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Peirce's Abduction of Science: Is Anti-Intellectualism of American Universities Rooted in Pragmatism?

***Michael Nosonovsky*[a]**

[a] *Department of Mechanical Engineering, University of Wisconsin–Milwaukee, 3200 North Cramer St, Milwaukee, WI 53211, USA.*

Abstract

Anti-intellectualism is deeply rooted in American culture. Charles Peirce (1839-1914) was a pioneering American scholar and one of the greatest thinkers of the *Fin de Siècle* period. Being a prominent logician and philosopher and living far away from European centers, he developed the original American concept of "Pragmatism," which later became a part of Analytic Philosophy. As the dominant school of philosophy in the US, Analytic Philosophy is characterized by scientism, nominalism, linguistic analysis of fundamental problems, and pragmatic attitudes towards science. Peirce's influential epistemological idea was the concept of *abduction* or selection of scientific hypotheses based on their practical, including monetary, value. *Abduction* was thought to be a third mode of inference, in addition to *deduction* and *induction*. In this way, money was introduced into epistemology and scientific methodology. One can hypothesize that the current obsession with measuring scientific discovery by research expenditures in American universities is a direct continuation of the Pragmatist tradition. I explore the metaphor of the "Abduction of Europa" (the Rape of Europe) and bring examples of measuring science by money from my faculty experience at the Mechanical Engineering Department of the University of Wisconsin-Milwaukee, and relate them to Peirce's ideas.

Abduction in the Epistemology of Pragmatism

The intellectual life of every nation is shaped by its national philosophical tradition. Kant, Hegel, and Heidegger in Germany, Descartes, Pascal, and Derrida in France, Dostoevsky, and Berdyaev in Russia influenced the mentality and attitudes of intellectuals to various issues at every level. In America, the original local branch of thought that influenced the intellectual landscape of the country is Pragmatism, associated with the names of Charles Sanders Peirce (1839-1914) and John Dewey (1859-1952). Pragmatism is an original school of philosophy, which on the one hand was an offspring of the classical European metaphysical tradition, but on the other hand, one that drifted far away from the traditional continental approaches towards fundamental philosophical issues.

Fig.1. Charles S. Peirce (1839-1914), c. 1870s.

The founder of Pragmatism, Charles Peirce (1839-1914), was a prominent scholar and thinker, whose legacy is so diverse that it has not yet been completely studied and published until today (**Fig. 1**). Born in Cambridge, MA, he was a son of a Harvard mathematics professor. Following his graduation from Harvard with an M.A. degree (1862), Peirce worked intermittently for the United States Coast and Geodetic Survey. He also served as a lecturer in logic at Johns Hopkins University, starting in 1879 until he was dismissed in 1884 for an extramarital affair with a woman apparently, of Romani origin (whom Peirce later married). Peirce was pro-slavery until the outbreak of the Civil War; however, later he became a Union partisan[1].

Being the first significant philosopher and logician in America, far away from European centers of thought and scholarship, Peirce made a huge contribution to various areas of science, often inventing unusual concepts and terminology: *Tychism*, *Synechism*, *Fallibilism*, to list a few. Working on logic, Peirce did not prove many theorems. Instead, he invented and developed novel systems of logical syntax and fundamental logical concepts. Besides the teaching of Pragmatism (which he later called *Pragmaticism*), Peirce is best known for being a pioneer of Semiotics (he actually viewed Logic as a part of Semiotics) and for his invention of the *Sheffer Stroke* (the *NAND* logical operation ↑, also known as the *Peirce Arrow*) long before Sheffer.

A part of Pragmatism's heritage is its epistemology, including the attitude towards science and the scientific method. Pragmatist epistemology has influenced attitudes towards the methodology of science in the US; however, this influence has not been well studied. It is not widely known that some adepts of Pragmatism believed that intellectual and scientific accomplishments should be measured by their cash value. Thus, the *Stanford Encyclopedia of Philosophy* states:

[1] Ibid. Also Brent, p. 34.

> "All resources for carrying out research, such as personnel, person-hours, and apparatus, are quite costly; accordingly, it is wasteful, indeed irrational, to squander them. Peirce proposed, therefore, that careful consideration be paid to the problem of how to obtain the biggest epistemological "bang for the buck." In effect, the economics of research is a cost/benefit analysis in connection with states of knowledge."[2]

One particular logical and epistemological innovation by Peirce was the concept of *abduction*. Peirce suggested distinguishing between three modes of inference: *deduction*, *induction*, and *abduction*. While deductive (from general to particular) and inductive (from particular to general) reasoning were classical methods of logic, abduction was a novelty invented by Peirce. Peirce started developing the concept of abduction during the early stage of his work on the logic of science in 1859-1890. However, a mature formulation was achieved during the later period in 1891-1914, stimulated by his interest in the topic of how scientific hypotheses emerge.

