CHESAPEAKE ENVIRONMENTAL PROTECTION ASSOCIATION, INC.
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NEWSLETTER **Spring 2016**

PRESIDENT'S MESSAGE

By Al Tucker, President, 2016

The future of drinking water has been on my mind for the past few months, but it's been on CEPA's agenda now for more than two decades. Without water, life is not possible, but as we have seen in California, even a moderate lack of water causes havoc in everyday modern life. Other cities and countries facing similar problems are implementing technologies and water saving strategies to face the uncertainties of climate change and population growth.

Many of you are aware that CEPA took up the banner in the 1990's, when arsenic was found in some locations in the coastal aquifer systems and again during the statewide drought of 1998-2002 which brought the subject of water availability to the fore. The extreme conditions then were cause for alarm and literally forced the governor to take action. He appointed the Advisory Committee on the Management and Protection of the State's Water Resources, which issued an interim report in 2004 and the final report in 2008. (This report is often referred to as the "Wolman Report". The CEPA forum of 2008 featured Prof. Gordon Wolman, the primary author, and Dr. Robert Summers, who discussed the findings.)[1]

I have traversed the Southern Maryland counties talking about "The Future of Drinking Water in Maryland," and I have gained several perspectives from people's reactions to the information I present. To share with you some of my observations, there is a lack of awareness of these looming issues, a perception that they are not a problem, and a belief that Maryland has plenty of water now and we can deal with any problems later.

The further we distance ourselves from the last statewide drought, the less we remember about the conflicts of the sort that were the impetus for the governor to initiate the Wolman study. Farmers irrigating their crops ran into disputes with nearby residents who depended on groundwater for domestic needs. Reservoirs were lowered to maintain stream flows to the consternation of boaters and property owners whose property values plummeted. Recreational use of streams was in conflict with communities that needed the streams for local water supplies. The ire of developers was felt in Mount Airy and nearby communities, when all construction was brought to a halt. Middletown ,MD attempted to annex the water rights of the nearby state forest, only to be denied by DNR. These and many other problems have receded from our near term memory. In the meantime, the population of Maryland has increased by 14%, climate change is bringing rapid changes to our region, and southern Maryland is experiencing the fastest temperature changes in the entire northeastern US.

Severe droughts occur in Maryland approximately every two decades. The most recent major ones occurred in 1985 and of course in 1998-2002. Recently, research has identified weather precursors in the Pacific that predict droughts in the northeastern US. Since the 1985 drought, the Maryland Legislature has required the Water Supply Program at Maryland Department of Agriculture (MDE) to submit an annual report on the "State of Groundwater in Maryland". Year after year they have documented the issues facing many residents.

The geology of Maryland divides residents into distinct regional groups that make it even more difficult to unite around a common cause. These groups are further subdivided into those who receive their water from public supply and those who have wells. The publicly supplied folks assume that their supplier is watching out for their interests, and, generally, those who supply their own water are unaware of problems. Both communities assume there will be sufficient water in the future.

Approximately 66% of the state depends on surface water, while the remainder depends on the groundwater. Of the remaining 34%, only 17% get their water from groundwater wells. Surface water comes directly from precipitation, snow and rain. Much of this water is captured in reservoirs in the watersheds of our major rivers. West of the piedmont (approximately west of I-95), known as the fractured rock area of Maryland, groundwater users also depend on precipitation to replenish their surficial aquifers. On the far Eastern Shore, the coastal plain aquifers are too deep to access inexpensively; hence, these communities also depend on surface water and precipitation accumulating in the surficial aquifer. Thus, about 90% of Marylanders depend on precipitation to replenish their reservoirs and surficial aquifers.

However, Anne Arundel, Southern Maryland, and near Eastern Shore counties rely primarily on the coastal plain aquifer system and hence seem relatively immune to the effects of drought. Aquifers are basically huge underground storage systems, containing water that is thousands to millions of years old. Water enters these aquifers at the outcrops that come to the surface just east of the piedmont, generally east of I-95. These areas, called recharge areas, are relatively small compared to the volume of the aquifers, and they represent the primary places for water to enter the aquifer system. They, of course, depend on the surficial aquifers to have water available to recharge them. In general, these large underground reservoirs are sufficient to ride through the average long term drought in Maryland. But unanswered questions remain, namely: "Are the current levels of water withdrawals sustainable?", "Are the aquifers being recharged?" Year after year the aquifers show constant declines of 4-6 ft. per year.

