Happy and healthy 2022 to everybody!

In this issue we have, among other things, a timely article on the ongoing efforts by the American Physical Society to oppose scientific misinformation.

These efforts are highly commendable and necessary. But not sufficient. The problem will not go away as long as too many of us believe that it arises only from marginal, poorly educated sectors of society and that the institutions where we physicists operate are always on the right side of the question. I wish. Universities are a part of the problem. The one where I work, has a “Center for Spirituality and Healing”, devoted to pseudoscience, indeed to what I call superstition. Its existence encounters no meaningful opposition from STEM parts of the University. I have heard that one of my colleagues active in Physics outreach organized an exhibit of Physics demonstrations at the State Fair, some years ago, and found himself next to a person from this Center who offered to “read people’s auras”. To the public, it was all science. And in Physics we do not have the worst; parts of the medical sciences have it worse: witness the many articles on fashionable diets in the popular press all beginning with “A study at such University shows that...”. Mention of many questions related to chromosomes has become taboo.

This affects the credibility of all scientists. People do not believe us when we speak because too often we remain selectively silent.

On a more optimistic vein: as always, I remind you that the contents of this newsletter are largely reader driven. Please send your contributions and your suggestions. All topics related to Physics and Society, broadly understood, are welcome. Controversy is great: content is not peer reviewed and opinions given are the author’s only, not necessarily mine, nor the Forum’s, nor, a fortiori, the APS’s either. Letters to the Editor for publication are also welcome. The APS production people prefer MSWord formats. Book reviews should be sent to the reviews editor directly (ahobson@uark.edu). Everything else goes to me.

(Continued on page 2)
Announcement: How to Make Sure to Get This Newsletter

Since you are reading this, you are likely getting the newsletter, or rather the quarterly email with a link to the it. But it has come to my attention that some Forum members are not getting those emails. With some detective work and the crucial help from Ryan Kneapler at APS (thanks Ryan!) I have been able to spot the likely reason. Please share this information with any colleague that mentions not getting these emails any more.

APS has a rather new system to allow members to control what emails from APS they get. It is easy to set it up wrong by mistake. To get into the system one goes to https://www.aps.org/memb-sec/profile/Profile.cfm?page=mailing and, after logging in clicks on a link in the left column labeled “My communications preferences”. There one sees a long list of choices, each with a box. These are opt-out choices. If a box is unchecked, the member will be getting the stuff associated with it. If the box is checked, they will not. So, to get the newsletter one must scroll down (way down) and make sure the box marked “FPS email opt-out” is unchecked.

Also, the very top box in the page, labeled “all email opt-out” must be left unchecked. Otherwise you will get nothing from APS. It is easy to have checked that box by mistake when merely trying to get rid of unwanted solicitations or replying to an email that looked as junk. By doing so, one opts out of everything.

It is possible that among the emails that people do not get for the same reason are emails concerning elections and reminders of elections. See below.

Further on this topic, several readers who do get the newsletter email have complained that the format of the email, and that in the newsletter web page at https://engage.aps.org/fps/resources/newsletters/newsletter-archives has changed since January 2021. Before, each issue had a page with individual links to each article, so readers just wishing to read that article could just click on it. Now, there is a single link to the whole .pdf file with the issue, and readers that just want to look at the last item in the issue, have to scroll to it. This is inconvenient. Myself and the Forum for International Physics newsletter Editor (they are equally affected) have been trying to get APS to go back to the old and better system or something similar.

(From the Editor continued from page 1)

A note about republication: sometimes authors reproduce elsewhere articles that they have originally published here. Very nearly always they ask for my permission, which I invariably give and will continue to give. But the ‘no peer review’ policy may mean (I have anecdotal indication to this respect) that the articles may be found unsuitable for re-posting at arXiv, which has a rule of only accepting contributions that are, in their words, ‘refereeable’. Beware.

Oriol T. Valls
University of Minnesota
otvalls@umn.edu
Forum Election Results

The winners of the elections for the 2022 Forum positions are below. Thanks to all the candidates and congratulations to the winners. Turnout was not great, possibly because of the mail issues mentioned above, but not the worst. The bios below are short versions of the ones in the voting site, edited by me (OTV).