In general, abduction is the selection of certain hypotheses that are most promising from a particular point of view, at the expense of disregarding less promising conjectures. This approach includes economic considerations in terms of a cost-benefit analysis. Below is an example of the use of abduction:

> "Consider, for instance, the inference of *John is rich* from *John lives in Chelsea* and *Most people living in Chelsea are rich*. Here, the truth of the first sentence is not guaranteed (but only made likely) by the joint truth of the second and third sentences.[3]"

However, abduction goes much farther than regular common-sense reasoning or conventional wisdom. Peirce viewed abduction as a necessary part of a successful scientific methodology. According to Peirce, actual research is not motivated by the goal of the ascertainment of truth but rather by the purpose of attaining the "personal distinction" of a researcher or by some other practical utility. This "utility of knowledge" enables us to calculate how we should act[4]. By introducing abduction into his system of reasoning, Peirce, for the first time in history, incorporated money into logic, epistemology, and the methodology of scientific research[5].

The term "abduction" has many meanings and one of the meanings is kidnapping or rape. The *Abduction of Europa* also called the *Rape of Europa*, is the common motif in ancient mythology and European painting (**Fig. 2**) explored by Titian, Rembrandt, Rubens, Goya, and many others. Europa was a legendary Phoenician princess[6] abducted by Zeus, mentioned in

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[2]Burch, Robert, "Charles Sanders Peirce", *The Stanford Encyclopedia of Philosophy*.

[3]Douven, Igor, "Abduction", *The Stanford Encyclopedia of Philosophy* (Summer 2021 Edition), Edward N. Zalta (ed.).

[4] Writings, 4:73, 78. For more details of Peirce's epistemology see Rescher (1976).

[5] According to the Merriam-Webster dictionary, the word "abduction" has two meanings: "1: the action of abducting; the condition of being abducted. 2 (archaic): the unlawful carrying away of a woman for marriage or sexual intercourse." Compare two names of the mythological motif "The abduction of Europa" and "The rape of Europa."

[6] The etymology of name Europa may be derived from the Semitic root ברע / *'RB* meaning

Homer's *Iliad*, in Ovid's *Metamorphoses*, and in other Greek sources. Europa was kidnapped by Zeus, who attained the bodily image of a bull and brought her by the Mediterranean Sea to the West (namely, from Phoenicia in modern-day Lebanon to the island of Crete). Metaphorically, the European epistemology was kidnapped (and one could argue, raped) by these pragmatic attitudes towards scientific research, after being transmitted overseas to the West.

Fig. 2. Europa and a bull (circa 480 BCE, Tarquinia Museum, Italy), *The Rape of Europa* by Titian (1562), Gardner Museum, Boston; *The Rape of Europa* by Félix Vallotton (1908). Images from Wikipedia.

The recognition of the epistemological role of money had far-fetching consequences, and I will explore them in the consequent sections of this essay.

Analytic Philosophy and the English language

Peirce's ideas were suggested at the right time and at the right place. Pragmatism was supported by Peirce's followers such as John Dewey. The young American nation was constructing its intellectual identity and needed its own scholars and philosophers. Peirce, with his classic background and broad interests, in addition to his enormous energy and productivity (in terms of written work, manuscripts, and drafts), could become an icon of American humanities, despite his lack of formal doctoral training and sometimes weird ideas. Since Peirce worked on logic, including mathematical logic, he can also be viewed as the first significant mathematician who worked in America.

More importantly, Pragmatism was associated with the "Linguistic Turn" in philosophy at the beginning of the 20th century, and eventually, it became a part of the Analytic Philosophy movement. The *Linguistic Turn* is "a radical reconception of the nature of philosophy and its methods, according to which philosophy is neither an empirical science nor a supraempirical enquiry into the essential features of reality; instead, it [studies]… interrelationships among

"West".

philosophically relevant concepts, as embodied in established linguistic usage, and by doing so dispel[s]conceptual confusions and solve[s] philosophical problems."[7]

While Gottlob Frege (1848-1925) and Ludwig Wittgenstein (1889-1951), who are often viewed as founders of Analytic Philosophy, had a German language background, the analytic school of thought is typically associated with English language countries and mostly with the US[8]. The contraposition of the "continental" (or metaphysical) and "analytic" thinkers is the common *cliché* in numerous philosophical and culturological discussions. Many experts say that Analytic Philosophy, with its inclination towards scientism, reductionism, nominalism, the denial of the transcendent, and attempts to present fundamental philosophical problems as language games and paradoxes, has drifted far away from the continental (mostly German) metaphysics.