[1] See CEPA 2008 forum presentation: http://cepaonline.org/past%20forums.htm

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There are other signs that the coastal aquifer system is under stress. Charles County has determined that with expected growth, it will not be able to supply water to its public in 2040. MDE has mandated that Charles County find alternative sources of supply, so they are studying water reuse, desalination, and obtaining additional water from other counties. In other counties, property owners, primarily in Kent County, are finding saltwater intrusion in their wells. In these cases, the aquifer cannot supply all the households making withdrawals. As a consequence, the levels in the aquifers continue to show a steady decline. We should be concerned.

The surficial aquifers in western Maryland are also showing signs of stress. In 2008 Maryland legislators passed a law that allows the Maryland Department of the Environment (MDE) to allocate more groundwater to public drinking water systems in Carroll, Frederick, and Washington Counties than would have been allocated under previous policies. This move was a tacit admission that these counties had insufficient water availability to supply either the current population or the needs for growth. A common issue in all these regions is population growth.

The Wolman report identified future problems that require assessment and planning. However, the apparently sufficient supply of water since 2002 has created an aura of confidence that is unfounded. The weather elements that caused previous droughts still exist and will return. The severity of the next drought cannot be predicted. By 2040 Maryland is expected to add another 888,000 residents. That number translates into approximately an additional 98.6 million gallons of water per day that will be needed. The effects of climate change will only exacerbate the need for more water for agricultural irrigation, which is now the fastest growing water-use in Maryland. In Southern Maryland the question of whether population growth will cause the withdrawal of groundwater to be unsustainable is especially critical.

Woefully, the recommendations of the Wolman report have not been implemented. To quote from its executive summary:

"Maryland's investment in water resources management, however, has been inadequate. Despite the combined efforts of federal, State and local agencies, information on surface water, groundwater, and ecosystem health is incomplete. Furthermore, the available data have not been completely analyzed or integrated to ensure that current and proposed future water uses do not exceed the available supplies."

These recommendations need to be implemented!

DRUGS IN THE ENVIRONMENT

by Sally Hornor

Pharmaceuticals and Personal Care Products

We have all heard discussions about the impact of sewage effluents on nutrients in the Bay, but there are many more chemicals in sewage that are of concern. Consider all the pharmaceutical products and personal care products (PPCP) that end up going down the toilet or drains in households all around the world. Products in sewage may end up in receiving waters or they may be deposited on land via sludge application. Many prescriptions for medications that have expired end up going down the drain, although there are now specified take-back days for turning in expired drugs sponsored by local governments. The Food and Drug Administration requires not only that drugs be tested for safety to humans, but they also require an environmental assessment be submitted as part of a new drug application if the expected concentration of the drug into the aquatic environment is at least one part per billion. The amount of the drug expected to be produced over the next five years determines whether this threshold is reached (Sherer, 2006). This article focuses on the effect of PPCPs in the environment rather than on humans.

What are the most significant compounds classified as PPCPs that are of concern to ecotoxicologists? Since there are more than 4,000 such compounds, ranking them for priority for research is essential. At a recent international conference, ecotoxicologists developed a list of twelve PPCPs of greatest concern (Donnache et al., 2015). Ranking is based on prescription data, concentration in the environment, the predicted concentration at which they may be toxic, their persistence, and their ability to be bioaccumulated or concentrated up the food chain. The top priority compounds are the estradiols, which are used for hormone replacement therapy and birth control. These tend to travel through the human gut unchanged so they are excreted at a fairly high rate by any woman who is taking them. Estradiols are classified as endocrine-disruptors, meaning that they have a profound impact on the reproductive function of animals. Male smallmouth bass exposed to environmental concentrations of estradiol have been shown to have immature eggs in their testes, becoming so-called intersex fish. In an experimental lake in Canada, estradiol addition caused the population of fathead minnows to crash while the population of prey species increased. Upsets at the ecosystem level are not generally considered when assessing the impact of a toxic substance.

Other compounds besides PPCPs, including pesticides, have also been shown to be endocrine disruptors, including the most widely prescribed anti-diabetic drug, metformin. This drug is not metabolized by humans so, within 24 hours of ingestion, it is excreted essentially unchanged.

In a 2014 study of pharmaceuticals in Lake Michigan, the ecotoxicologist Rebecca Klaper found evidence of 32 PPCPs in the water and 30 in lake sediment. Fourteen of them were found to be of medium or high risk to the ecosystem, based on data from EPA. Metformin is at the top of the list of concerns from EPA, and it is found at concentrations of concern even 3 kilometers off the shores of Milwaukee (Scudellari, 2015).

