THE VORTEX

AMERICAN CHEMICAL SOCIETY **CALIFORNIA SECTION**
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To all its members,

Best Holiday Wishes From the California Section

TABLE OF CONTENTS

WCC November Meeting Report

On Saturday morning November 7, 2020, 44 members of the WCC had the pleasure of hearing Dr. Nancy Falk give a Zoom presentation of her life journey in chemistry. She began by stating that our world is changing pretty dramatically even within a day and, more than ever, chemistry matters. It is easy to feel overwhelmed about making things better in the world so a work-life balance is a necessary foundation throughout one's life.

Dr. Falk grew up in the tiny town of Harrington (pop. 500) in east Washington State so it was a close-knit community around various public events. Her school was small (only 21 students in her graduating class!) and as a student, she was initially interested in science and math but did not meet chemistry until her senior year when she came to realize that she could not only understand it, but she could use it to change the world. She then chose to major in chemical engineering at Washington State University because it was more multidisciplinary than chemistry alone, and she knew that chemical engineers' salaries were higher!

Following graduation, the next thing to decide was whether to go to grad school or begin her career in science. Her undergraduate adviser helped her pick a school using her stretch goals and the University of Texas at Austin helped her to expand her body of chemical knowledge. However, after achieving her Ph.D, she was again faced with a choice - academia or industry, teaching or project development. Having decided on the cleaning products industry, she then had to determine what her passion was with the product and its scientific technology and how to deal with the company culture. While at Unilever, she worked in laundry R&D where she developed a number of laundry products and is now the owner of 17 US patents. Later she moved from New Jersey to California and joined Clorox Company, based in Pleasanton, to pursue her work on cleaning products that used chlorine and chlorine compounds as antimicrobials.

In her work on surfactants, Dr Falk explained how the hydrophilic surfactants, which are derived from plants or hydrocarbons like crude oil, form micelles which lift the soil off the surface to be cleaned. Ionic surfactants can also form reverse micelles which, in the hydrophobic phase, are used to trap water or emulsify oils. Other cleaning products can contain non-ionic surfactants which cut the grease and enzymes (the new kids on the block), which are very specific proteins, are engineered to disrupt other proteins which cause stains, like milk, blood and grass. In disinfection science, the chemical is adsorbed onto the bacterial cell membrane, penetrating the cell wall and disrupting the inner structure and function of the bacterium.

She explained to her audience that companies have not only a mission and vision but have a certain position within the industry. Also their code of ethics, the company's financial position, benefits, and location all affect one's career path and, by going into a consumer product group, she found there were even more considerations – namely the product itself, its processing and analytical development, regulatory compliance and manufacture. Other concerns that can impact one's career are marketing, consumer research, sales, patent law, and procurement.

Dr..Falk also spent some time talking about how to be a manager, whether it was of project development or people and whether to focus on the broader business strategy and its impact or just the technological strategy. She said we had to ask ourselves "What do I value?" "What am I really good at?" "What scientific applications appeal to me?" "Where can I get more information?". There are also what she called "mid-career pivots" which are sometimes forced on you, for example, when the company decides to move the lab to another state, which is what happened to

(continued on page 4

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Chair's Message

In contemplating a topic for the last article of 2020, the weirdness of the year quickly came to mind and that made me think about weird chemistry. In that light, I ran across these topics:

Salmon semen can be used to extract rare earth elements from waste. Since it appears that binding occurs on the phosphate site of the sperm DNA, perhaps the research applies to humans as well. Y. Takahashi etal, " Recovery and Separation of Rare Earth Elements Using Salmon Milt" 2014.

A patent has been awarded for a fire alarm intended for use by the hearing impaired. It emits the pungent odor of allyl isothiocyanate when triggered to alert the occupant. US Patent 20100308995 A1

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The odor of Odorous House Ants has been determined to be that of blue cheese. The experiments first used humans and then GC-MS to determine that the smell of freshly-crushed Odorous House Ants was made up of several methyl ketones similar to those emitted by blue cheese. (Note: this research does not apply to common ants which emit formic acid when crushed and smell like vinegar.) C. Penick & A. Smith. 2015. "The True Odor of the Odorous House Ant." American Entomologist 61(2): 85-87.