It is not by chance that Pragmatism developed in America, remote from European centers of metaphysical (neo-Kantian and Hegelian) philosophy, by Peirce who was a stranger to academia for most of his life. Being a thinker of great intellectual potential and erudition who was isolated from other scholars due to his geographical location, Peirce spent most of his efforts on the development of his original systems, terminology, and paradigms, whether in logic, metaphysics, ontology, or epistemology, hence his use of unusual terms and words.

The spirit of Pragmatism fitted well with the economic and social environment in the rapidly developing United States at the end of the 19th – beginning of the 20th centuries. America was viewed as a land of opportunities, where the combination of dynamic capitalism and freedom manifested pragmatic attitudes not only towards economics but towards life in general.

Another, more subtle factor that is sometimes cited as a reason why Analytic Philosophy thrived in America is the English language itself and English cultural traditions. Languages are classified as *synthetic* and *analytic* depending on whether they use inflections to express syntactic relationships or use word order. English is one of the most analytic European languages, which relies heavily on word order. The same word form, such as "water" can be a subject ("Water flows"), an object ("She drinks water"), or a predicate ("They water the garden"). This characteristic is different from synthetic languages, where subject and object would be distinguished by inflections such as case endings.

Apparently, in some situations, this linguistic usage might create difficulties for understanding subtle metaphysical concepts by English speakers. In the early modern period, some translators of classical Greek metaphysical works complained that they did not understand why so many metaphysical terms were introduced by Aristotle[9]. According to this theory,

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[7]Glock and Kalhat, 2018.

[8] According to some estimates, about 70% of American academic philosophers consider themselves Analytic Philosophers (while the rest are typically Marxists).

[9] Thomas Hobbes wrote in 1655 that he did not understand Aristotle's identification of words with things based on words being different parts of speech "Lastly, I confess I have not yet seen any great use of predicaments in philosophy. I believe Aristotle when he saw he could not digest the things themselves into such orders, might nevertheless desire out of his authority to reduce words to such forms" (*De Corpore, Of Names*). Russian philosopher M. K. Petrov (1923-1987) paid attention to this fact. His ideas are developed by a contemporary Russian philosopher

languages with a rigid word order and no inflection are well suited for commerce but not for metaphysics. It is just not natural for them to see isolated concepts (such as "water") as implying subject-predicate or subject-object relations, unlike in the languages where a word form already implies a relation. Compare with Russian, вода*voda* "water [as a subject]" in the Nominative, воду*vodu* "water [as an object]" in the Causative, etc. Consequently, analytical languages have more limited resources for expressing metaphysical concepts, implying that there is nothing accompanying a word (just "water" in my example), making the concepts of subject or object elusive.

Moreover, the Anglo-Saxon precedent law system with no external Legislator also supported the anti-metaphysical (and somewhat atheistic) tendencies of the perception that "there is nothing in the world except for moving matter." In a pure precedent system, the laws are defined by court cases themselves rather than by a Legislator. Making an analogy with the laws of nature (and this analogy became prominent in the 17th century) would imply that matter itself defines its own laws, such as laws of physics. Again, this attitude could eventually deny Metaphysics by assuming that there is nothing beyond Physics. The practice-oriented and pragmatic attitudes towards knowledge thrived in the English-speaking world. As a result of colonial activity, the English language became a language of international commerce, of popular culture, and later the language of science. It is not surprising that concepts such as Pragmatism and Behaviorism became extremely popular in the English-speaking world.

Another interesting observation is that the term "science" is often used in English in a narrow sense meaning "natural sciences" (although in some cases a more general meaning is used; for example, the University of Wisconsin-Milwaukee has "a Department of Mathematical Sciences"). Moreover, some American religious sects gladly refer to themselves as "scientific" (The Church of Christ-*Scientist*, *Scienta*logy).

One can conclude that the English language tradition favored scientism and pragmatic, materialist attitudes towards science. The most material thing and simultaneously the symbol and the essence of the material is money, a universal measure of goods, time, work, effort, quantity, quality, energy, and information. It is not surprising that money became also a measure of scientific research.

John Dewey and the rise of American education

John Dewey (1859-1952), a student of Peirce at Johns Hopkins University and later his follower, the most influential American intellectual of the first half of the twentieth century, was another prominent figure associated with Pragmatism. Dewey, whose name today is associated mostly with the "universal language" of library classification, was a major contributor to establishing a philosophy of education in the US. Dewey argued that philosophy had become an

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Andrey Paribok, who studies the relations of language grammatical structure to the typology of mentality of various civilizations. I am not aware about any Western scholars investigating this matter, although modern incarnations of the Sapir-Whorf hypothesis (often called "Linguistic relativity") are a central topic for many modern cognitive scientists such as George Lakoff or Steven Pinker.

overly technical and intellectualistic discipline separated from assessing problems of everyday life. Dewey's objective was to reconnect philosophy with the mission of education-for-living[10].

