, who had amassed fortunes rapidly during the industrial revolution, used foundations to safeguard their wealth. As time passed, the state assumed a dual stance on foundations. First, it sought to prevent the emergence of financially powerful entities exempt from public obligations or temporal limitations. To achieve this, federal governments enacted laws mandating foundations to allocate a portion of their annual profits to the government. Second, especially during times like the two world wars, the state introduced tax incentives to leverage philanthropic resources from foundations. A closer examination of the chronological evolution of the legal and fiscal framework for philanthropy revealed that Canada often emulated transformations initiated in the USA.

Despite following parallel timelines, Canadian foundations generally remained less influential than their US counterparts. For instance, during the interwar period numerous powerful foundations emerged in the USA, including the Ford Foundation in 1936. By contrast, Canada saw the establishment of only two foundations in the three decades following the creation of the Massey Foundation in 1918: the Winnipeg Foundation and the McConnell Foundation (Elson et al. 2020).

Lack of aggregate data on the scale of science philanthropy in the USA and Canada

Philanthropy is by nature the domain of private individuals and foundations and lacks the transparency or aggregated reporting of federal and state/province funding. Still, at least in the USA there are private initiatives to assess this sector annually. The Giving USA Annual Report is perhaps the most comprehensive

resource providing data on charitable giving in the USA. It breaks down gifts by sources (individuals, foundations, bequests, and corporations) and sectors (education, healthcare, religion, etc.). The report is widely recognized for its thorough analysis and is a key reference for understanding philanthropic trends. It is based on research conducted since 2000 by the Indiana University Lilly Family School of Philanthropy and provides an estimation of all giving to all charitable organizations across the USA. These national estimates do not show the changes any one organization or geographical region might observe – they calculate the total giving of about 53 million households across the USA, approximately 16 million corporations that claim charitable deductions, over a million estates, and about 82,000 foundations. The donations go to about 1.1 million IRS (Internal Revenue Service)-registered charities, plus a conservative estimate of 300,000 US religious organizations (Giving USA 2024).

In Canada, the General Social Statistics Program (GSSP) has two main objectives: (a) to collect data on social trends in order to monitor changes in the living conditions and wellbeing of Canadians and (b) to provide updated information on particular social policy issues of current or emerging interest. As part of the GSSP, the Survey on Giving, Volunteering and Participating every five years provides a comprehensive overview of the contributions Canadians have made by donating their time and money; it also provides data-driven information to the non-profit sector to help organizations strengthen their capacity for action, mobilize funds, recruit volunteers, and manage their operations (Statistics Canada 2023). Similar to the USA, private initiatives and foundations have themselves seen the need to form a more data-driven picture of philanthropy in Canada. Philanthropic Foundations Canada (PFC) and the Ontario Trillium Foundation, with the support of Powered by Data, have for example engaged in a consultative process with foundations and key stakeholders to develop recommendations towards a data strategy for the philanthropic sector (PFC 2024).

Further sources include publications like Forbes, the Chronicle of Philanthropy, and others that release annual rankings of the largest charitable contributions, foundations, and philanthropists. Such rankings provide a snapshot of major players and significant contributions in the philanthropic landscape.

For this report on science philanthropy specifically, even these significant efforts to map the philanthropic sectors in the two countries are too general because specific donations to basic and applied research still need to be identified. There have, however, been organizations specifically catering to foundations interested in science philanthropy that also aim to compile better data on this type of phi-

lanthropy. Most of the data in what follows rely on the published findings of these organizations.

Surprisingly large relative contributions according to emerging indicators for science philanthropy

The Science Philanthropy Alliance in the USA (SPA) recently published its inaugural Science Philanthropy Indicators Report (SPA 2023c). SPA combines spending from higher education institutional funds and nonprofit organizations to estimate legacy and current philanthropy. SPA defines "legacy philanthropy" as institutional funds derived from past philanthropic giving to research institutions, often in an endowment. They use "current philanthropy" to describe nonprofit funding, typically from foundations.

The report shares five key findings, which are reproduced below in their entirety:

1. Philanthropic funding for basic research via higher education and nonprofit support has increased from less than 20% of the total in the 1960s to an estimated nearly 40% (or US$24.7 billion) in 2021. Meanwhile, federal funding has declined as a relative source of support for basic research at US universities and nonprofit research institutes, from more than 75% in the 1960s to approximately 50% in 2021. Basic research accounts for approximately 15% (US$118 billion in 2021) of R&D spending in the USA, and applied research for approximately 18% (US$144 billion in 2021).

2. Philanthropic support increased by approximately 40% for basic and 100% for applied research from 2006 to 2021. Meanwhile, federal support for basic research at US universities and nonprofit research institutions has not increased over the last 15 years when adjusted for inflation, while federal support for applied research increased by over 70% from 2006 to 2021.

3. Philanthropy especially favors biological, biomedical, and health sciences, with over 70% of nonprofit funding for science R&D at universities consistently devoted to these fields. Biological, biomedical, and health sciences accounted for two-thirds of science R&D spending at universities and over 80% of science R&D spending at nonprofit research institutions in 2021.