An astute postmaster might have been able to deliver a letter to Glenn Seaborg with just the address Sg, Lr, Bk, Cf, Am, that is Seaborg(ium) at Lawrence Hall of Science, Berkel(ium), Californ(ium), U.S. Americ(ium).

But I am not sure that any of these tidbits match the truly weird properties of the moist common substance, ordinary water, such as:

Water is the only compound that expands when it freezes. (Gallium and Bismuth and some of their alloys also have this property.)

\Without the above property, liquid water would be rare on the earth and life would likely be impossible (or certainly different than we know.)

When you add table salt to water, the volume decreases (by as much as 2%.)

Water (vapor,) not CO_2, is the greatest contributor to the Earth's global warming. Water is the only non-carbon-containing molecule that is a liquid at room conditions.

Continued on Page 4

continued from page 2)

her. This then becomes the time to reflect upon your strengths and values and she re-emphasized networking, using professional societies, like the ACS, or LinkedIn to connect with other scientists. These days it is easier than ever to get smart on a new career direction and to find out what a company is doing as well as network through social media. However what has changed is that resumes are prescreened by search engines and so they must be written for a specific position. Her recommendation is to go "broad and deep".

There were questions from the audience about her dissertation as well as career choices and how to get more involved in ACS and, specifically, WCC. This was a very successful meeting.

Linda Wraxall

continued from page 3

("Only" may be a slight exaggeration; your homework: find another.)

Water has the greatest surface tension of any room-temperature liquid other than mercury.

Water can be sticky and slippery at the same time. Two microscope slides with water between slide easily but are difficult to separate.

I hope your 2021 is not as weird as 2020 has been but that you can still find interest in the chemistry of the ordinary things around you.

Jim

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Book Review

I'm right and you're an idiot: The toxic state of public discourse and how to clean it up by James Hoggan

This book is a good attempt to address the inability to have a civil conversation on important issues. We often avoid the subject with those we think have opposing views or walk away from a potentially awkward argument. Most of the book is based on about 20 different interviews conducted with noted scholars in as many fields dealing with communication. and allied disciplines.

The author frames the interviews in the context of climate change. He offers his opinion in various sections but mainly states the position and perspective of those that he selected to interview and publish

The first chapter is based on the work of Daniel Yankelovich who developed both quantitative and qualitative aspects to polling. This skilled use of dialogue successfully dealt with highly polarized public issues. Yankelovich notes that the scientific community is largely innocent of the rules of public discourse, We have gifted experts offering abstract technical, difficult qualified statements and a media that presents what they say in the form of controversy. The scientific community assumes that people should be convinced by facts and data. Debate is about seeing weaknesses in other people's position, while dialogue is about searching for strength iand value in our opponents concerns.

In another chapter Carol Tavris a social scientist, discusses how cognitive dissidence shapes our thinking, This discord produces mental discomfort which people seek to reduce in self deluding ways.

In the following chapter, Jonathan Haigt, also a social scientist, discusses why certain people distrust scientists and others. We are prewired with a world view that orients us to specific perspectives. It is best to acknowledge those perspectives and find the value in the balance.

Dan Kahan in a later chapter confirms that social context is important as to who we trust for information. Humans are good in finding out who to believe, and once we

continued on page 8

Hu, B., Guo, H., Zhou, P. et al. Characteristics of SARS-CoV-2 and COVID-19. Nat Rev Microbiol (2020). https://doi.org/10.1038/s41579-020-00459-7

To date, there are no generally proven effective therapies for COVID-19 or antivirals against SARS-CoV-2, although some treatments have shown some benefits in certain subpopulations of patients or for certain end points (see later). Researchers and manufacturers are conducting large-scale clinical trials to evaluate various therapies for COVID-19. As of 2 October 2020, there were about 405 therapeutic drugs in development for COVID-19, and nearly 318 in human clinical trials (COVID-19 vaccine and therapeutics tracker). In the following sections, we summarize potential therapeutics against SARS-CoV-2 on the basis of published clinical data and experience.