Richard Hofstadter wrote in his classical study of American anti-intellectualism:

> "Anyone concerned with the new education must reckon with its use of Dewey's ideas. To consider this in a study of anti-intellectualism may, unfortunately, be taken as an attempt to characterize Dewey simply as an anti-intellectual—which hardly seems just toward a man who was so intent on teaching children how to think… Although it is tempting to say that Dewey's work was crudely misread by the most anti-intellectual spokesmen of the new education, it seems fairer to admit that even the life-adjustment educators could have arrived at their use of Dewey through an honest and intelligent exegesis of the master…
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> Although Dewey himself began to warn in the 1930s against the overuse or the oversimplified use of his theories, he found it difficult to define, even in his later works, the points at which the lines of restraint could or should be drawn without at the same time abandoning certain of his essential commitments."[11]

According to Hofstadter, both misinterpretation of Dewey's ideas by anti-intellectuals and shortcomings in Dewey's formulation of his concepts contributed to the deterioration of American education. Although Hofstadter concentrated on school education, similar problems apply to college-level education. Given that in America scientific research is performed mostly at universities (there are few governmental research institutions, for example, zero in Wisconsin) this means also that American perception of science was influenced by that situation.

Measuring science by money in promotion criteria of American universities

In the preceding sections, I have discussed the pragmatic, money-centered view of scientific research and scientific discovery as a part of the epistemology of Pragmatism. Apparently, this pragmatic view on scientific research has influenced attitudes towards science in American universities in general, making them more anti-intellectual. While traditional criteria of successful research include acceptance of results by peers, for example, in the form of publication in prestigious journals and citations, in many American universities the amount of research expenditures generated by a scientific project is the main (if not the only) criterion of research quality.

Certainly, research administrators in Europe, Asia, and in other regions of the world also use money as a criterion of scientific accomplishments. However, their intellectual traditions have antidotes against that measure. European colleagues tend to laugh in disbelief when I tell them that American scholars use research expenditures as a criterion of scientific achievements and that we even have special research awards for top spenders.

I have to note that embedding money into research criteria does not work the way Charles Peirce envisioned it, when he wanted to maximize the number of scientific discoveries per dollar. Somehow it tends to work the opposite way. Researchers prefer maximizing the amount of

[10]Hildebrand, David, "John Dewey," *The Stanford Encyclopedia of Philosophy*.
[11]Hofstadter. *Anti-intellectualism in American Life,* pp. 360-377.

dollars per even minor discoveries or results. This "bang for the buck" attitude inevitably leads to the maximum "buck for the bang."

Unlike most European and Asian countries, the US does not have any centralized "ministry of science," and scientific criteria are not established by any state-approved body. One of the consequences of this situation is that whether a particular work is counted sufficient for a doctoral dissertation depends only on the dissertator's advisor. Technically there is also a small thesis committee, appointed by the advisor, which usually rubberstamps the dissertation if it is approved by the advisor. In many universities, there is no external review of dissertations, no publication requirement, and no oversight process (all these processes are common and mandatory in almost every country except for the US). This results in some Ph.D. dissertations being of low quality. I witnessed a dissertation in Engineering based *entirely* on a freshman-level mathematical mistake. When I asked the Associate Dean for Academic Affairs (who oversees the Ph.D. program) about his opinion on this type of pseudo-scientific dissertation being approved by the state university, his response was "I also agree that I think that many of us (myself included at times) are not as attentive to dissertations as we should be. I do think that quality could be improved. I think the most straightforward way to do this is actually to get more research funding and use it to recruit higher-quality students with generous stipends." This is the widespread belief that if you pour money into students, mathematical mistakes would be eliminated and the quality would improve by itself. The motivation beyond that attitude is that administrators get control over the facilities and administration costs (known as "the overhead") fraction of the money.