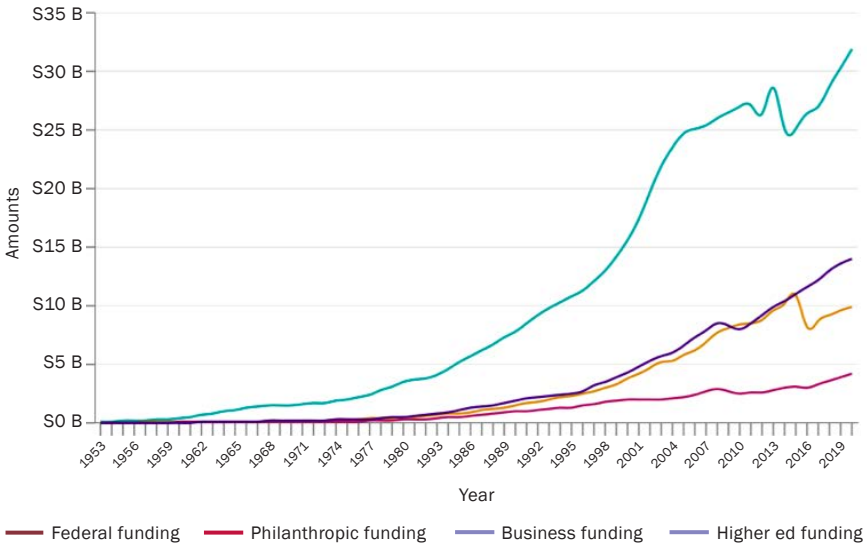
4. Philanthropy can drive research in smaller fields. In the social sciences, for example, higher education and nonprofit funding supported over half of university R&D spending in 2021. Philanthropy has also transformed less-funded fields such as ocean and marine sciences, which account for less than 2% of science R&D spending at universities across all sources.

5. Partnerships and new models of philanthropy offer mechanisms for increased impact and effectiveness. Philanthropists are for instance working together to advance equity in science, evaluate basic research, and promote open science.

To illustrate the first key finding, Stiffman (2023) has put together a graph (see Figure 1) showing the relative decline of federal funding. Trends in funding for basic science by source are captured in annual survey data collected since the 1950s by the National Center for Science and Engineering Statistics of the National Science Foundation (NSF). The analysis below relies on the most recent release (January 2023), which contains preliminary data for 2020 and forecasts for 2021.

After World War II, the federal government became the primary funder of basic science research at universities and nonprofit institutions. Currently, federal funding for basic science focused on knowledge and discovery still surpasses combined contributions from corporations, universities, and philanthropy, although the gap has narrowed. However, the government's share of total funding for basic research has been declining since the 1960s according to NSF surveys (Stiffman 2023).

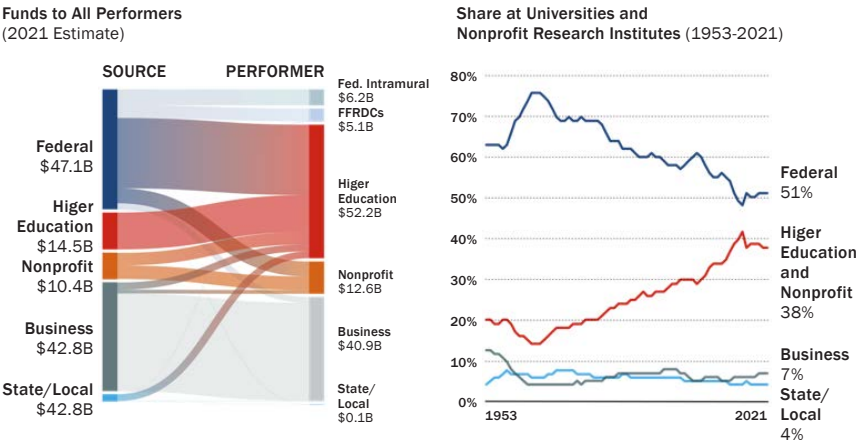
Figure 1: **Science research funds are increasingly coming from philanthropy**



[Source] Stiffman (2023) from the National Center for Science and Engineering Statistics, National Patterns of R&D Resources: 2020–2021; Data Update, Graph: Yesica Balderrama, data reporter and producer.

Recent analyses from the Science Philanthropy Alliance illustrate the large portion of support for basic research at universities and nonprofit research institutions from philanthropic sources. I include below a figure published in their 2023 Indicators Report that shows the flow of funds from source to recipient and, on the right, funding for basic research at universities and nonprofit research institutions over the last seven decades as a percentage of the total (see Figure 2). The upper line in blue shows basic research expenditures from federal sources. Over the last several decades, the relative contribution of federal funding has decreased from over 75% in the 1960s to about 50% in recent years. The upward-trending red line represents the combination of higher education funds (including returns from philanthropic endowments) and current nonprofit and philanthropic funds for science. This combined contribution of higher education institutional funds and nonprofit funding sources has doubled from less than 20% to around 40% since the 1950s.

Figure 2: **Funding sources for basic research expenditures of universities and research institutions in the USA (1953–2021)**



The left panel shows 2021 estimates for the flow of funds from the major funding sources to basic research performers. The right panel shows the share of basic research support that universities and nonprofit research institutes received over time from each funding source. Reproduced with permission from Science Philanthropy Indicators Report, Science Philanthropy Alliance, 2023. Based on NSF National Patterns 2021 data update (NCSES NSF 23-321, 2023).

Business, as well as state and local government, contributed only a small portion of the basic research funding at these institutions, although business is a large contributor to the overall R&D landscape, with these investments mostly in development. (SPA 2023a). Taken together, these findings showcase how science philanthropy is a major positive force and competitive advantage for the USA.

In another recent take on calculating the sum of science philanthropy in the USA was made by researchers Robert W. Conn, Peter F. Cowhey, Joshua Graff Zivin, and Christopher L. Martin in 2023 in a report titled Science, Philanthropy, and American Leadership. These researchers belong to the National Bureau of Economic Research (NBER) – a private, nonpartisan organization headquartered in Cambridge, Massachusetts that coordinates a network of more than 1,750 economists who hold primary appointments at North American colleges and universities.