Other drugs of concern are propanolol, a beta blocker used to treat cardiovascular disease and paracetomal, an anlagesic and antipyretic, similar to aspirin. Others include ibuprofen, several anti-inflamatory drugs including aspirin and carbamazepine, used to treat epilepsy. A key aspect of all of these compounds is that they are designed to be biologically

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active and therefore, even at low concentrations, they tend to have an impact on animal metabolism. Effects of exposure to low concentrations on marine animals such as shellfish, crabs and fish include damage to muscle tissue and gills, damage to liver and pancreactic tissue, decline in metabolic enzymes, and damage to regulatory systems affecting growth and reproduction. Many of the studies that show these effects were conducted in a lab with a single compound for a short time, ranging from 96 hours to 28 days. (Fabri and Franzellitti, 2016). Imagine what the impact will be when they are exposed to a combination of substances throughout their lifetime.

Effects of PPCPs in the Environment

Some PPCPs can be outright lethal to wildlife if a sensitive population comes in contact with them. One example of unexpected lethality was seen in India and Pakistan starting in the 1990's when tens of millions of vultures began dropping dead. At first it was thought to be due to an infectious agent but in 2004 it was discovered that they were dying of kidney failure after eating discarded domestic animals treated with the anti-inflammatory compound diclofenac (Scudellari, 2015).

Not included in the top twelve pollutants of concern are micro-plastic materials which have recently received attention. In addition to being consumed by wildlife, toxins leach from these particles. These are discussed more in the next article.

There is one antibiotic in the list of 12 PPCPs of concern: sulfamethoxazole, a common sulfa drug. The primary concern with antibiotics in the environment is that some bacteria in nature possess genetic elements that resist the antibiotic and their genes may be passed on to bacteria that have not even been exposed to the sulfa drug. Indeed, microbiologists have found plasmids, which are extra-chromosomal DNA, that contain genes for resistance to eight different antibiotics. Such bacteria end up as the "super bugs" that resist our best antibiotics, causing serious and life-threatening infections.

Effects of PCPPs on Animal Behavior

In addition to all of these impacts at the biochemical and physiological level, there has also been work done recently on the impacts of PPCPs on animal behavior. For example, when predatory perch are exposed to a psychoactive drug, they become more active while their damselfly prey are not affected by the same drug, illustrating that the same compound can effect members of different trophic levels differently.

This same study found that 46% of the drug that was in the prey accumulated in the predator; thus measuring environmental concentrations alone will not necessarily tell us the true exposure of predators in nature. Anti-depressants have been shown to reduce territorial aggression in coral reef fish, and both locomotion and agression in Siamese fighting fish. Rainbow trout, however, were unaffected by very high concentrations of the same drugs. The anti-depressant drug fluoxetine (Prozac) is the number 2 ranked PPCP. Side effects of this drug in humans are loss of libido and loss of appetite. When white bass and striped bass and goldfish are exposed to this drug, their feeding rate declines. Similarly, wild-caught starlings given fluoxetine ate less and at the wrong times. They fed throughout the day rather than at dawn and dusk. Not feeding heavily at dusk in the winter could result in death.

Exposure to the psychiatric drug diazepam caused increased activity in zebrafish and pumpkinseed. Antihistimines and the anti-epileptic drug carbamazepine caused fathead minnows to feed at a slower rate. Responses to drugs such as these are likely to be significant in wildlife, perhaps resulting in changes in population dynamics and food webs (Brodin et al., 2014).

Environmental Fate

What is the environmental fate of all these compounds once they leave our hands? Of course we don't really know the answer, but we are beginning to learn about some of the fates of PPCPs in the environment. They are ubiquitous and although their concentrations are generally quite low, they are persistent. Wastewater treatment plants (WWTPs) are not designed to reduce the concentrations of PPCPs, and they vary greatly in their ability to do so. In Germany, the removal of 14 drugs by a WWTP was quantified. For most of the drugs tested, the facility removed overall about half of the original concentration, but this ranged from only 7% for carbamazepine to 96% for propranolol. It is important to note that the metabolic breakdown products of drugs can be as or more toxic than the parent compound (Scherer, 2006).