Inhibition of virus entry

SARS-CoV-2 uses ACE2 as the receptor and human proteases as entry activators; subsequently it fuses the viral membrane with the cell membrane and achieves invasion. Thus, drugs that interfere with entry may be a potential treatment for COVID-19. Umifenovir (Arbidol) is a drug approved in Russia and China for the treatment of influenza and other respiratory viral infections. It can target the interaction between the S protein and ACE2 and inhibit membrane fusion..In vitro experiments showed that it has activity against SARS-CoV-2, and current clinical data revealed it may be more effective than lopinavir and ritonavir in treating COVID-19.. However, other clinical studies showed umifenovir might not improve the prognosis of or accelerate SARS-CoV-2 clearance in patients with mild to moderate COVID-19. Yet some ongoing clinical trials are evaluating its efficacy for COVID-19 treatment. Camostat mesylate is approved in Japan for the treatment of pancreatitis and postoperative reflux oesophagitis. Previous studies showed that it can prevent SARS-CoV from entering cells by blocking TMPRSS2 activity and protect mice from lethal infection with SARS-CoV in a pathogenic mouse model (wild-type mice infected with a mouse-adapted SARS-CoV strain. Recently, a study revealed that camostat mesylate blocks the entry of SARS-CoV-2 into human lung cells. Thus, it can be a potential antiviral drug against SARS-CoV-2 infection, although so far there are not sufficient clinical data to support its efficacy.

Potential antivirals target the different steps of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) replication, ranging from receptor binding, entry and fusion to replication. Furthermore, immunoglobulin-based and immunomodulatory drugs are potential therapeutics as well. Note that robust data on clinical efficacy are lacking for most of these treatments so far. 3CLpro, 3C-like protease; ACE2, angiotensin-converting enzyme 2; CR3022, a SARS-CoV-specific human monoclonal antibody; E, envelope protein; EK1C4, lipopeptide derived from EK1 which is a pan-coronavirus fusion inhibitor targeting the HR1 domain of the spike protein; ER, endoplasmic reticulum; gRNA, genomic RNA; HR2P, heptad repeat 2-derived peptides of SARS-CoV-2 spike protein; IL-6, interleukin-6; ISG, interferon-stimulated gene; M, membrane protein; RdRp, RNA-dependent RNA polymerases; sgRNA, subgenomic RNA; S, spike protein; TMPRSS2, transmembrane protease serine protease 2.

Chloroquine and hydroxychloroquine are other potential but controversial drugs that interfere with the entry of SARS-CoV-2. They have been used in the prevention and treatment of malaria and autoim-

continued on Page 9

Digital Dentistry Revisited

Part 3

Bill Motzer

In Part 1 (October 2020 Vortex), I discussed the formation of elements in stars and galaxies resulting from supernova's and supernova remnants (SNRs) that created elements above hydrogen, particularly calcium, phosphorous, and magnesium in our bones and teeth. SNRs dispersed these elements as gas and dust that, under subsequent gravitational attraction, formed future metal-rich stars and planets, including our Sun and solar system, which are calcium- and magnesium-rich. We therefore live in a metal-rich spiral arm of the Milky Way and have a metal-rich sun and rocky planets. We know this from spectrographic analysis of these stars, the Sun, the Moon, planetary exploration (e.g., Mars), and analysis of meteorites and these are summarized in Table 1.

Calcium, at approximately three percent, is the fifth most abundant element in the Earth's crust comprising sedimentary calcium carbonate ($CaCO^3$) deposits (limestone) largely formed from fossilized marine life. It occurs as two polymorphic minerals: (1) rhombohedral calcite (the most common) and (2) orthorhombic aragonite (which forms in temperate and tropical seas). Rocks of the first type include limestone, dolomite [$CaMg(CO_3)_2$], chalk, coral, and seashells. Aragonite beds occur in the Bahamas, Florida Keys, and Red Sea basins. Additional calcium minerals include gypsum ($CaSO_4 \cdot 2H_2O$), anhydrite ($CaSO_4$), fluorite (CaF_2), and apatite [$Ca_5(PO_4)_3F$].