Conn et al. (2023) found that when coupled with the US$7.0 billion in annual nonprofit giving to universities, total philanthropic support for basic and applied Science, Technology, Engineering, Medicine, and Innovation (STEMI) at universities comes to at least US$11.8 billion per year. Adding the US$9.7 billion in funding at private nonprofit research institutions as well yields a total figure of US$21.5 billion in philanthropic support annually for science research. This estimate is equivalent to roughly 42% of the federal outlay to these institutions, and approximately 23% of all federal government support for basic and applied research both inside and outside universities (US$91.9 billion in 2021). This surprisingly large percentage means that philanthropic contributions are sufficiently large to influence how the research system operates and performs at these institutions. Overall, and even after including business spending on basic and applied research, philanthropy constitutes about 8.2% of nationwide spending on all basic and applied research by all funders, making it an important and distinctive feature of the US research ecosystem. No other country comes close to matching the US level of philanthropic funding for STEMI, either absolutely or as a share of their total national investment.

Business overwhelmingly devotes its spending to development, but its basic and applied research budget is still US$127 billion (exceeding federal spending in this area by just more than a third). This arguably makes business a major driver of the entire US basic and applied research effort. However, most business research is used largely for internal projects and those projects are mainly tied to business strategies because of the fiduciary responsibility of firms. In short, because research furthers corporate missions there is less freedom for pure discovery. This means the largest funders of basic and applied research with a truly broad scope of agendas are the federal government and private philanthropists (Conn et al., 2023).

The PFC periodically produces a snapshot of Canada's top 150 private and public grantmaking foundations (with grantmaking as primary activity). Its latest review (published 2021, with most recent data from 2018) shows that Canada had 10,881 foundations with combined assets of close to CA$92 billion and total

giving of over CA$7 billion. These summaries cover all charitable foundations: philanthropy for research is included, but also a number of other causes such as emergency food, shelter and basic needs, adult literacy, employment training programs, music and art. The review classifies 32% of total donations as education and research, resulting in around CA$ 2.2 billion.

Decentralized science adding dimensions other than financial support and "supercharging" systems from the bottom up

Researchers, including Conn et al, have also pointed out that science philanthropy may have positive effects beyond providing funding and its strength lies in its decentralized nature. As shown above, philanthropy plays a special role in driving the performance of the US basic and applied research system because of the size of the support provided primarily to universities and NPOs. This is crucial, because decisions made by business and the federal government over decades have rendered research universities and NPOs the primary centers for basic discovery, and these institutions have greater freedom to define agendas and strategies from the bottom up. In these institutions, philanthropy plays a significant role in supercharging the discovery system.

The rise of science philanthropy in the late 19th century catalyzed the creation of a decentralized set of research universities and private, nonprofit research institutions. These, along with federally funded national laboratories, are the primary performers of research in the present era of philanthropic and governmental support. Although the federal government looms large, a huge pool of resources is controlled from the bottom up in a wide variety of institutions. Philanthropic spending, including investments in people, has incentivized behaviors that enhance the productivity of this system and altered the portfolio mix of US investments in its STEMI enterprise. The more than thirty interviews on which this report is based, literature in the area, and my own experiences allow me to conclude that philanthropy makes the overall enterprise more risk-tolerant and more creative than government or business funding alone could. Furthermore, it enables significant innovation in the development of human capital in STEMI areas.

Within this decentralized institutional environment, an informal but effective division of labor among federal, commercial, and philanthropic funding of basic and applied research has evolved. The interaction of philanthropy with other institutional funds allows for flexibility in the bottom-up strategies set by research institutions. Science philanthropy boosts research because it adds to flexibility in the use of funds at these decentralized research institutions to amplify agendas

around basic and applied research. Researchers can leverage these funds to explore new ideas and apply for additional funds from other sources, e.g. the federal government.

Philanthropy accelerates the road from risky fundamental discovery to a scalable working out of downstream investigations and infrastructure using federal funds. Philanthropy further permits competitive research institutions to explore different ways of combining and developing their human capital. People are perhaps the most important asset of basic and applied research discovery. This in turn is fundamental to the evolution of novel paths for the discovery enterprise (Conn et al., 2023).

A confident conclusion is that science philanthropy plays a significant role in both the USA and Canada, contributing to advancing scientific research, innovation, and education. While government funding remains the primary source of scientific research support in the USA and Canada, science philanthropy enhances research capabilities, addresses funding gaps, supports innovative projects, and strengthens science education and outreach efforts. Its contributions are instrumental in advancing scientific knowledge, driving technological advancements, and addressing societal challenges in both countries.

Comparing Philanthropic Science Funding with Public Funding

The nature of science philanthropy and its impact on the North American research ecosystems has been established above. Data also show that although the share of funding received from these foundations and individuals is surprisingly large, the largest share of funding is still provided by taxpayers via all the public funding actors. In addition, funding is received from the private sector. Philanthropic and government research funding can differ in several ways, including their sources, objectives, decision-making processes, and scope. The main characteristic of philanthropic funding is, of course, its source – private foundations, corporations, individual donors, and NPOs. These entities allocate resources based on their specific missions, interests, and priorities. How does philanthropic funding differ from government research funding? Do they complement each other? What are the main benefits and drawbacks of philanthropic vs. government funding of science?

Some distinct advantages of science philanthropy over public research funding

Based on interviews and research and discussion papers written on the subject, four value sets or features arguably brought to the table by science philanthropy – besides capital – are addressed, as is their impact on the research community. The following discussion especially relies heavily on the work of Conn et al (2023) providing much deeper argumentations and nuances than this report can provide:

1. *Flexibility:* Philanthropic funding often offers greater flexibility compared to government funding. Donors can target specific research areas, support innovative or high-risk projects, and provide resources to emerging fields that may still need to receive attention from traditional funding sources. This may result in greater risk-taking.

2. *Diversity:* Science philanthropists come from a diverse set of areas of interest and backgrounds and, in turn, fund a considerable variety of research projects. Additionally, the flexibility of philanthropic funding positively impacts the development of a more diverse research community.

3. *Expedited decision-making:* Philanthropic organizations typically have more streamlined decision-making processes than government agencies. This allows for faster funding decisions, enabling researchers to initiate projects and make progress more swiftly.

