RIGHTWORDS

Science Writing Clips by Alan McNairn

UNUNSEPTIUM

The most recently discovered chemical element, temporarily named ununseptium, is number 117 on the periodic table. Ununseptium is not a naturally occurring element.

Russian scientists hypothesized that fusing the atomic nucleus of the element berkelium, which has 97 protons, with the nucleus of calcium with 20 protons, a new element would be created. The fused nucleus would, they theorized, have 117 protons or the sum of those in the two fused atomic nuclei. The new element with an atomic number of 117 would, like other elements, exist in various isotope states, that is, with nuclei having different numbers of neutrons.

The actual synthesis of ununseptium was a collaborative effort between Russian and American scientists. At the Oak Ridge National Laboratory near Knoxville, scientists produced 22 milligrams, or 22 thousandths of a gram, of an isotope of berkelium. Their synthesized isotope, berkelium-249, with a nucleus comprised of 97 protons and 152 neutrons, has a half-life of 330 days so that within that time, half of the isotope will decay to become another chemical element.

In 2009, the US manufactured berkelium-249 was quickly transported to Russia where it was placed in a laboratory particle accelerator and bombarded with an isotope of calcium.

The synthesis of new elements is accomplished by nuclear fusion. In a particle accelerator the nuclei collide at a very high velocity and occasionally the nuclei of the elements placed in the accelerator fuse. Fused atomic nuclei created by nucleosynthesis have a large number of protons and are very unstable. They decay quickly, or have very short half-lives and are transformed into another element. Their decay is measured by the radioactivity they emit in the process. Elements with a large number of protons decay and give off radioactive energy at a high rate. Hence their half-life is very short

FRACKING

Extraction of oil and gas in the United States, until recently, was nearly all from subterranean pools or reservoirs in carbonate and sandstone geological formations. These pools were tapped by drilling vertical wells. In the 1940s a technique was devised to extract oil and gas trapped in rocks surrounding these pools. The injection into the well of water under pressure was used to fracture these rocks thus allowing additional gas and oil to flow into the reservoir. This was the origin of hydraulic fracturing or as it is popularly known, fracking.

Since the 1940s there have been significant advances in the engineering of oil and gas extraction. One of these significantly reduced the cost of bringing oil and gas to the surface by horizontal drilling. The amount of oil and gas extracted through a vertical well was increased by drilling laterally to tap into pools of oil that lay nearby at the same depth. This meant that several pools of oil could be accessed and the oil pumped to the surface through one vertical shaft.

In the 1990s, horizontal drilling was combined with hydraulic fracturing to free oil and gas from tight formations of shale. This is a more expensive extraction process than that of traditional vertical and horizontal drilling to tap oil reservoirs but the high prices for oil fueled a boom in fracking. There is considerable variation in cost of oil production using hydraulic fracturing from well to well across the US. The cost of producing a barrel of oil is from $30 to $70 depending on well depth, horizontal position and the oil content and brittleness of the shale. When the market price of oil dips to approach production costs fracking becomes unprofitable and oil companies curtail investing in new wells.

THE RISE OF ANTIMICROBIAL RESISTANT BACTERIA

Since the discovery of penicillin by Alexander Fleming in 1928 countless lives have been saved using antibiotics for the treatment of bacterial infection. Antibiotics inhibit the formation of cell walls in bacteria so that cells do not multiplicity and they weaken the walls of existing bacteria causing the cells to die. Specific antibiotics have over time been developed to effect the destruction of specific strains of bacteria that infect the human body causing illness.

Bacteria like all other organisms have the capacity to mutate. When bacteria cells divide into two daughter cells, the genetic makeup of one or both of the offspring may not be identical to that of the parent cell. If a genetically different or mutated cell has an enhanced ability to survive in its environment it will reproduce and in doing so will replicate the mutated gene and pass it to its own daughter cells. A bacterial mutation in effect creates a new species and that species may have new characteristics some of which may make it less vulnerable to a specific antibiotic.

There is no known way to prevent bacteria from mutating. They do this at random. When a mutated bacterium is in an environment which is hostile to bacteria without the mutation, it thrives and reproduces. A bacterium vulnerable to an antibiotic is replaced by one that isn't. There is a way to reduce the probability of the proliferation of bacteria mutating into an antibiotic-resistant strains. This involves the reduction of the use of antibiotics so that they are prescribed only for specific infections. The effectiveness of antimicrobial drugs such as antibiotics depends on the relative absence of drug resistant strains. The more pervasive antimicrobial drugs are in an environment the more likely mutant microbes will thrive and reproduce.