Samples taken from sediment cores have shown that the anti-anxiety drug oxazepam has been accumulating in sediment layers for over 30 years. Based on the samples, researchers were able to determine the year that the drug went on the market and they can correlate the concentration in the sediment with the number of prescriptions written each year. No degradation of the drug had occurred over that time. In general, environmental conditions such as temperature, salinity, pH, and organic content will certainly affect the rate at which a chemical is degraded. In the case of the water-sediment-interface, where many compounds end up, it is tremendously complex and very hard to predict the true fate of the myriad chemicals that we dump into our waterways every day. Although the concentrations of PPCPs are low in natural systems, they are predictably higher in the vicinity of WWTPs, and this is the area often studied to determine ecological impacts. Clams, sea urchins and fish that live in the Antarctic Ocean in the vicinity of the Scott and McMurdo stations have shown elevated concentrations of estradiols and anti-anxiety medications in their tissue (Fabri and Franzellitti, 2016).

How We Can Reduce These Compounds in our Waterways

Once they are in sewage, there is some decomposition by the bacteria in sewage, but, again, some breakdown products may be just as or more toxic than the original compound. Treatment of secondary effluents by UV or ozonation or nanofiltration may also reduce concentrations, but at a high cost. None of these treatments work for all contaminants and, in the case of ozonation, there is the possibility of making a drug more toxic. It is preferable to prevent their presence in sewage to begin with. One suggestion is to design drugs that degrade quickly but this would decrease their stability. Drugs could also be designed with a more efficient delivery system so that the dose could be decreased. Encouraging collection of expired drugs at take-back events is a natural solution. Collected drugs are generally disposed of by incineration. Also, drugs and their packaging could be designed with a longer shelf life. (Boxall et al., 2012)

Concentrations of PPCPs in nature is generally quite low, so humans are not considered to be at risk from these, but the development of antibiotic-resistant bacteria is of concern and calls for careful disposal of expired drugs. Pharmaceuticals affect specific aspects of animal metabolism and we need to do our best to reduce the presence of these drugs in nature. Even at part per billion concentrations, the impact on the environment can range from changes in gene expression to changes in population structure and ecosystem function (Rodriguez-Moza and Weinberg, 2010).

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PLASTICS IN THE OCEAN

By Gary Antonides

Kamilo Beach is an isolated stretch of shoreline on the southern tip of the island chain of Hawaii. Just a few hundred yards from shore, humpback whales rise up from the depths, colorful fish fill the reefs and rare sea turtles swim in to nest on the beach. But http://ensia.com/features/what-will-it-take-to-get-plastics-out-of-the-ocean/ reports that, even in this remote place, toothbrushes, combs, plastic bottles and other garbage wash ashore each day. Old Hawaiian sayings have described the bay as a place where people went looking for loved ones if they got lost at sea. Historically that area has accumulated all manner of things that float in the ocean. Now, the main thing that washes ashore is a lot of plastic. It's happening all around the world.

The reason a remote place like Kamilo can get so swamped by massive amounts of trash is because of ocean currents. Hawaii is located in a huge circular system of ocean currents, the North Pacific Gyre. Within the gyre, trash can get trapped and circulate for years. One region between the islands and California contains such a high density of man-made debris that it has been nicknamed the Eastern Pacific Garbage Patch. The currents vary somewhat, causing the garbage to wash ashore in various places, like Kamilo Beach.

The International Pacific Research Center in Honolulu has taken major steps in understanding how marine debris travels the oceans' currents. They have developed a computer simulation that can project the behavior of floating items at sea. Based on drifter buoys and satellite data, the model indicates how trash accumulates in the oceans.

http://www.oceanhealthindex.org/news/Making_Least_Most_Marine_Trash reports that the world produces 300 million tons of plastic each year, but only about 10% is recycled. The rest is dumped, landfilled or escapes as trash into landscapes, lakes, rivers and the ocean. About 7 million tons end up in the ocean each year, making up roughly 75% of all marine debris. Ocean trash contains many different types and sizes of plastic, each harmful or even deadly in its own way.

Nanoplastics, the tiniest bits, not even visible to the human eye, come from cosmetics, face washes, toothpaste and other consumer goods as well as the breakdown of larger particles. Some states have been working on banning the use of these particles in personal care products.

Microplastics, in the millimeter size range, come mainly from the breakdown of larger pieces of plastic, but also from plastic pellets (nurdles) used for making plastic products. Microplastics comprise most of the plastic in the ocean.

We cannot get nanoplastics and microplastics out of the ecosystem, and, unfortunately, both enter food webs because they are ingested by filter feeders and small fish. The feeders gain no nutritional value, but do soak up toxins that leach from the particles, and scientists suggest these can be passed on to humans as well as other wildlife.