VICE CHAIR, ANNA QUIDER
Anna is an astrophysicist who strives to improve local and global communities as an award-winning science and higher education policy professional. Presently, she advocates for the students and faculty of Northern Illinois University (NIU) as the Assistant Vice President for Federal Relations based in Washington, D.C.

SECRETARY TREASURER, RUTH HOWES
Ruth holds a Ph.D. in nuclear physics earned at Columbia University under C.S. Wu. From 1976 to her retirement she was on the Faculty at Ball State University. By the time she retired in 2003, she was the George and Frances Ball Distinguished Professor of Physics and Astronomy, a fellow of APS and AAAS, had served as president of AAPT and the Indiana Academy of Science, as a program director in the Division of Education at NSF, as a Foster Fellow at the U.S. Arms Control and Disarmament Agency and as a AAAS Congressional Fellow. She did a term as chair of FPS in 2016 when she hired the current newsletter editor.

MEMBER AT LARGE, ELIANE LESSNER
Eliane is a physical scientist at the Office of Basic Energy Sciences (BES), Department of Energy. She plans, implements, and evaluates research programs in accelerator physics and detectors on a national and international level. Under her tenure, the program has grown by several orders of magnitude to encompass a varied research portfolio. She frequently organizes BES workshops that help set future directions in the field discussed.

MEMBER AT LARGE, IDALIA RAMOS
Idalia is a professor in the Department of Physics and Electronics of the University of Puerto Rico at Humacao and a fellow of APS. Her research interests are the preparation, characterization, and application of nitrides, oxides, and carbon composites for the fabrication of optoelectronic devices and sensors. Her outreach efforts for the public have included talks and hands-on demonstrations in community centers and distribution of water filters for communities that spent months without power or water supply after hurricane Maria devastated Puerto Rico in 2017.

POPA REPRESENTATIVE LAURA GREGO
Laura is a Stanton Nuclear Security Fellow at the Laboratory for Nuclear Security and Policy at MIT. She is on leave as a senior scientist and research director of the Global Security Program at the Union of Concerned Scientists, where she has worked at the intersection of science and public policy, in particular nuclear weapons, missile defense, and space security issues, for nearly twenty years. She has authored numerous articles and reports and gives talks frequently to expert and non-expert audiences. She has testified before Congress and addressed the United Nations, and meets regularly with U.S. government staff and officials to provide information and advocate for better policies. She regularly serves as a subject matter expert for the media on security issues.
APS Set to Launch New Initiative to Oppose Scientific Misinformation This January

*Callie Pruett, pruett@aps.org, APS Senior Strategist for Grassroots Advocacy*

The last eighteen months have presented unique and complex challenges on mis- and disinformation with regard to issues such as COVID-19 and climate change, and leaders within the organization recognized the need for more to be done on the issue. This year, APS is launching a new initiative to address scientific misinformation.

In April of 2021, the APS Office of External Affairs and APS Public Engagement partnered with Critica, an organization founded to ensure trust in medical sciences, to pilot test a training program for APS members to counter misinformation. More than 80 members attended at least one of the pilot training sessions, which far exceeded preliminary expectations. The sessions trained participants in how to speak effectively with their neighbors about vaccine hesitancy.

Using emotional and empathetic appeals, some of those members reported genuine successes in their conversations with their neighbors, but surveys after the sessions found that attendees were hungry for more. After further investigation of the broader membership more than 70% said they wanted to take part in an initiative to address scientific misinformation.

With such high numbers of members reporting interest, the team at APS knew that a more permanent effort needed to be established. Thus, the Science Trust Project was born.

The Science Trust Project is a new APS initiative with the long-term goals of developing a better understanding of the extent, causes, and impact of the spread of scientific misinformation, and empowering APS members to meaningfully contend with scientific misinformation in their professional and personal lives. This involves training members in cutting edge science communication skills - for both online and in the real world - and mobilizing members to apply their new skills to take action to prevent the spread of scientific misinformation.

The project team, which includes APS Head of Public Engagement and Project Co-Lead Claudia Fracchiolla, APS Senior Strategist for Grassroots Advocacy and Project Co-Lead Callie Pruett, APS Public Engagement Programs Manager Allie Lau, and APS Programs Intern Zack Pruett, views these activated members as facilitators in the driver’s seat of the discussion around scientific dis- and misinformation, and as proactive players in the work toward truth, understanding, and greater trust in science.