Most calcium and magnesium began dissolving in the Earth's oceans, probably as ions, when they formed perhaps 3.8 to 4.0 billion years ago (Ga). (Note: Earth's age is about 4.54 Ga ±0.05Ga.). However, it was not until cyanobacteria, via photosynthesis, began converting the Earth's CO_2 to O_2 (known as the Great Oxidation Event) at about 2.4 Ga, that calcium geochemical cycling (aka the carbonate–silicate cycle) began. Once free atmospheric concentrations were high enough, the oceans became oxygenated (probably at ~2.25 Ga). Bacteria (eukaryotes) began forming at ~1.6 to 2.1 Ga and the earliest multicellular plants and animals (at ~0.75 Ga). However, it was not until The Cambrian Explosion in the Cambrian Period (~0.541 Ga) that the major animal phyla began appearing in the fossil record, including multi-cellar forms incorporating $CaCO_3$ as their protective shells. It lasted for about 13 to 25 million years resulting in one of the greatest divergence of most modern metazoan phyla, including the chordates – our ancestors with bones and nerves.

Calcium in the Earth's mantle, crust, ocean, and atmosphere involves complex geochemical cycling that includes plate tectonics, climate, and the carbon cycle, where mountain uplift results in chemical weathering of calcium-bearing rocks releasing Ca^{2+} to surface water (see Figure 1). These ions are transported to the ocean, which react with dissolved CO_2 forming either limy sediments that are incorporated into $CaCO_3$-producing animals and/or chemically precipitated limestone; these settle to the sea floor where they're incorporated into new rocks. The actual reaction also involves the bicarbonate ion (HCO^{3-}), forming when CO_2 reacts with water at seawater's pH (currently at 8.1):

$$Ca_2{+}{+} \; 2HCO^{-3} \rightarrow CaCO_3 + CO_2 + H_2O$$

Most CO_2 is converted back into HCO^{3-} resulting in a net transport of one molecule of CO_2 from the ocean/atmosphere into the crust or lithosphere. Therefore, for each chemical weathered released Ca^{2+} ion, one CO_2 molecule is released from the surficial system (atmosphere, ocean, soil, and living organisms). It is then stored in carbonate rocks where it tends to remain for hundreds

(continued on page 7

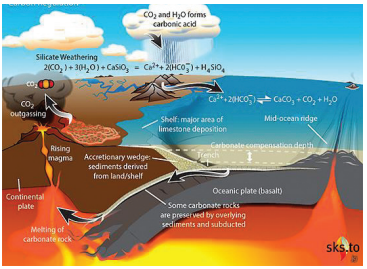
of millions of years. Weathering of calcium from rocks thereby scours CO_2 from the ocean and atmosphere; this has a long-term effect on Earth;s climate.

So now we know where the calcium and magnesium in our teeth and bones comes from. Next we will explore more about digital dentistry, particularly the evolving science of dental forensics.

Table 1: Calcium and Magnesium Concentrations in the Solar System and Earth

Source	Calcium (Ca)	Magnesium (Mg)	Concentration Basis
Solar System*	6.11×10^4	$1.074\ 10^6$	Number of atoms for every 10^6 atoms of silicon
Sun	6.36±0.02	7.58±0.05	Number of atoms for every 10^{12} atoms of hydrogen
Earth's Crust	4.15×10^4	2.33×10^4	Ca=mg/kg; Mg=%
Earth's Mantle	26,100	22.17	Ca=mg/kg; Mg=%
Bulk Earth	1.71	15.4	%
Ocean Water	4.22	1.326×10^3	mg/L

* largely from meteorites.
Reference: http://www.knowledgedoor.com/2/elements_handbook/calcium.html



Garret, J. https://www.skepticalscience.com/print.php?n=1959

(continued from page 4)

trust that source or belief, facts and data do not change our mind, but personal narratives can.