4. *Gap-bridging and buffering:* Philanthropy helps bridge funding gaps in scientific research by supporting areas that may be underfunded or overlooked by government funding mechanisms. It provides additional resources to advance research in niche or interdisciplinary fields.

Philanthropic funding introduces more f*lexibility* to the choices available to research institutions and enables a greater element of "bottom-up" discretion in research. This is, for instance, seen in how most research institutions balance restricted (earmarked for a specific project) and unrestricted funding sources. Much of the funding received by research institutions, including philanthropic funds, is earmarked for the current costs of specific research projects. Philanthropic grants often do not cover the full cost of the projects including full overhead (Indirect Cost Recovery or IDC). If a research project is important to an institution, it generally accepts the funding. Although unrestricted or lightly restricted philanthropic funding is the hardest to raise, such gifts provide vital flexibility to any institution.

The flexibility of philanthropic funding can help encourage risk-taking, innovation in project development, and the exploration of new strategies. This flexibility promotes the adoption of novel approaches to organizing research. In research, risk-taking involves a greater willingness to undertake projects with a lower expectation of success at the outset, especially when the underlying knowledge is still at an early stage. The nature and scale of philanthropic funding have an impact on flexibility. Philanthropic organizations are often established or led by individuals or groups theories of change, research priorities, and strategies that differ from those of government or business. This diversity results in a more open-minded approach to projects with longer time horizons, a greater tolerance for risk, and an interest in frameworks that promote interdisciplinary collaborations or new ways of organizing research (Conn et al. 2023).

Perhaps as fundamental as risk taking, the *diversity* of philanthropic donors yields a sprawling agenda of research and support. Philanthropic funding allows donors to target specific research areas aligned with their interests and priorities. Arguably, this diversity is not only translated into a diverse set of research topics but also to diversity in the human capital performing the research, for instance by bringing in more support for younger researchers.

A recurring theme in the comments from foundations, interviewees, and researchers is that science philanthropy especially helps to fund research on new problems and areas, along with new approaches for tackling them. Philanthropy is more open to funding advanced use cases or newer fields of science beyond traditional disciplinary inquiries. Indeed, some foundations see their charters as

precisely the advancement of new lines of inquiry or younger scientific fields. As an example, the Heising-Simons Foundation awards grants in the sciences typically to the order of US$5 million for projects. The foundation staff select very specific topics for inquiry based on their analysis of significant problems requiring new thinking. The foundation then invites participants to a brainstorming roundtable to define specific lines of attack. This exercise begins to define who the best researchers might be to conduct the studies. The roundtable also seeds what the foundation hopes will be an emergent network of researchers whose bonds will propel further research efforts on the topic. Catalyzing new networks across institutions is one way of incentivizing further innovation.

Flexibility created by philanthropy through its unrestricted and lightly restricted endowment elements is also key to allowing research institutions greater freedom in making strategic choices about human capital development. Philanthropic resources allow institutions greater latitude in deciding which people and skills can best advance new research agendas. Support for young faculty is critical. Many philanthropists and foundations now provide junior faculty with endowed chairs so that they receive an annual payout to supplement the funding of their early work. Endowment payout funds also support investments that universities make in the development of their junior researchers, frequently by super-charging the cluster hiring of post-doctoral students around new undertakings or subfields. In addition, a number of foundations (such as the Packard Foundation) fund early career scientists.

One advantage of philanthropy is facilitating *expedited decision-making*. Philanthropic funding decisions are often quicker and more flexible than government processes, enabling rapid initiation of projects. When assessing a potentially good idea in its early stages, the costs are usually not high. Universities utilizing their annual endowment payouts and foundations have access to funds that offer flexibility. They further have faster decision-making cycles and researchers therefore encounter less bureaucratic red tape than when applying for government funding. Success at these initial stages often strengthens the case for securing larger federal funding. Interviewees agreed that little reporting and other paperwork is required from researchers in comparison with federal funding grants.

Finally, philanthropy can act as a *bridge or buffer* in areas and times when public funding is minuscule or lagging. Philanthropic funding can provide long-term support for research projects and initiatives, offering stability and continuity to researchers, particularly in areas that may experience fluctuations in government funding. Philanthropy fills critical funding gaps by supporting research that may not receive sufficient attention from traditional funding sources. Science philan-

thropy is complementary to other funding sources such as government, industry, and universities, and can serve as a buffer against variation in those sources of funds. Research institutions develop strategies to pair early-stage risk funded by philanthropy with scaling-up strategies that later rely on federal funding. On the other hand, interviewees agreed that if federal funding is already provided, philanthropists are not as interested in funding the research.

Potential inherent weaknesses of science philanthropy

It should be noted from the outset that many public research funding bodies share science philanthropists' aims of agility, flexibility and trying new approaches, including support targeting young researchers. One of many examples is that the NSF has provided quick grants through its Grants for Rapid Response Research program since 1990 and through its Eager (Early-concept Grants for Exploratory Research) program since 2009. These grants are swiftly distributed by avoiding the lengthy review process by external experts (Stiffman 2023). Nevertheless, government funding processes can generally and without exaggeration be characterized as bureaucratic; they involve complex applications and lengthy decision-making cycles, which may delay the initiation of research projects.

A not fully convincing argument is that the lower degree of flexibility and overall innovation among public research funders is due to increased pressure for transparency and scrutiny when handling taxpayer money. Extra layers of checks and balances to avoid subjectivity and bias simply slow down the process. On the other hand, philanthropic funding decisions may be more vulnerable to accusations of being *subjective and influenced by the priorities and perspectives of donors,* potentially leading to biases in research support. Interviewees attested that the founders' interests are often closely considered, especially if they are still active donors and engaged in the foundation. Betty Moore for example almost died when she was younger due to medical malpractice, which led the foundation to have special programs for nursing. Foundation statements often also clearly illustrate areas of special interest to their founders. Government-funded research typically undergoes rigorous peer review to ensure scientific merit, quality, and feasibility before receiving funding. Decisions are based on scientific evaluation by experts in the field.