The Executive Committee of the Natural Sciences Division of my university is a committee of peers (scientists from various departments), who establish, among other things, the policy of what constitutes a scientific accomplishment. The criteria of research excellence of the Division of Natural Sciences prominently emphasize monetary accomplishments:

> "Research achievements. The Subcommittee regards to evidence-based upon scholarship and expertise in research as the foremost criterion for promotion to full professor, provided that the individual's teaching career has been progressive and successful. Refereed publications, together with funding from government agencies, industry, and/or foundations provide prima facie evidence of the candidate's research accomplishments. The candidate is expected to have achieved a high level of scholarship, expertise, and stature in his/her field as evident from a consistent record of refereed research publications, particularly of primary research, and successful research funding.[12]"

Anti-intellectuals in American Academe are often quite aggressive. After I criticized a senior colleague who had zero journal publications in the last twenty years, without stating his

[12] "Criteria for the evaluation of a departmental recommendation for promotion or appointment to associate or full professor" https://uwm.edu/secu/wp-content/uploads/sites/122/2020/06/20-21-NS-Criteria-2.pdf. Being a member of the UWM's Executive Committee of the Natural Sciences Division in 2018-2021, I have raised these issues during various discussions of the promotion criteria. The Secretary of the University (who oversees faculty governance) instructed the committee that the change of the criteria can be discussed only at closed meetings, essentially blocking any public discussion of the matter.

name (describing the phenomenon), the colleague filed a lawsuit accusing me of defamation, tortious interference into his employment contract, and of a conspiracy against him in the form of disclosing to others his zero scientific productivity.

If money is viewed as a criterion for the success of scientific research, then new inconvenient questions can be raised. There are many cases when grants are given to Principal Investigators with very little scholarly accomplishment, not known for any significant discoveries or results. At the same time, distinguished and renowned theoreticians often do not receive grant money. This raises natural suspicions of corruption. However, neither university administrators nor funding agencies are eager to investigate these suspicions.

In one case I was criticized by a senior colleague for not having enough money. I decided to check for which expenses this colleague spends his grant money, in other words, why does he view money as a sign of academic accomplishment. Immediately, I found that during his trips to Japan this colleague consistently spends $229 per day for his personal meals. In my opinion, this is too much, assuming that scientific conferences are not Sumo competitions and they do not require excessive food consumption. When I complained, I was told that this is normal practice. When I asked my university's Office of Legal Affairs on whether I could report this finding to an external agency, the answer was that it is not inappropriate or even unusual for the amount of a faculty member's external funding to be considered as part of their promotion and that faculty are regularly encouraged to increase their external funding, so it is legal for senior colleagues to request from their junior colleagues "to find a way to bring money to the department." I was further warned that it is not helpful to repeatedly raise this claim when my allegations have already been reviewed by the institution.[13]

Post-Tenure Review and the Academic Freedom of Research

Post Tenure Review (PTR) was instituted in the University of Wisconsin System in 2017 and caused a lot of controversy at that time. At the University of Wisconsin Milwaukee (UWM), tenured faculty members are reviewed by their departments once every five years. A committee determines whether their performance "meets expectations" and issues a performance evaluation letter. Then the evaluation is reviewed by the dean and by the chancellor.

Practice showed that negative reviews (when a professor does not meet expectations) are rare. If a faculty member does not meet expectations, a remediation plan of improvement for two years can be prepared, after which that professor will be reevaluated again. Eventually, the failure to meet expectations may lead to discipline up to dismissal for cause. As far as I know, no one has been fired from the UWM as a result of the PTR so far.

However, other issues of concern have emerged. One of them is that the performance evaluation letters may interfere with the faculty member's research agenda. Normally, university professors have independence in choosing topics of their research, especially when it comes to

[13] The UWM Office of Legal Affairs did not permit me to cite the exact language of their email response, claiming copyright issues. Normally, all UWM emails are in public domain under the Wisconsin Public Records Law with access presumed; however, a number of exemptions exist including trade secrets (Wis. Stat. § 19.36(5)). It is possible that some university officials consider measuring science by money as their trade secret (see also footnote 12 above).

topics that do not require a lot of funding or expensive equipment, such as mathematical research or theoretical research in natural sciences. This is reflected in the concept of "academic freedom." The American Association of University Professors (AAUP, a quasi-trade union organization that establishes academic standards related to Freedom of Speech and Academic Freedom of faculty members) states that "teachers are entitled to full freedom in research and in the publication of the results, subject to the adequate performance.[14]" Academic freedom gives both students and faculty the right to study and do research on the topics they choose. Faculty members have every right to work successfully on their own scientific problems and topics, rather than on external sponsors' agendas.

From my experience, PTR letters sometimes dictate faculty research agenda, such as "to seek extramural funds from federal and corporate sponsors." I think the infringement of academic freedom, which sometimes comes with the PTR, should be a topic of consideration and discussion by faculty.

Trump era repressions against brain drain from the US

The perception of science and attitudes towards science and towards the role of national governments in the development of science and technology are very different in the Old World and in America. Countries like China, Russia, or United Arab Emirates view science as a matter of their national prestige and a priority enterprise. In America, the priorities are different. American politicians and top administrators (such as say, a Governor or Lieutenant Governor) rarely discuss funding science and technology in their public statements or during meetings with voters. They also rarely meet with scientists or visit labs. Many foreign governments are interested in the development of science, and they are ready to invest their taxpayers' money into scientific research and attracting foreign experts.