The team at APS is working to build out infrastructure to inform and activate a wide range of members in the work of addressing misinformation. An announcement of further programming and planning is set to be made by APS CEO Jonathan Bagger at APS’s Annual Leadership Meeting on January 27th, 2022. The session will be publicly viewable and posted to YouTube after it airs.

If you are interested in joining this effort, the Project is accepting early interest inquiries now. Please email Zack Pruett at zpruett@aps.org.
Education, particularly foundational STEM education, has contributed to significant positive impact on society, human life and individual economic empowerment. Prior to this pandemic, it had become clear that our globalized world is evolving and distorting politically, socially, culturally, and technologically at a rapid pace and the challenges have complex, complementary, and opposing dimensions. In response to this, over the last three decades, education system planners have leveraged metaphors like, 'STEM pipeline', 'leaky pipeline', and interdisciplinary. There have been significant strides also in digital delivery of college education but most people earn their credentials in traditional, in-person situations. This pandemic has brought into sharper relief the growing inequity of access, economic inequality and the erosion of faith in scientific truths complicated by political and cultural factors. Human-driven climate change will result in natural disasters and pandemic scale events in the future, each time significantly disrupting all our systems including education systems, further exacerbating this challenge, threatening to put years of hard-won progress at risk. The need for a digital-first and hybrid-adaptable creation and delivery of education content from kindergarten through college in preparation for a work life that will resemble similar attributes factoring in age requirements as well as local environments. This necessitates expanding the metaphoric model to an ecosystem or a mosaic that enables people with a diversity of skills and life experiences to collaborate on solving multi-dimensional, large-scale problems with transdisciplinary, non-linear training and thinking. The result could be an education system designed for resilience and equity at scale.

The pipelines were intended to highlight a potential scarcity of Ph.D. scientists and engineers additionally describing the ways in which minorities and women, in particular, become underrepresented in the STEM fields. This ‘leak’ is defined by social and cultural forces that corrode the pipeline and keep talented minority and female individuals from realizing their full potential and has proven to be a complicated, multifactor problem. The conflation of the two metaphors brought attention to the lack of STEM diversity but was driven by the perceived scarcity of Ph.D.s, with fewer women choosing to major in these fields rather than by the underlying premise that scientific research should be driven by more people than mostly white men. A woman, with a physics undergraduate degree, who chooses a career in science policy would be considered a drip-out, a drop-out. Unfortunately, girls face different gender norms regarding expectations, access to resources and opportunities, and the stigma surrounding their right to education. The disequilibrium starts meaningfully in middle school where the leaky pipeline metaphor refers to how girls are less likely to be interested in science than boys. This lack of diversity is markedly visible in the STEM field, with fewer women choosing to major in these fields. Conversely, women in the biological and life sciences represent more than half of the students earning PhDs, yet many fail to achieve tenured faculty positions as women in science are more likely than their male counterparts to put an emphasis on life-work balance. Recently, the NSF has started using the term “pathways” in place of pipeline to refer to the different routes that people can take to achieve a STEM career.

All efforts to increase STEM diversity and foster a more inclusive and accessible environment are laudable and have given rise to many innovative programs to mitigate these disparities such as creating healthy and diverse STEM education programs for students before they enter college and the professional world. National Girls Collaborative Project is a national, umbrella organization dedicated to change the gender gap in STEM and works with organizations like Girls Who Code focused on addressing the gender gap in technology and changing the public perception of a programmer. Global organizations like Million Women Mentors are focused on preventing the opting-out of women from STEM careers while, Scratch Foundation wants children, particularly minority children and girls, to opt-in the wonders of programming.