It is of course important that donors' entrepreneurial ambitions to try new ways of doing science are accompanied by evaluations. Good ideas and good intentions may be sidetracked without solid evidence to determine whether investments were successful. Further an element of expectations management is involved, as inexperienced philanthropists who have come from the business world often

want to see results quickly. The interviews and case studies this report is based on lead me to the conclusion that at least the major science philanthropy actors conduct themselves professionally. It is helpful that many staff members of philanthropic foundations have backgrounds in research and/or public research funding and can relate to researchers and how they write applications.

The main drawback of science philanthropy is l*imited resources*. Government funding typically offers greater financial resources compared to philanthropic sources, enabling support for a broader range of research projects and initiatives. Although the availability of philanthropic funding is increasing, as has been shown, it is still limited compared to government funding, which may restrict the number and scale of research projects that can be supported. Government research funding is derived from taxpayers' money and is allocated by government agencies and departments responsible for science and research, which should provide continuity.

With a few exceptions and areas such as astronomy, foundations and philanthropists have for example generally been *reluctant to fund large-scale infrastructure projects,* especially big science projects with large and complex physical infrastructure needs (e.g. colliders). While philanthropy helped to launch the early stages of medium-scale research infrastructures, as has happened in ocean monitoring, bigger, long-term efforts are still largely left to government and business. An implicit division of labor seems to have evolved in the USA regarding basic research, where government and business dominate so-called Very Large Research Infrastructure (VLRI) projects for basic and applied research (Conn et al. 2023). This seems natural, in that VLRIs are unique, complex undertakings with a strong international dimension that play a critical role in frontier research in most scientific domains. VLRIs require considerable care in their construction and operation, as well as very substantial investments and technological innovations (OECD 2023).

To a lesser extent, philanthropic funding is also subject to the priorities and financial capacities of the donor organizations, which may change more quickly over time than those of major public funding bodies. This can affect the long-term sustainability of research initiatives. Government funding mechanisms often provide long-term support for research projects, allowing researchers to plan and execute studies over extended periods.

Government funding is also often aligned with national priorities, such as economic development, healthcare, environmental sustainability, and national security. It arguably reflects broader societal goals and addresses public interest. On the other hand, government funding decisions may be subject to political considerations and shifts that potentially affect research allocation and priorities.

In summary, both philanthropic and government research funding have their respective strengths and limitations. Collaboration and a diverse funding landscape that includes both sources can help maximize the support available for scientific research, foster innovation, and address diverse societal challenges effectively.

Major Science Philanthropists and Their Organization

So far, this report has established the importance of science philanthropy and some of its characteristics compared to better-known public research funding. This section provides an overview of the major players in each country. How are major philanthropic funders organized and to what extent do they collaborate? This section draws on selected examples of the tools funders use as illustrations. However, as pointed out in the previous section, each foundation seems to have found its own niche and way of working, so generalizations must be made with some caution.

Ongoing organization of major science philanthropists in the USA while Canadian ecosystem still lacks a center of gravity

The Science Philanthropy Alliance (SPA) is a US-based organization established in 2013 in response to declining government funding for basic research. It works to support philanthropic investment in curiosity-driven and use-inspired basic research across various disciplines. Since its founding with six members, SPA has grown to include nearly 40 members. Beyond providing advising services, SPA fosters a community that encourages networking, shared learning, and collaborations among its members, thereby enhancing the overall impact and visibility of science philanthropy.

The current public member list – some have chosen to remain anonymous – comprises (SPA 2024):

- The Lasker Foundation
- Paul G. Allen Family Foundation
- The Conrad Prebys Foundation
- Azrieli Foundation
- Alfred P. Sloan Foundation
- Bill & Melinda Gates Foundation
- The Brinson Foundation
- Burroughs Wellcome Fund
- Chan Zuckerberg Initiative
- Dalio Philanthropies
- Dana Foundation
- David and Claudia Harding Foundation
- Doris Duke Charitable Foundation
- The David & Lucile Packard Foundation
- Heising-Simons Foundation
- Gordon and Betty Moore Foundation
- John Templeton Foundation
- The Kavli Foundation
- Leon Levy Foundation
- Lyda Hill Philanthropies
- Open Philanthropy
- Research Cooperation for Science Advancement
- Rita Allen Foundation
- Ross M. Brown Family Foundation
- Schmidt Futures
- Sergey Brin Family Foundation
- Shanahan Family Foundation
- Shurl and Kay Curci Foundation
- Simons Foundation

– W.M. Keck Foundation
– Walder Foundation
– Wellcome Foundation
– Winn Family Foundation
– WoodNext Foundation

In Canada the landscape is more scattered, and there is no real membership organization specifically for science philanthropy. The list of most influential science philanthropists must be deduced from piecing together each foundation's mission and actual donations to research.

The Philanthropic Foundations Canada (PFC) is the national network for grantmakers. This registered charitable organization was founded 20 years ago and works in collaboration with civil society, the private sector and governments to connect philanthropists. Members are Canadian grantmakers – comprising private, public, and community foundations, corporate giving programs, donor-advised funds, charitable organizations, and nonprofits. The PFC periodically produces a snapshot of Canada's top 150 private and public grantmaking foundations (with grantmaking as primary activity) but does not cater specifically to science philanthropy. Charitable foundations include philanthropy for research, but also a number of other causes such as emergency food, shelter and basic needs, adult literacy, employment training programs, music and art.