George Lokoff a cognitive scientist, describes frames as structures of thoughts. that determine meaning, a tool to organize thoughts. They are metaphors of how we see the world. He recommends that we communicate using the language of values: a combination of emotion and logic and drop the language of policy, facts and data.

In chapter seven Bruno Latour, a French philosopher agrees that facts and figures do not address the people's concerns and adds that the subject of climate change is very complicated, involving many disciplines and long studies. The nonscientific community need time to process the information. People are not motivated to address complex problems on the basis of truth and facts, because these issues do not have incontrovertible truths , Latour recommends that we look at complex issues as how they concern us and our values If we frame that as a narrative and share,others may also share their concerns

In a previous chapter Noam Chomsky, said similar things but was specific on the position that large corporations and the very rich and elites are self-absorbed, and unconcerned with making a deal that is good for everyone. Further, We do not have a government for the people, it is a government for the 1% The American people have been asleep at the switch and it will be a long, hard struggle.

Adam Kahane, an authority on social change brings the concept of Power and Love, and that both are necessary to resolve a complex problem. As powerful as dialogue is Kahane says it would be a fundamental error to focus on that alone. It is part of the story.-a love method. Power helps get the job done to achieves our ambitions. Love without power pays attention only to the good of the whole and ignores the drives and interests of the parts.

Peter Senge, is a world leader in systems thinking. On a biological level one of the definitions of a living system is the ability to maintain balance crucial to survival. A living thing's first impulse is to maintain itself and homeostasis is the fundamental process in creating that balance. All systems resist change from the outside. We forget this with humans as we try to convince them with facts, we may trigger a response for them to dig in.

Otto Scharmarer was part of the MIT Learning Center founded by Peter Senge. who developed the concept of presencing. Basically it means moving beyond our ingrained default positions and deep rooted habits, judgements, and thoughts, A part of the answer is learning how to move beyond fear and loss. Sharmarer's suggestion is empathy immersion where one takes a journey and confronts extreme, raw and unfiltered situations. 'This experience opens the heart to other opportunities.

Skipping a few chapters, we come to the last chapter and the interview with The Dali Lama and a quote. by the Dali Lama. "I acknowledge that the Western brain looks more sophisticated. In Tibet we operate from the heart. Combine these two; the Asian heart and Western mind and then we will have real success."

Lou Rigali

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jor innate immunity defences against virus invasion. Interferons induce the expression of diverse interferon-stimulated genes, which can interfere with every step of virus replication. Previous studies identified type I interferons as a promising therapeutic candidate for SARS.. In vitro data showed SARS-CoV-2 is even more sensitive to type I interferons than SARS-CoV, suggesting the potential effectiveness of type I interferons in the early treatment of COVID-19. In China, vapor inhalation of interferon-α is included in the COVID-19 treatment guideline..Clinical trials are ongoing across the world to evaluate the efficacy of different therapies involving interferons, either alone or in combination with other agents.

Immunoglobulin therapy

Convalescent plasma treatment is another potential adjunctive therapy for COVID-19. Preliminary findings have suggested improved clinical status after the treatment153,154. The FDA has provided guidance for the use of COVID-19 convalescent plasma under an emergency investigational new drug application. However, this treatment may have adverse effects by causing antibody-mediated enhancement of infection, transfusion-associated acute lung injury and allergic transfusion reactions.

Monoclonal antibody therapy is an effective immunotherapy for the treatment of some viral infections in select patients. Recent studies reported specific monoclonal antibodies neutralizing SARS-CoV-2 infection in vitro and in vivo, Compared with convalescent plasma, which has limited availability and cannot be amplified, monoclonal antibodies can be developed in larger quantities to meet clinical requirements. Hence, they provide the possibility for the treatment and prevention of COVID-19. The neutralizing epitopes of these monoclonal antibodies also offer important information for vaccine design. However, the high cost and limited capacity of manufacturing, as well as the problem of bioavailability, may restrict the wide application of monoclonal antibody therapy.

