BOSON

....an yearly newsletter,

Department of Chemistry , Pragjyotish College

DEPARTMENT OF CHEMISTRY ধাতু ..... a forum of Department of Chemistry

PRAGJYOTISH COLLEGE
SHANTIPUR,GUWAHATI

Volume 3 Issue 1 **14 June 2019**

THE WOMAN WHO DESERVE NOBEL PRIZE

On 16 April 1958, the world lost British chemist and X-ray crystallographer **Rosalind Franklin** who received no recognition for her contribution in understanding the structure of the molecule that is the basis of heredity i.e. DNA.

She was born in 25 July 1920 in Notting Hill, London. She graduated from university of Cambridge in physical chemistry. In 1942, she worked for British Coal Utilisation Research Association where she investigated the physical chemistry of carbon and coal and used this research to receive doctorate from Cambridge.

In 1951, Franklin joined the Biophysical Laboratory at King's College, London as research fellow where she began her research to find the chemical structure of DNA . In May of 1952, one of Franklin's graduate student, Raymond Gosling, took a historic photograph named "**Photo 51**", it is an X-ray diffraction image of crystallized DNA which provide key information that was essential for developing the model of DNA. But without Franklin's permission, her fellow researcher Maurice Wilkins showed the photograph to **James Watson** who along with his research partner **Francis Crick** used it to develop a model of the chemical structure of DNA and published their work in journal NATURE in 1953 with only a footnote acknowledging "having been stimulated by a general knowledge of Franklin and Wilkins's "unpublished" contribution." Wilkins published in her own work in the same issue of the journal and so did Franklin co-authored with her student Gosling.

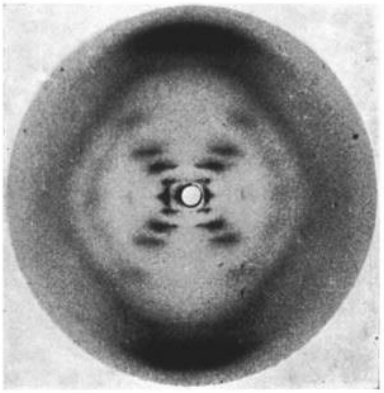


Photo 51

And a decade later, Watson shared the Nobel Prize with Crick and Wilkins for discovering the spiralling ladder structure of DNA and its role in heredity. Rosalind Franklin who produce the photograph upon which the structure of DNA was based by Watson and Crick, received no credit for her role until her death. At the time of her death, she was working on the molecular structure of Tobacco mosaic virus with her colleague **Aaron Klug**, who would go on to win Nobel Prize in 1982 for his development of crystallographic electron microscopy. She was denied of the scientific community's highest honour for her work. Just as her career was peeking, it was cut short when she died of ovarian cancer at age of 37.

FACT

Johannes Friedrich Miescher

The first person who isolate DNA from cells in 1869 but he didn't knew what its importance was. It took 75 years to realise that DNA contains humans' genetic blueprint.

By-

Abhik Bordoloi

4th Semester,

Department of chemistry

Source- https://www.nature.com/scitable/topicpage/rosalind-franklin-a-crucial-contribution-6538012

INTERNATIONAL YEAR OF PERIODIC TABLE,2019

BY-

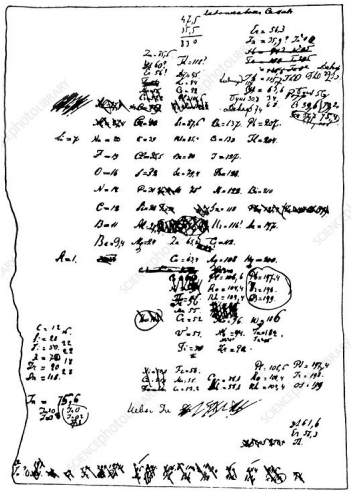
Payal Ambastha

6th Semester

Department of Chemistry

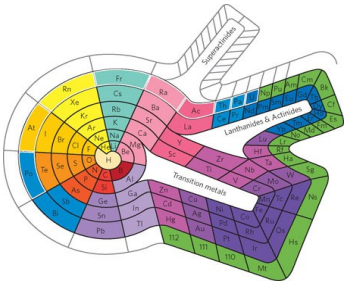
Source- www.bbc.com/news/science-environment

Dmitri Mendeleev's iconic periodic table turns 150 years old this year. 2019 has been designated as the International year of periodic table by the UNESCO organization.