Based on the largest Canadian philanthropic foundations by assets and gifts in 2021 (PFC 2021) and a review of their missions and actual donation areas, these are the foundations most impactful in science philanthropy:

– The Mastercard Foundation
– The Azrieli Foundation
– Li Ka Shing (Canada) Foundation
– The Rossy Foundation
– The McConnell Foundation
– La Fondation Marcelle et Jean Coutu
– Fondation Mirella & Lino Saputo
– The Joseph Lebovic Charitable Foundation
– The Schulich Foundation
– The Slaight Family Foundation
– The Gerald Schwartz & Heather Reisman Foundation
– The Weston Family Foundation
– Michael Smith Foundation for Health Research
– Trottier Family Foundation
– The Rick Hansen Foundation
– The Pierre Elliott Trudeau Foundation

Diverse approaches and common traits in science philanthropy

Science philanthropists each have their own distinct style and mission to advance research, education, and innovation. Foundations all work differently and interviewees professed the sentiment that getting to know one foundation is getting to know one foundation only. Each foundation organizes itself according to its specific

mission, objectives, and legal requirements. However distinct their governance structures, decision-making processes, and mechanisms for identifying, evaluating, and allocating resources to support scientific research may be, science philanthropists still operate in common ways. Often the modus operandi is not too different from that of the larger public funding agencies.

The core of each science philanthropy is of course the *foundation* established with a donation from one or several founding donors. These entities serve as vehicles for managing and distributing funds to support research, education, and related activities. Private foundations are typically established as independent legal entities governed by a board of directors or trustees. They operate as charitable organizations with specific missions and goals. The foundations have decision-making processes to determine funding priorities, evaluate grant proposals, and allocate resources. The board of directors or trustees, along with professional staff, assesses funding requests and makes funding decisions. The foundations may focus on specific areas of interest, such as health, education, environment, or scientific research. They develop grantmaking strategies aligned with their mission and objectives.

The *founder* can be a family or one or several individuals passionate about scientific research and its impact on society and who contribute significantly to science philanthropy. Prominent individuals like Bill Gates, Mark Zuckerberg, Ted Stanley, and Paul Allen in the USA have in recent years made substantial donations to advance scientific knowledge and address global challenges. Some individual donors contribute to donor-advised funds, which are charitable giving vehicles managed by third-party organizations. Donors recommend grants to specific projects or organizations, and donor-advised funds facilitate the disbursement of funds. However, not all foundations have donors who are actively involved in current strategies or who had left detailed instructions regarding the type of research that may be funded. Research Corporation was for example founded by a Berkeley chemist in 1912 when he donated intellectual property rights donating for the general good of others and in principle founded the first tech transfer office in the USA.

Some corporations establish their own philanthropic foundations to manage their charitable giving programs. These foundations operate independently but align with corporate values and objectives. A prominent example is the Mastercard Foundation, by far Canada's largest foundation with CA$24 billion in assets; it is also the country's largest grantmaker with over CA$114 million in grants. Mastercard is a significant funder in three areas: 1. Education & Research, 2. International Activities, and 3. Government. In 2019, the Mastercard Foundation gave more than CA$70 million to qualified recipients in Canada.

Sometimes there is controversy about corporations' support of philanthropic initiatives. Founded in 2006 by MasterCard International, the MasterCard Foundation endowment is almost 25% of all philanthropic capital of Canadian foundations. The assets of the foundation are MasterCard shares and it may be argued that while the foundation is autonomous from a governance perspective, relations between the parent company and the foundation are synchronous from the point of view of philanthropic focus (Elson 2020). One mission of the foundation is to tackle the youth employment challenge in Africa for the next decade and to advance financial inclusion and education to economically disadvantaged young people in developing countries to improve their lives. A cynic could argue that this translates to the establishment of credit cards as an important part of the financial and social fabric just as in North America, and indirectly results in MasterCard International's growth and profit. Additionally, interviewees attested to a great deal of sensitivity and necessary firewalls when an individual donor is an active shareholder or involved in the running of a publicly traded company, as for example Mark Zuckerberg who is deeply involved in both the Chan Zuckerberg Initiative and Meta (Facebook).

Financial support is the core activity stemming from the foundations, and that which many other initiatives depend on, whilethe two most prevalent vehicles used are grant funding and endowments. Philanthropists provide financial support through grants to research institutions, universities, and NPOs. These grants fund specific research projects, educational programs, or initiatives aligned with the philanthropist's interests. Philanthropists may establish new endowments to provide a lasting source of funding for scientific research, scholarships, or academic positions. Endowments generate income that can be used to support ongoing initiatives. A rarer approach involves philanthropists' adopting a venture philanthropy approach, treating their contributions to scientific endeavors as investments. They may actively engage with and support startups, innovation hubs, and entrepreneurial initiatives in the scientific community. Some examples of early investments as venture philanthropy are in the realm of very applied research, such as with the funding of oceanography research by Schmidt Futures and the Dalio Foundation (Conn et al. 2023). Managing the screening, evaluation and reporting from the funding requires substantial manpower, and the largest foundations are well staffed; the Gordon and Betty Moore Foundation for example employs some 90 staff members including administration and program officers.

These funds may be ear-marked for specific *recipients,* such as individuals and/or research institutions. Research institutions and universities actively engage in science philanthropy by seeking philanthropic support for their scientific programs, re-

search initiatives, and infrastructure development. They often establish partnerships with foundations and individual donors to secure funding for their scientific endeavors. Research institutions and universities typically have offices dedicated to development and advancement, responsible for fundraising efforts, including science philanthropy.

Most, but not all, major science philanthropists also *engage in advocacy and policy.* Philanthropists may engage in advocacy efforts to promote science-friendly policies, support evidence-based decision-making, and contribute to public discourse on scientific issues. Philanthropists may also support initiatives that aim to communicate scientific advancements to the public, promote science literacy, and foster a better understanding of the importance of research.