Most ocean debris ends up in five big subtropical ocean gyres located in the Pacific, Atlantic and Indian Oceans. They rotate clockwise in the Northern Hemisphere and counterclockwise in the Southern. Water samples collected from all these regions show elevated concentrations of plastic particles, and the evidence shows that the marine debris caught in the oceanic gyres continues to grow.

There are many efforts to control the plastics from entering the ocean in the first place. Each September, on International Coastal Cleanup Day, volunteers across the globe roam the shores to collect trash. In 2014, more than half a million participants from 91 countries collected over 16 million pounds of trash in just one day. The top five most commonly found items were cigarette butts, food wrappers, bottle caps, straws, stirrers and beverage bottles. Collectors also found lawnmowers, light bulbs, wigs and even shopping carts.

*Extremely littered beach in northern Norway. Source: **©© Bo Eide***

The damage and suffering this causes for ocean life is severe. Plastics are found in the stomachs of whales, fish and many other marine animals. Turtles suffocate when they confuse shopping bags with jellyfish, or drown when they get entangled in discarded nets. Seals get stuck in plastic rings from six-packs that slowly cut through their necks. In the middle of the Pacific, albatross chicks die, weakened from eating bottle caps and toys. The Convention on Biological Diversity counts 663 species affected by ocean plastics. Humans are also affected. In 2015, researchers sampled fish and shellfish being sold for human consumption in Indonesian and Californian markets. They found plastic or textile fibers in a quarter of the samples.

A solution is urgently needed, and many schemes for cleaning up the oceans have been proposed. These include marine drones, waterborne kites, huge artificial drains for the gyres, and creating microorganisms to break up the plastics. Experts have tried to convey what a massive challenge it would be to clean up the ocean's trash. The National Atmospheric and Oceanic Administration has estimated it would take 68 ships an entire year to survey just 1 percent of the North Pacific. In another, more hypothetical calculation, ocean activist Charles Moore estimates that to clean all five garbage patches, 1,000 boats would need to filter the water 24 hours a day for 79 years, and that's only if the technology existed.

Boyan Slat, a young Dutch inventor, presented his idea to filter the open ocean in 2012. Instead of sending out boats to go after the trash he would take advantage of the rotating currents of the gyres. If a filtering platform could be fixed to the seabed underneath the North Pacific garbage patch, one could get the trash out while the water flowed through it. Some experts say that Slat's project could cause more harm than good by threatening delicate zooplankton and other animals living near the sea surface. They also point out how difficult it would be to fix the structure to the seabed.

For many decades, environmental organizations have tried to raise awareness of how all this debris impacts marine life. But what finally alarmed many citizens were reports of massive trash islands in the ocean, one reportedly "twice the size of Texas." In fact, plastic is distributed quite widely over the vast oceans. The garbage patches are not solid islands, but regions where high concentrations of small plastic pieces are dispersed in the upper part of the water column, hardly visible from above.

For a long time, with good reason, the development of plastics was perceived as a big success story. Synthetic materials have advanced human civilization, wealth and comfort in uncountable ways. Their development started in 1907 when the Belgian-born chemist Leo Baekeland developed Bakelite, the first synthetic plastic polymer. Bakelite was moldable, heat-resistant and nonconductive, so it was soon used for a multitude of products, from electrical insulators and casings for telephones and radios to toys, poker chips and firearms. Most plastic applications were industrial until the 30's and 40's when it was used increasingly in consumer products including telephones, furniture, and dishware. Global plastic production rose from 1.9 million tons in 1950 to close to 330 million tons in 2013. And the numbers continue to grow. Now plastic products can be found from the surface of oceans to deep-sea sediment, in lakes and rivers, even frozen in Arctic ice. They are ubiquitous, and we find ourselves forced to think about the consequences. Unfortunately, plastics are not the only new technology wholeheartedly adopted without an appreciation of the long term consequences.

While efforts to find a viable method to clean existing ocean plastic are laudable, it is more important to stop more trash from entering the oceans in the first place, which means keeping it out of the rivers and streams that empty in the oceans. Cleanup projects and research are being undertaken worldwide, but here we will mention only two commendable local efforts.

In Baltimore, John Kellett worked near the city's heavily polluted harbor for many years and realized that much of the plastic reaching the harbor came from Jones Falls, a stream that accumulates trash as it winds through residential neighborhoods. With local partners, Kellett constructed a device that would skim garbage from the surface of the stream before it could float downstream. Utilizing a waterwheel to take advantage of the Jones Falls current and solar panels, the Inner Harbor Water Wheel was deployed in 2014 and has become a prominent city landmark. Resembling a giant nautilus, it has orange booms that cover the 35-meter-wide (40-yard-wide) mouth of Jones Falls and directs items floating on the surface to a conveyor belt, where they are collected before they can reach the harbor. The trash is then emptied into a large container and hauled off.