In this situation, when prestigious scientific publications or high citations of a scientist are valued by foreign administrators but ignored in the US, it is not surprising that some American scientists start to look for research opportunities abroad. The reactions of American administrators and authorities to this situation may be different and sometimes unpredictable.

One of the founding fathers of nanotechnology, Professor Charles Lieber from Harvard University, got arrested in 2020 in Boston for his international scientific collaboration. Dr. Lieber, Chair of the Chemistry Department at Harvard, was awarded (together with Paul Alivisatos) the 2012 Wolf Prize in Chemistry as well as many other awards. Lieber was also nominated for the Nobel Prize many times. According to the press reports, he has not disclosed certain details of his collaboration with a university in China to his main employer, Harvard University, in some web forms that require clicking checkmarks. These details included disclosure of his participation in the Chinese program "Thousand Talents." This action resulted in Harvard not providing this information to federal agencies, such as the NIH, ONR, and AFOSR. Consequently, Dr. Lieber has been arrested and he is facing up to five years in jail.

[14] "1940 Statement of Principles on Academic Freedom and Tenure" https://www.aaup.org/report/1940-statement-principles-academic-freedom-and-tenure (accessed on 8/22/2021).

There are also numerous reports about dozens of American scientists being fired from the NIH system in 2020-2021 for their collaboration with Chinese institutions[15].

Fig. 3. Prof. Nosonovsky (right) meets with the Vice-Governor of St. Petersburg (Russia) V. Knyaginin (left) and ITMO University center director E. Skorb to discuss the perspectives of the new discipline of Triboinformatics in June 2021. Meeting at such a level would be highly unlikely in Wisconsin due to the different priorities of American politicians.

From my own experience, I participated in 2017 in the visiting professor program in the Technion in Israel funded by the Israeli Lady Davis fellowship. No questions were asked at that time. In 2020 I applied for the Russian Mega grant program, and a lot of questions about "Export Control" and "Deemed Export" were asked by my employer. Of course, my research is purely fundamental as defined by the US Export Control law[16]. However, clearly, some restrictive regulations were introduced between 2016 and 2020. In my university, the outside activities reporting forms were modified and now they require separate reporting of foreign collaboration.

There are signs of corruption in funding science in the US due to the tendency to measure scientific accomplishments by the research expenditures. There are always people who get too much money due to their connections in the governmental agencies, such as a recent infamous case of a Drexel engineering professor[17] or an earlier story of a bright and talented Russian-

[15] Jeffrey Mervis Jun. 12, 2020 "Fifty-four scientists have lost their jobs as a result of NIH probe into foreign ties" https://www.sciencemag.org/news/2020/06/fifty-four-scientists-have-lost-their-jobs-result-nih-probe-foreign-ties

[16] 15 CFR § 734.8(c) defines that "Fundamental research means research in science, engineering, or mathematics, the results of which ordinarily are published and shared broadly within the research community, and for which the researchers have not accepted restrictions for proprietary or national security reasons." It is particularly weird, that in the US the Export Control Law establishes what constitutes fundamental science and what constitutes applied science. The matter is usually perceived by public as an issue of methodology of science rather than a legal mater.

[17] "Former Drexel professor arrested and accused of spending $185,000 in grant money on strippers, sports bars and iTunes" By Hollie Silverman and Steve Almasy, CNN Updated 6:26

American mechanical engineering professor who was facing 20 years in jail for misusing grant money[18]. All these people had *too many* grants. At the same time, there are always people who get nothing despite their outstanding accomplishments. The real question to ask is who gave money to that PI and who did not receive grants instead. However, I have never heard about program directors or other administrators in federal agencies being prosecuted or convicted. We always hear only about scientists and PIs being blamed.

How money still provides an advantage?

Despite the money-centric attitudes towards science (and some people would claim that exactly because of these attitudes), the US remains a world leader in successful scientific research. The following question is often asked, and it should certainly be addressed: if the American attitude towards science is so anti-intellectual, why does the US remain a world leader in scientific research? The US is in the first place in the world by the number of Nobel Prize winners, having390 Nobel prizes out of the total 889, with the UK (134) being at the 2nd place, EU countries totaling about 396, Russia/Soviet Union at 31, followed by Japan (28), Switzerland (27), Canada (27), Israel (12), and so on. Moreover, resonant scientific discoveries of recent decades were made in America. The human genome was deciphered in the United States, the Internet and mobile phones came from the United States, gravitational waves were discovered in America, as well as black matter and Mars exploration. All these accomplishments indicate that the US remains a world leader in science and technology in the 21st century. How that can be consistent with the alleged anti-intellectualism of American research administrators?