While most philanthropists may target their efforts toward addressing grand challenges, such as global health issues, climate change, or technological innovation, some are much more specific, and more tailored to the founders' specific beliefs or interests. Large science foundations may have a complementary creative element imparted by their founders while they are still alive. These foundations simply do not exhaust their founders' range of interests and financial commitments, and founders commit separate gifts that complement the foundations' primary agenda. Good examples are Gordon Moore's gift for the design of the Thirty Meter Telescope and James Simons' for the Simons Observatory. The late Paul Allen had a somewhat different strategy for the Paul Allen Science Research Institutes, each funded separately. The Allen Institutes are funded to support work in four specific scientific areas each at US$100 million, spent as US$10 million per year over ten years. These Allen institutes hire their own research staff and conduct basic research as private non-profit research institutions. In this case, the Allen Institutes are separate and independent from the Paul Allen Foundation, which has its own process for selecting areas of focus and determining grantees.

According to interviewees, *partnerships and collaborations* have intensified in recent decades, both with other philanthropists and public funding agencies, as well as with research institutions. Philanthropists often collaborate with research institutions, universities, and other foundations to amplify the impact of their contributions. These dialogues can foster interdisciplinary research, knowledge sharing, and joint initiatives. While primarily responsible for government-funded research, government agencies in the USA and Canada may also collaborate with philanthropic organizations to support scientific research and address societal challenges. Partnerships between government agencies and philanthropic entities can enhance the impact of scientific research and amplify the resources available for scientific ad-

vancements. NPOs dedicated to advancing scientific research, education, and public engagement indirectly play a vital role in science philanthropy by partnering with philanthropists. These organizations include scientific societies, research advocacy groups, science communication organizations, and science-focused philanthropic intermediaries like the SPA in the USA.

One example of an initiative resulting from collaboration between several private philanthropic foundations is the Scialog format launched by the Research Corporation for Science Advancement (RCSA). Scialog is a program that addresses globally significant scientific challenges by supporting research, fostering intensive dialogue, and building a community. Through multiyear initiatives, Scialog Fellows engage in discussions, identify bottlenecks, collaborate on high-risk discovery research, and share progress in closed conferences. Guided by leading senior scientists, Scialog aims to empower early career researchers, encouraging them to form multidisciplinary teams and tackle challenging problems. The program supports Fellows in expanding research, transitioning to further funding, and measuring success through impactful results and ongoing support from foundations and agencies. The RCSA promotes an inclusive and respectful environment for diverse perspectives. Approximately 50 early career faculty, ranging from first year-faculty to those who recently obtained tenure, are invited to become Fellows for each Scialog. Recent examples include the RCSA and Heising-Simons Foundation's co-sponsorship of Scialog: Early Science with the Legacy Survey of Space and Time (LSST) and the RCSA and Arnold and Mabel Beckman Foundation's co-sponsored Scialog: Automating Chemical Laboratories (RCSA 2024).

Recent Trends in Science Philanthropy

This final section outlines emerging trends in science philanthropy. Philanthropy has never remained static, but rather tried to fulfill societal needs of the time. Science philanthropy as a "problem-solving machine" must therefore by its nature be influenced by external conditions, how society changes. What major trends have been seen in science philanthropy in recent decades and looking ahead?

Second Gilded Age of science philanthropy fueled by venture capital and tech entrepreneurs

The largest trend in science philanthropy in recent decades has run like a red thread through this report – the importance and impact of science philanthropy in the USA and Canada have been steadily growing. Alluding to the rise of philanthropy in the USA during the First Gilded Age of philanthropic giving by the financial titans of the 1870s to the 1920s, researchers have started to label the last decades the "Second Gilded Age" of philanthropy. In a 2023 article Eden Stiffman walks the reader through several of the most recent trends in science philanthropy and how they can be partially traced back in time to early philanthropy. In the following several of the examples from that work has been included.

In the 1980s, a significant shift occurred in the US financial landscape with the introduction of new federal investment rules that facilitated the expansion of venture capital and private equity. This surge marked a transformative era, providing increased risk capital for innovation in early-stage startups and corporate buyouts. Despite venture capital taking on more risk at the initial stages, its reliance on universities and non-profit research institutions for fundamental discoveries remained unchanged. Essentially, philanthropic support for basic research serves as a vital complement to venture capital investments. Simultaneously, the scale of this new venture capital approach allowed founders to maintain a substantial ownership percentage in their companies.

The magnitude of wealth and the count of affluent individuals, notably in the digital technology realm, experienced significant growth. Notable entrepreneur founders include Bill Gates, Paul Allen, Jeff Bezos, Sergei Brin, Larry Page, and Mark Zuckerberg. These individuals have transitioned into influential philanthropists with substantial resources. Similar to the philanthropic trends of the First Gilded Age, they have directed significant portions of their wealth towards philanthropic endeavors, encompassing basic and applied science as well as education.

Eric John Abrahamson, a historian focusing on corporate and nonprofit organiza-

tions, draws parallels between current donors in science philanthropy and historical figures like Andrew Carnegie and John D. Rockefeller, who aimed to reshape science institutions in the 1910s, '20s, and '30s (Stiffman 2023). As a result, the magnitude of giving has boomed in the Second Gilded Age of philanthropy. This new wave of philanthropy has significantly influenced the dynamics of the US ecosystem and added to its flexibility. It has injected new elements of dynamism into an institutional landscape where the decentralized nature of private and state control makes institutions more amenable to experimentation and risk taking (Conn et al. 2023).

Since the 1990s, the influence of private donors has expanded. According to NSF surveys, nonprofit and philanthropic contributions to basic research grew from US$1.5 billion in 1990 to US$9.8 billion in 2020. Higher education fund contributions, including donations to university endowments, increased from US$1.9 billion to over US$14 billion in the same period, largely driven by new philanthropies leveraging wealth from technology, data, and finance (Stiffman 2023, SPA 2023c).