Vaccines

Vaccination is the most effective method for a long-term strategy for prevention and control of COVID-19 in the future. Many different vaccine platforms against SARS-CoV-2 are in development, the strategies of which include recombinant vectors, DNA, mRNA in lipid nanoparticles, inactivated viruses, live attenuated viruses and protein subunits. As of 2 October 2020, ~174 vaccine candidates for COVID-19 had been reported and 51 were in human clinical trials (COVID-19 vaccine and therapeutics tracker). Many of these vaccine candidates are in phase II testing, and some have already advanced to phase III trials. A randomized double-blinded phase II trial of an adenovirus type 5-vectored vaccine expressing the SARS-CoV-2 S protein, developed by CanSino Biologicals and the Academy of Military Medical Sciences of China, was conducted in 603 adult volunteers in Wuhan. The vaccine has proved to be safe and induced considerable humoral and cellular immune response in most recipients after a single immunization. Another vectored vaccine, ChAdOx1, was developed on the basis of chimpanzee adenovirus by the University of Oxford. In a randomized controlled phase I/II trial, it induced neutralizing antibodies against SARS-CoV-2 in all 1,077 participants after a second vaccine dose, while its safety profile was acceptable as well.. The NIAID and Moderna co-manufactured mRNA-1273, a lipid nanoparticle-formulated mRNA vaccine candidate that encodes the stabilized prefusion SARS-CoV-2 S protein. Its immunogenicity has been confirmed by a phase I trial in which robust neutralizing antibody responses were induced in a dose-dependent manner and increased after a second dose164. Regarding inactivated vaccines, a successful phase I/II trial involving 320 participants has been reported in China. The whole-virus COVID-19 vaccine had a low rate of adverse reactions and effectively induced neutralizing antibody production165. The verified safety and immunogenicity support advancement of these vaccine candidates to phase III clinical trials, which will evaluate their efficacy in protecting healthy populations from SARS-CoV-2 infection.

Future perspectives

COVID-19 is the third highly pathogenic human coronavirus disease to date. Although less deadly than SARS and MERS, the rapid spreading of this highly con-

tagious disease has posed the severest threat to global health in this century. The SARS-CoV-2 outbreak has lasted for more than half a year now, and it is likely that this emerging virus will establish a niche in humans and coexist with us for a long time166. Before clinically approved vaccines are widely available, there is no better way to protect us from SARS-CoV-2 than personal preventive behaviours such as social distancing and wearing masks, and public health measures, including active testing, case tracing and restrictions on social gatherings. Despite a flood of SARS-CoV-2 research published every week, current knowledge of this novel coronavirus is just the tip of the iceberg. The animal origin and cross-species infection route of SARS-CoV-2 are yet to be uncovered. The molecular mechanisms of SARS-CoV-2 infection pathogenesis and virus–host interactions remain largely unclear. Intensive studies on these virological profiles of SARS-CoV-2 will provide the basis for the development of preventive and therapeutic strategies against COVID-19. Moreover, continued genomic monitoring of SARS-CoV-2 in new cases is needed worldwide, as it is important to promptly identify any mutation that may result in phenotypic changes of the virus. Finally, COVID-19 is challenging all human beings. Tackling this epidemic is a long-term job which requires efforts of every individual, and international collaborations by scientists, authorities and the public.

Typical symptoms of coronavirus disease 2019 (COVID-19) are fever, dry cough and fatigue and in severer cases dyspnea. Many infections, in particular in children and young adults, are asymptomatic, whereas older people and/or people with co-morbidities are at higher risk of severe disease, respiratory failure and death. The incubation period is ~5 days, severe disease usually develops ~8 days after symptom onset and critical disease and death occur at ~16 days. ARDS, acute respiratory distress syndrome; ICU, intensive care unit.

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