Several answers are possible for this question. *First*, many US academic researchers are not US-born Americans. Many of them are foreigners and naturalized US citizens recruited by American academic institutions, although top administrators are typically natural Americans. It is just easier to recruit scientists with skills for research, analysis, and academic presentation of the results from the countries where such skills are cultivated in elite schools rather than to create a cultural environment needed to develop such skills. For that reason, educational institutions overseas, such as elite mathematical high schools, prepare graduates who later become key personnel in American research institutions.

Second, there is a difference between money-intensive "big science" and the intellectual "small science" where most scientific discoveries are made. Wikipedia defines them in the following way:

> "Small Science refers (in contrast to Big Science) to science performed in a smaller scale, such as by individuals, small teams or within community projects. Bodies that fund research, such as the National Science Foundation, DARPA, and the EU with its Framework programs, have a tendency to fund larger-scale research projects. Reasons

PM ET, Sat January 18, 2020 https://www.cnn.com/2020/01/18/us/drexel-former-professor-grant-money-strippers-trnd/index.html

[18] "University of Colorado Professor Pleads Guilty to Mail Fraud" July 10, 2018 https://www.justice.gov/usao-co/pr/university-colorado-professor-pleads-guilty-mail-fraud

> include the idea that ambitious research needs significant resources devoted for its execution."[19]

The greatest American Mechanician, Clifford Truesdell (1919-2000) was a huge and passionate opponent of Big Science, although he apparently criticized the money-intensive science from elitist positions, missing the understanding that making money a pragmatic universal measure leads to the deterioration of American science. He wrote:

> "Plebiscience is *big science*. Small science was done by a few great men. Big science calls for many little men. As Chargaff sees, 'We are sailing straight into a managerial dictatorship in which the individual scientist can no longer have a voice… It is well known that wherever money is abundant, charlatans are brought forth by spontaneous generation.'
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> While Newton wrote of his having 'had entry' into the method of fluxions, as if he had taken a beautiful woman, today's heroes of science make 'breakthroughs' as if to penetrate the lines of a mob of rival gangsters. Plebiscience, like everything dear to the plebs, is dear for the taxpayers, and in a social democracy value and cost are the same… In the eyes of efficiency experts, small science must appear as trivial science. Small science costs too little to be worth anything. Big science, Plebiscience, is invincible[20]"

It is hard to agree with Truesdell's blaming democracy and with his sexist language. Moreover, the discovery of calculus by Sir Isaac Newton, who was celibate, perhaps does not deserve such a vulgar analogy as having sex with a beautiful woman. However, Truesdell, who is considered by many as the most prominent scholar in Mechanics in America, essentially makes a remarkable comparison of Big Science motivated by money with gang rape.

Examples of money-intensive scientific enterprises that are best known to the wide public are the LIGO collaboration on gravitational astronomy, the supercolliders, or molecular biology research. These are mostly experimental areas that require huge investments. The intellectually intensive science includes such areas as mathematics, theoretical physics, mechanics, control theory, and similar. If we look into these areas, the situation in the US will not compare well with Europe and Asia.

Saying that, note that mathematical education has a different organizational structure, and because of that difference, some pure mathematicians succeed. In mathematical departments, professors train postdocs and doctoral students who in turn teach basic mathematics courses for engineering, science, and business students, thus mathematical education is in demand. While the American school of mathematics is perhaps among the three top in the world (along with French and Russian), it is sustained by a significant brain drain from countries like Russia, EU countries, China, India, Iran, and Israel. Out of 60 Fields Medals, 26 are Americans, but only 10 of them are US-born, and the proportion is even bolder, with 3 US-born and 12 non-US-born American mathematicians, if 15 American Fields Medals since 1985 are considered.

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[19] Cited from https://en.wikipedia.org/wiki/Small_Science (accessed on 8/18/2021).
[20] C. Truesdell. *An Idiot's Fugitive Essays on Science* (Springer, NY, 1984), p. 117.