Accelerated experimentation in the aftermath of the pandemic

The immediate aftermath of the COVID-19 pandemic led to another boost around 2019–2020. Donors have given hundreds of millions of dollars in both the USA and Canada to research labs and NPOs, aiming to address perceived issues in how government agencies and institutional philanthropies fund science. The donors argue that scientists spend too much time on restrictive grant applications with long lead-times in a time of crisis, and again see a role for philanthropy in supporting risky projects often neglected by government funding.

In an article describing the latest trends in philanthropy, Stiffman (2023) argues that science philanthropy in Silicon Valley is at an inflection point for experimentation. Much experimentation with new funding constellations and vehicles is taking place in the aftermath of the pandemic, especially from the newer foundations with tech billionaires as founders. Allegedly this creativity is spilling over to the older foundations as well. One example is Collison, which, along with Vitalik Buterin and other donors, committed over US$500 million to the Arc Institute, a new nonprofit for biomedical research. The goal is to allow scientists to concentrate on their research rather than spending time chasing grants. Another example is when Collison and Skype co-founder Jaan Tallinn backed the Good Science Project, a new advocacy group that is pushing government agencies to make their science grantmaking more innovative and efficient. A third example is Schmidt Futures' 2021 creation of Convergence Research, a nonprofit that reviews scientists' proposals and supports the creation of independent organizations in specific areas like

synthetic biology or drug targeting. These organizations, named focused research organizations, act like temporary start-ups for specialized projects that founders think might be ignored otherwise, either due to their being too risky or complex for academic labs or because they are creating tools that are not immediately profitable for venture capital or industry funding. Each focused research organization has a US$20–100 million budget and a five- to seven-year duration.

Surging philanthropic megagifts affect both universities and Big Science

When public research funding was compared to science philanthropy above, it was mentioned that Big Science generally, and at least outside astronomy, mostly remains the domain of public funders. Although this might still be the case, one trend is even larger so-called philanthropic megagifts, defined as gifts greater than US$50 million from science philanthropists, both for the establishment of new schools and institutes and new Big Science research infrastructure.

A university may use this recent surge in philanthropic megagifts to amplify human capital development, for instance with the positive effects on diversity discussed above. Such gifts are somewhat analogous to the megagifts made by donors to create universities in the First Gilded Age. Megagifts draw together new combinations of talent and fresh forms of human capital training along with needed university infrastructure. The scale of funding may also encourage an engagement with problems that are deeply rooted in training and education, often in new interdisciplinary models, and that are at the more basic research end of the scale. One example is John and Ann Doerr's 2022 megagift of US$1.1 billion to Stanford University that established the Stanford Doerr School of Sustainability. This gift will allow Stanford to hire faculty in clusters in the area of global sustainability, which Stanford deems central to its future. Similarly, Stewart and Lynda Resnick provided a megagift of US$750 million in 2019 to the California Institute of Technology (Caltech) to establish the Resnick Institute of Science, Energy, and Sustainability. Again, cluster-hiring of faculty and new infrastructure facilitate an educational and research direction that Caltech has deemed central to its future leadership (Conn et al. 2023).

A significant shift in the division of labor for large research infrastructures, whether for basic or applied research, may also be emerging. The Allen Institutes, the Howard Hughes Medical Institute's Janelia Research Campus, and the Chan Zuckerberg Initiative are three examples of philanthropic funding explicitly seeking to create large-scale infrastructure for complex basic and applied biological research problems. Also, the Schmidt Futures initiative was formed to address gaps and to serve as an accelerator of innovation. If this becomes a broader movement, the

agenda of philanthropy for large infrastructure efforts could alter the dynamics of large infrastructure in ways that mimic the behavior patterns of other fields of philanthropic funding.

In astronomy there is already a tradition of large private donors where foundations have provided the primary support for the construction of new facilities. For example, the Keck Foundation provided funds for Keck I & II in Hawaii, the largest current US telescopes. The personal interests of wealthy founders of large science-focused foundations, such as the Gordon and Betty Moore Foundation and the James and Marilyn Simons Foundation, led the founders to decide separately to fund new observatories. Gordon Moore personally funded the early design stages of the proposed Thirty Meter Telescope at hundreds of millions of dollars. The Simons Foundation provided US$40 million to build the Simons Observatory in the Atacama Desert of Northern Chile, which aims to measure the universe's cosmic microwave background. If this trend expands, it could reshape the philanthropic agenda for large-scale infrastructure projects, potentially mirroring patterns observed in other fields of philanthropic funding (Conn et al., 2023).

This section on trends concludes with a single example of extreme "experimentation"– the decision to respond to an external time-critical event of great importance by simply going all in at once. At the end of 2022, Canadian media reported on how one of the most prominent Canadian family foundations funding climate action had decided to give away all its money almost all at once, thereby upending the traditional model of philanthropy and possibly forcing other foundations to rethink their own responses to the climate crisis (CBC 2022). The Ivey Foundation, a Canadian institution with a 75-year history, has been a significant donor, contributing approximately CA$100 million over its lifetime. Traditionally, the foundation has donated CA$3–5 million annually to various advocacy groups, think tanks, and university research projects focused on the environment. The foundation revealed its decision to wind down and give away its remaining CA$100 million within the next five years. This departure from the conventional approach, where foundations maintain and invest an endowment for sustained annual donations, is driven by the pressing urgency of the climate crisis. The foundation's board questioned the necessity of persisting for another 75 years in the face of the climate emergency, prompting the decision to distribute the funds rapidly when they may be most needed. While Ivey's CA$100 million represents a substantial contribution, other foundations in Canada boast even larger endowments, like that of the Trottier Family Foundation which totals around CA$230 million. If other foundations were to adopt a similar approach to Ivey, immediate donations of millions or even billions of dollars may potentially be unlocked.

Many other trends shared with the public sector funders, including emphasis on interdisciplinarity, open science and data sharing as well as paying special attention to equity, diversity, and inclusion, collectively reflect the dynamic and evolving landscape of science philanthropy, driven by a desire to address pressing societal challenges and propel scientific progress.

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