Local organizations include Girls Empowered in Math and Science (GEMS), a student-run program in the Bay Area with a mission to ignite interest in STEM for girls aged seven to eleven. With the support of the San Jose Public Library, this organization holds student-run in-person, hands-on science workshops to introduce young girls to basic science concepts by leveraging an effective hybrid mentorship/role model concept where pre-teen girls see girls, a few years older to them, convey their enthusiasm for science in ways that they can relate to easily. Women in STEM (WiSTEM), an organization that I am also involved with, hopes to empower high-school girls to visualize success in STEM fields by creating mentor (successful professional women in STEM) experiences, workshops with women guest speakers, and lively student moderated discussions. As has been mentioned, that intertwined with equity in STEM is the broader challenge of gender equity that surfaces not only for women in STEM professions but in all

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2. [https://ngcproject.org/](https://ngcproject.org/)
3. [https://girlswhocode.com/](https://girlswhocode.com/)
4. [https://mwm.stemconnector.com/](https://mwm.stemconnector.com/)
5. [https://www.scratchfoundation.org/](https://www.scratchfoundation.org/)
aspects and walks of life. FEM (Feminism) club, is a club at the Harker School which derives its mission from the simple idea that 'Women in Power Empower Women' by advocating for the right for women to have a voice at the largely male, white, political groups across all levels of government.

After the initial shock of the pandemic to the education system, generally funding-strapped school systems, leveraging federal emergency funds, have made great efforts to bridge this gap. GEMS and WiSTEM adapted and transferred group activities to an online setting. In the case of GEMS, instructional videos for the science experiments were created; zoom meetings were conducted to explain scientific concepts to the young children. I observed that the children had more trouble paying attention to the presentation online, but they were still curious about the science behind the experiment. In WiSTEM, online discussions and workshops lost their interactivity due to the size of the group and were less effective while one-on-one mentorship sessions strengthened connections between mentor and mentee. Smaller attention disassociation was observed in FEM club panel discussions since the audience was smaller of motivated and passionate high school students. The key first-hand takeaways were that digital content retroactively and reactively retrofitted is substantially less effective particularly if audience age and local situations are factored in. A digital-first, hybrid and adaptable content creation and delivery needs to be comprehensively planned ground up.

A recent Mckinsey report\(^6\) summarizes that the pandemic “widened preexisting opportunity and achievement gaps, hitting historically disadvantaged students hardest. In math, students in majority Black schools ended the year with six months of unfinished learning, students in low-income schools with seven. High schoolers have become more likely to drop out of school, and high school seniors, especially those from low-income families, are less likely to go on to postsecondary education.” It further asserts that the impact on student mental health, reduced secondary and advanced education opportunities, constricted career opportunities impacting their family’s future prospects are all ripple effects that will need continued and extensive study. It further states that a holistic reimagining of the education system for the long-term to address the complex factors and priorities including listening to students and parents to design programs that meet the academic and non-academic needs is imperative. Recently, the Surgeon General issued a rare advisory regarding the teenage mental health crisis.\(^7\) In addition, this article highlights key criteria and requirements that must be considered in reimagining the education system from elementary through high school to college focused around addressing the inequity of access and opportunity. Education is critical to mitigating income and wealth inequality, in essence, to the perseverance of the idea of the ‘American dream’ for the 21st century.

Simone Merani is a current senior at The Harker School in the Bay Area, California. Her interests lie in the intersection of STEM and social policy. She has devoted her time in high school to scientific research as well as in social research and policy with hands-on experience in various school organizations like WiSTEM, GEMS (as the current Director of Curriculum), and FEM (as the current President of the club). Her travel to Costa Rica and remote volunteering at a Costa Rican NGO exposed her to the need and challenges of online learning in third world countries. Her interactions and experiences through the above organizations have heightened her awareness regarding the scale of the problem which requires sustained and substantial efforts with a new framework for the education system built around the right principles.

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\(^7\) [https://www.hhs.gov/sites/default/files/surgeon-general-youth-mental-health-advisory.pdf](https://www.hhs.gov/sites/default/files/surgeon-general-youth-mental-health-advisory.pdf)

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**REVIEWS**

Radiological and Nuclear Terrorism: Their Science, Effects, Prevention and Recovery


I first began to ponder the problem of nuclear terrorism around 1975 when I read John McPhee’s book *The Curve of Binding Energy*, a long interview of Dr. Theodore B. Taylor, a former nuclear weapons designer. McPhee and Taylor made clear to me that if a malicious actor could somehow obtain a significant quantity of highly enriched uranium--say greater than 80% U\(^{235}\), building a nuclear explosive was relatively simple. This was borne out by the Manhattan Project’s budget which allocated only 7% of the $2,000,000,000 cost in 1940s dollars to weaponization at Los Alamos and 90% to procuring enriched uranium and plutonium.