While in "Big Science" the US has clear leadership, the state of "Small science" is not that prospering in the US. My own area of mechanics is almost non-existent here, with old professors retired and no new professors hired for the vacant positions, because ME departments prefer hiring faculty (usually not mechanicians and often not even Mechanical Engineers) who would bring grants with overhead. This is not a new phenomenon, but it is a long-standing trend. Already in 1985, Eli Sternberg (1917-1988), an NAE/NAS member and my academic "grandfather" (Ph.D. advisor of my advisor's advisor), said in his Timoshenko Medal acceptance speech:

> "To begin with, there is the undeniable observation that mechanics, as an independent academic discipline, has suffered worrisome setbacks during the past twenty years or so. This fact is reflected in the demise of several mechanics departments at major American universities, the erosion of existing mechanics faculties, and the decline of the student population in mechanics. There are various and diverse reasons for this trend…
>
> Let me move on to some troubling trends in the role played by sponsored research at our universities. It is a fact - a regrettable fact, but a fact of life just the same - that American universities depend on sponsored research for their survival. As consequence professors are expected to cover a substantial portion of their salaries through outside support. This, in turn, compels them to spend an appreciable portion of their time on entrepreneurial chores, such as the composition of seductive proposals - hardly the most appealing genre of creative writing.
>
> More disturbing is the spreading practice of making new academic appointments explicitly contingent upon the faculty member's ability to attract a specified percentage of outside support. This practice is particularly burdensome for younger faculty, and especially so in a field such as mechanics, where funding is increasingly difficult to come by. It seems to be easier to obtain a multi-million dollar grant for an accelerator or a giant telescope than to secure relatively modest support for a study of, say, the foundations of the theory of elastic instability.
>
> Of late, however, federal support for academic research in engineering has taken a rather ominous turn… Since the National Science Foundation is presumably a guardian of fundamental research, I was all the more taken aback by a list of ten recommended research areas, which was distributed at an NSF conference on "Future Directions in Solid Mechanics Research," about a year ago.
>
> My first qualms concerning this manifesto were aroused on noting that it comprised exactly ten items, "ten" being a conspicuously round number. I always suspected that the committee charged with drafting the Ten Commandments initially arrived at only nine and then added "Thou shalt not commit adultery" for good measure. I will not bore you by quoting the complete list of suggested research areas to which I am referring. Suffice it to mention that one of the categories listed is the "Mechanics of Modern Manufacturing," while another is headed "Mechanics in Strategic and Conventional Military Systems"; here "missile systems", "tube-launch systems", and "warhead design" are cited as representative examples… There is a general consensus that research conducted at universities ought to be basic research. Admittedly, everyone has his own

definition of "basic research," tailored to include his own work. But I cannot conceive of any acceptable definition that would accommodate the design of warheads."[21]

Third, one could argue that the Fields-level and Nobel-level science is restricted to a small number of elite American universities, who are autonomous in their operation, and to a large extent they can be viewed as international, rather than American, institutions. Many scientists with experience of looking for academic jobs would agree that such elite institutions as Harvard or Stanford are simply not on the American job market, i.e., they do not advertise positions and never call for interviews. Consequently, I would just exclude them from my discussion – my essay is not about them. The Nobel-level science almost does not affect the regular American way of doing scientific research. Say, in southeastern Wisconsin, I could remember only one occurrence when a Nobel Prize winner gave a lecture at UWM.

However, it is more important for the objective of my essay, that money speaks and money has material power. While being a symbolic substance absent from nature, money is indeed a material force, which drives some types of scientific research and the expansion of human knowledge, although in a somewhat twisted way. Anti-intellectualism brings its benefits along with costs. Therefore, money has its epistemological function, and Charles Peirce was not very wrong when he introduced his concept of abduction, which departed from the earlier European idealistic tradition of considering scientific knowledge as a value by itself, independent of its monetary benefits.

Conclusion

When Charles Peirce added "abduction" as the third type of inference, in addition to deduction and induction, his intention was to account for potential pragmatic usefulness in the process of selection of scientific hypotheses. Only the most promising and the most effective hypotheses should be selected, to maximize the economic impact. This implied that money would become an integral part of the epistemological process combining money and knowledge, so that money is viewed as a universal measure not only of material goods and of labor, but also of scientific knowledge.

Modern American followers of Peirce (who often are not aware of his existence) apply monetary criteria, such as research expenditures, to judge scientific success. Many universities provide examples of such criteria. This approach undermines the importance of the scientific discovery. It is not by chance that the word "abduction" has a connotation of "the unlawful carrying away of a woman for sexual intercourse." These people are trying to abduct science by using the power of money.

Peirce was an outstanding philosopher and logician. Perhaps he was the greatest scholar and thinker of the 19th century in America, the creator of Pragmatism, and an icon of American intellectual culture, whose huge and often controversial legacy is being studied by various professional and amateur institutions of philosophers. Pragmatism contributed to Analytic Philosophy, the dominant school of philosophy in the English-speaking world, which is

[21] Cited from https://imechanica.org/node/182 (accessed on 8/18/2021).

sometimes criticized for breaking ties with continental European metaphysics. Peirce was also a part of the wealthy white Protestant New England establishment. In our time of cancel culture and institutionally cultivated resistance to "whiteness" (understood as the arrogance of predominantly white US-born administrators) his legacy perhaps could be reevaluated.

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