As we look into the future a truly frightening prospect presents itself. It is predicted that by 2050 global mortality caused by antimicrobial resistant (AMR) strains of bacteria will eclipse mortality due to other medical conditions. Why is this number so large?

PLUTO, PLANET, DWARF PLANET AND NEW DISCOVERIES IN SPACE

In July 2015, the New Horizons space probe passed within 280,000 miles of Pluto and beamed back to earth a series of astonishing photographs. Aboard the space probe, engineered by the Johns Hopkins University Applied Physics Laboratory, were some of the ashes of American astronomer, Clyde William Tombaugh (1906-1997). The symbolic presence of Tombaugh in Pluto's neighborhood in space was a fitting tribute to this astronomer's discoveries.

Tombaugh, working at the Lowell Observatory in Flagstaff, Arizona, devised a method of comparing photographs of the same region of outer space taken days apart. He proved mathematically than an object in his astrographs that jumped from one position to another in relation to the stationary background stars, was an orbiter of the sun. In 1930, he discovered such an orbiting planet which was given the name Pluto. As time went on, using his methods, more sun-orbiting bodies were discovered in the same region of space beyond the distant planet Neptune. Named the Kuiper belt, this trans-Neptune volume of space contains a number of objects which are thought to be comprised of frozen gases. The largest of these bodies are Pluto, Eris and Makemake.

Pluto with a radius of 715 miles is much smaller than the Earth which has a radius of 3,959 miles. In size Pluto is more like the earth's moon than any of the planets in our solar system. The mass of Pluto is .0025 that of the earth. It has a gravitational pull that is only .071 times that of the earth. In size, mass and gravitational pull, Pluto is miniscule in comparison to what was once considered the next smallest planet, Mercury.

Traditionally the word planet referred to a limited number of observed sun-orbiting objects. As astronomers improved their ability to study space beyond Neptune the number of these objects increased, first with the discovery of Pluto and then with Eris, discovered in 2005. Eris appeared to have a greater mass than Pluto. Another object in the Kuiper belt, Makemake, was discovered in the same year. It is two-thirds the size of Pluto. In response to these discoveries and the potential for detection of more

BIOLUMINESCENCE

Bioluminescent organisms produce and emit light. Bioluminescence is common in marine micoorganisms like phytoplankton, marine invertebrates such as squid and octopuses, marine vertebrates among them anglerfish and krill and terrestrial invertebrates like fireflies and glow worms. It is estimated that 80% of the world's bioluminescent species live in the ocean where light emission is used for camouflage, concealment and as means of locating and attracting prey.

One of the most striking phenomena of nature, bioluminescence has fascinated scientists who have studied light emitting organisms to determine the mechanisms of controlling light emission and the biological function of it in various families. Squid use their capacity for bioluminescence to change their appearance so as to blend in with the color of the surface of the ocean when seen from below. The anglerfish use a kind of bioluminescent fishing rod protruding from the head to attract small fish to approach within striking distance of the anglerfish's mouth. Some species of squid will expel a cloud of bioluminescent bacteria in order to confuse predators and some organisms that live deep in the ocean, such as the Black Dragonfish, emit light to see their prey.

The most commonly observed bioluminescent phenomena in nature occurs in the ocean where phytoplankton or dinoflagellates light up sea at night. These tiny plants absorb sunlight during the day and at night in response to water movement emit light in flashes that range from less than a second to as much as 6 seconds.

The emission of light in flashes is controlled by the release of chemicals within a plant or animal that starts or stops the light producing chemical reaction which is called chemiluminescence. In chemiluminescence a chemical pigment,

ASIAN CARP

The Great Lakes which hold 21% of the world's fresh water have been under siege for many years. More than 180 invasive species have affected the biodiversity pushing some native species to the verge of extinction. The predicted arrival of the Asian Carp in the Great Lakes is expected to have even more catastrophic effects than the lamprey eel and zebra muscle that have severely altered the aquatic environment of the inland lakes.

Two species of Asian Carp, the bighead carp and the silver carp, were imported by fish farmers in the Southern states to reduce the algae in their ponds. These carp are particularly efficient pond cleaners because they can daily consume algae weighing up to 20% of their body weight. Their voracious appetite is due to their inefficient digestive tract.

Some carp escaped from the fish farms and entered the Mississippi River and in the 1990s the number of escapees increased dramatically as the commercial fish ponds overflowed in a series of floods.

Asian carp adapt quickly to new environments and this allowed them to proliferate in the Mississippi River. Their ability to reproduce exponentially in environments where they have few predators and their remarkable ability to exploit new ecosystems has led to their rapid expansion into all of the tributaries of the Mississippi moving upstream into rivers and lakes as far north of South Dakota.