The then-new Nuclear Regulatory Commission dismissed...
my concerns with a curt brush-off letter saying that no matter whether or not the fissile material was available, building a nuclear explosive required the all out efforts of a major nation state. As the number of nuclear-armed states has grown, and as their membership has included some of the poorest nations on earth, that 1970s optimism has been shown to be wrong.

Both nuclear and radiological terrorism conducted by comparatively small sub-national groups are very real possibilities. I and my former colleagues at the National Defense University and King’s College, London have described the “how” of nuclear and radiological terror in some detail, always being careful not to provide a recipe for nuclear success. Others have done so as well whether in fiction (Nicolas Freeling’s novel Gadget is a good example of the class—full disclosure: I was his technical consultant), or in serious academic journals or in highly classified government reports. But almost without exception these analyses stop at time zero, when the bomb explodes or the radioactive material is dispersed.

P. Andrew Karam’s new book Radiological and Nuclear Terrorism, is a most welcome exception. After introducing the reader to the unclassified and simplified basics of fission weapons and radiological weapons, Karam starts with time zero and asks what really happens if an improvised nuclear device (IND) is detonated or radioactive material emplaced or dispersed.

Nobody, least of all Karam or I, will argue that an IND explosion in a city is anything less than horrific, but Karam usefully points out that the area a primitive device is likely to destroy is small compared to the size of major cities of the 21st century. Horrific, but not totally catastrophic.

Karam covers the entire spectrum of nuclear threats, and does so in detail. He explains, for example, how to set up an effective and efficient search pattern for a lost or concealed radioactive source, how it might (or might not) be possible to detect a simple fission explosive being transported either on the open road or through a city. This is not a thriller, so to point out that he is pessimistic about our ability to do so is not a spoiler.

Radiological and Nuclear Terrorism goes into detail on many of the problems that will afflict responders and remediation workers and decisions, from how to enter and search a room in which one suspects there is a radioactive source to showing how to make rational decisions about the subsequent cleanup of a deliberately contaminated area. How clean is clean enough, and how safe is safe enough, given that it is unlikely that a remediate area can ever approach the low levels of normal background radiation? Economic, physical, and psychological factors all enter into that equation, with the psychological ones possibly playing the dominant role. It is probable that if cleanup to the natural background standard is required more workers will be injured or killed on the job than would have perished simply from living a lifetime at the site of the radiological or nuclear attack. Such is the danger posed by heavy construction.

Few physicians will ever have seen, let alone treated, severe radiation burns and acute radiation sickness. Using (somewhat gruesome) photos as well as charts and text, this book even has critical information for radiological triage. At least the basics for responders and physicians can be found in the book.

It is lavishly illustrated with photographs and diagrams, and where color printing would be beneficial the publisher has not hesitated to use it. In addition, Karam has worked many practical examples which really help understand the details; they’re set off in grayed text boxes. In sum, the book is not a classic text book, but it has all the elements needed to bring even an expert in some of the problems up to speed in the rest.

P. Andrew Karam has done the physics, national security, and responder communities a major service with this elegant, comprehensive, and attractive book. There is hardly a topic of importance to deterring, preventing, mitigating, and possibly punishing nuclear and radiological terror. If he has omitted anything it is some clues to identifying a radiological hoax event and distinguishing it from the real thing. Fortunately hoaxes have been far more common than real events.

Without question Karam’s new book belongs on the shelf of every emergency responder who might have to cope with a radiological dispersion device (RDD), radiological emplacement device (RED), in the worst of cases a nuclear explosion. Every physics department and every nuclear engineering department should invest in the book, and any nuclear physicist or health physicist who suspects that they might be confronted with such an attack and drafted to help the recovery needs to be familiar with the material.

The book is handicapped by lacking an index or consolidated bibliography. That omission will slow the reader looking for a specific topic (e.g. the shipment of contaminated rebar and steel from a Mexican foundry, discovered when a truck carrying rebar delivered a consignment to Los Alamos National Laboratory where the surveillance detectors picked it up and so led to the confiscation of the entire production including steel outdoor furniture). Some of the graphics copied from other sources are too small to read the text without a magnifier.