Photo by Inhabitat (Flickr/Creative Commons)

Kellett estimates that about three-quarters of the trash that would have floated into the inner Baltimore harbor is now being caught. *National Geograpic, April 2016* reports that 12 dumpsters were filled in 48 hours after a severe storm last year. Kellet is being praised by experts for his efforts to catch trash closer to the source. He has received a number of requests to deploy his technology in other places around the world, including the trash filled Guanabara Bay in Brazil where Olympic events will be hosted this year. He sees good potential to scale it up for midsize rivers and harbors, but he points out that if there were better education, legislation and technology, the trash might not show up in the rivers and travel to the ocean in the first place.

Those who live near Annapolis may remember Matt Rutherford the sailor who, in 2012, was the first person to circumnavigate the Americas non-stop and solo. Since then he has founded the non-profit Ocean Research Project (ORP), teaming with NASA, Smithsonian, and 5 Gyres to study climate change, ocean acidification and marine plastics in one of the most remote regions of the world

http://oceanresearchproject.org/2652-2/ reports that last summer he and Nicole Trenholm sailed their specially equipped 42' schooner to uncharted fjords off western Greenland to conduct first-of-its-kind scientific research in one of the most remote and least-understood places on the planet. The 100-day expedition gathered scientific data on some of the critical environmental challenges of our time, including climate change, ocean acidification and marine plastics.

For one of their projects, ORP will use finely webbed nets to collect, for one of the first times in an Arctic environment, small pieces of plastic refuse. Samples of these microplastics will be analyzed for their composition, any harmful toxins and various micro-bacteria. This research will support international models that show the characteristics of marine debris in various climactic regions. Trenholm, a former NOAA scientist, said the marine debris research builds upon previous ORP surveys.

CEPA's Fall newsletter will include an article that focuses on the many effects of plastics on marine life.

PROFILE OF A TRUSTEE
RICHARD DUNN

Rick got his B.A. cum laude from University of New Hampshire in 1966 (Distinguished Military Graduate), his J.D. from University of Maryland in 1969, and his LL.M. with Highest Honors from George Washington University in 1976.
From 1970 to 1979 he served as a Judge Advocate in the United States Air Force in the United States and in Turkey. His awards include the Air Force Meritorious Service Medal. He was active in the Air Force Reserve and Air National Guard until 1991.

From 1979 to 1980 he was in private practice with the Washington law firm of Sullivan and Beauregard. From 1980 to 1987 he served in several positions at NASA including Counsel to the Space Commercialization Task Force and Deputy Associate General Counsel. In 1987 he was appointed as the first General Counsel of DARPA. He organized the office and provided a full range of legal services for the nation's foremost national security research and development agency. He pioneered innovative techniques to support science and technology projects by championing the enactment of legislation that authorized DARPA to enter into cooperative relationships with commercial companies or "partnerships" of companies and other organizations. Other pioneering efforts involved obtaining authority to conduct prototype projects outside the normal contracting statutes and special authority to recruit and pay scientists and engineers without regard to Civil Service laws. Awards include the Presidential Rank of Meritorious Executive and the Secretary of Defense Medal for Meritorious Civilian Service.

From 2000 to 2007 he was Visiting Scholar/Senior Fellow at the University of Maryland, in the Department of Logistics, Business and Public Policy, R.H. Smith School of Business. Research was the primary emphasis of this position, but it also included teaching. The research was on the implementation of technology and historical national security studies.

Currently, as an independent consultant, he provides advice and engages in research and analysis on the deployment and implementation of technology in the military and civil sectors through partnering and other innovative means; he conducts research in national security operations, technology and their interactions; and analyzes laws, policies and practices that impact the implementation of technology. Pro bono work includes appointment to several study groups of the National Academy of Science and Defense Science Board.

He has taught graduate and continuing education courses at the University of Maryland. He has provided formal testimony before the House Science Committee of Congress, and has been a speaker at conferences of the National Academy of Sciences, National War College, American Bar Association, and other organizations

Rick has lived near the South River for over 30 years and spent many summers of his youth and early adult years on the Choptank River. In law school he wrote an influential research paper on water resources conflicts in Dorchester County. He now is doing research on World War II and has written several articles and a book on several aspects of the war.

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