Fair disclosure: I have known Dr. Karam for about 20 years and greatly respected his work; although we have corresponded we have neither worked together nor collaborated on any projects.

Peter D. Zimmerman
Emeritus Professor of Science & Security
War Studies Department
King’s College, London
& Former Chief Scientist US Arms Control and Disarmament Agency
A common lament amongst members of the public concerned about climate change seems to be that U.S. state and federal governments have failed to enact any meaningful legislation to address the issue. Upon reading "Short Circuiting Policy" by Leah Cardamore Stokes, one take-away becomes abundantly clear: It's not for lack of trying. This book is a dense and thoroughly researched look at the underlying political landscape behind clean energy legislation along with detailed accounts of attempts by opponents to undermine such legislation.

The author begins by framing the problem--first by establishing some of the basic science and the technologies and approaches to mitigate climate change, and second by laying out the more popular legislative approaches to encourage rapid adoption of these technologies. Many clean energy initiatives, including net metering and renewable portfolio standards, are relative newcomers to the political game. Stokes makes a strong case for an inevitable consequence of new legislation--what she calls the "fog of enactment." In essence, any new legislation that has no legal precedents leads to this "fog" where neither advocates nor potential opponents fully understand the implications until the law is fully enacted. This fog plays heavily into many early successes in clean energy legislation and still occurs frequently today.

Stokes follows up by discussing the major opponents to clean energy legislation--primarily the public utilities and energy companies. These entities have built more than 100 years of successful enterprise on the backbone of fossil fuels and stand to lose the most from a changing energy landscape. The author lays out a broad history, helping the reader understand the complex history of the utility companies in most states--many of which are essentially a form of publicly sanctioned monopoly. She then lays out some of the tactics that she sees as most commonly used to undermine legislation.

The majority of the book is dedicated to case studies of failed clean energy legislation in four states: Texas, Kansas, Arizona, and Ohio. Stokes goes into great detail in each of these cases, and we see the aforementioned tactics that clean energy opponents use time and again. She identifies all the significant players and organizations on both sides, and delivers a blow-by-blow recounting of events starting with the introduction of promising new legislation and leading the reader through a series of events and decisions that effectively ends that legislation.

The Texas case study and history of that state's public utilities and energy companies was prescient given the recent publicized failings of its energy grid during the historic February 2021 arctic blast, followed by a widespread summer heat wave. Despite these state energy crises being only tangentially related to the material in the book, the history of the Texas utility companies factored strongly into the legislative history in the book. This made reading the book painfully difficult in view of the Texas news reports over this past year.

Some case studies read as unbelievable dramas--unbelievable were it not for the fact that the information presented is thoroughly researched and vetted. At times the stories were laughably absurd. In one instance, it was discovered that actors were hired as part of an astroturfing campaign and posed as concerned citizens making prepared statements at a public hearing in favor of new fossil fuel plants. In another instance, opponents to a very progressive clean energy bill in Texas were able to successfully unravel the legislation by innocuously changing a single word in the bill.

At other times, the drama was frustratingly depressing as the reader is given blow-by-blow accounts of how opponents of clean energy legislation are able to successfully carve up bill after bill like expertly trained butchers. Sometimes these efforts occur during drafting of the bill, but more often the efforts occur after implementation through stretched interpretations, through capture of regulatory bodies, or through legal challenges. Often, already-passed clean energy laws are continually revisited in the state's legislative chambers. Advocates for these bills seek to further entrench their goals and move the case for clean energy further along, while opponents seek to retrench those laws by pulling back standards, undermining the effectiveness of these laws, or in extreme cases by completely reversing those laws. If these case studies are any indication, the legal battles faced by clean energy advocates are truly daunting.

The author ends the book on a positive note by pointing out that there are still many hopeful outcomes including rapidly falling costs for solar and wind, successful legislation in many other states, and growing strength of advocates in those states. As frustrating as some of these case studies can be to read, Stokes makes a good point in presenting them. Her stated goal is to empower clean energy advocates to know their legal enemies and to be better prepared to wage battle against them. Between the successes of advocates in other states and perhaps even by learning to use a few of their opponents' own legal tricks, clean energy advocates can in the future be more successful in every state across the Unites States.

Brian Geislinger
Physics Instructor
Gadsden State Community College
bgeislinger@gadsdenstate.edu