Two centuries later, the world had witnessed the discovery of close to 60 chemical elements. In 1869, Dimitri Mendeleev, a Russian chemist, mapped all these 60 elements onto a table based on their weights and properties. He called it, "an attempt at a system of elements, based on their atomic weight and chemical affinity".

In 1871, Mendeleev published his periodic table with groups of similar elements arranged in columns and those columns numbered I to VIII. He also gave detailed predictions for the properties of elements he had earlier noted were missing, but should exist. These gaps were subsequently filled as chemists discovered additional naturally occurring elements. What makes this idea so remarkable was, it was **a way of organizing elements in the absence of any theory**.



Alternate Form of periodic table called **Benfey's periodic table**

The arrangements of elements in the periodic table, based on properties and atomic mass, made the life of scientists easy as they were able to save time in choosing the elements for their experiments rather than testing them individually. Significantly, there are many female scientists whose contributions gave rise to the present day periodic table. **Marie Curie** discovered Polonium and Radium in one of her PhD experiments on uranium rays. The difficult part of distinguishing almost similar elements based on their atomic weight and chemical properties was taken up by a Russian chemist **Julia Lermontova**.

Stefanie Horvitz, a Polish-Jewish chemist provided the experimental proof of Isotopes.

The first periodic table of elements was published before the discovery of protons, electrons or neutrons. After the discovery of protons, scientists realized that the atomic number of an element is the same as the number of protons in its nucleus. Thus in the modern periodic table, the elements are arranged according to their atomic numbers not their relative atomic mass.

There are now more than 100 elements, laid out in order of increasing atomic number. There are repeating patterns in the properties of the elements, which give the periodic table its name. **One can now understand certain things just by considering the place of an element in this table, or in this arrangement, that's why it's so useful to chemists**.

The modern periodic table is sometimes expanded into its **long or 32-column form** by reinstating the footnoted f-block elements into their natural position between the s- and d-blocks. Unlike the 18-column form this arrangement results in "no interruptions in the sequence of increasing atomic numbers and easy understanding of the relationship of the f-block to the other blocks of the periodic table"

In 2017 with a brand new Periodic Table, because four more elements have officially been added to the seventh row: nihonium (Nh), moscovium (Mc), tennessine (Ts), and oganesson (Og).

The invention of periodic table is regarded as one of the greatest scientific contributions of all time because of **its amazing ability to put enormous information under one single roof**.

Period \ Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Fl	115 Uup	116 Lv	117 Uus	118 Uuo

LET'S LOOK AT LIFE THE CHEMICAL WAY

BY-

Manash Jyoti Sarmah

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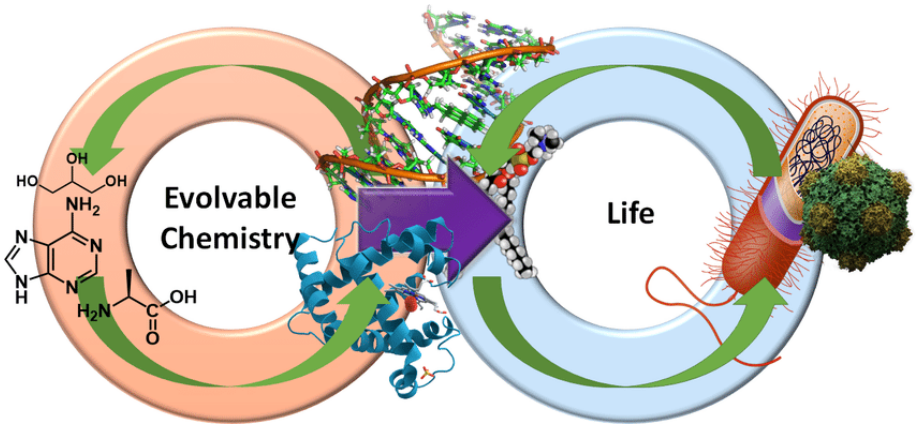
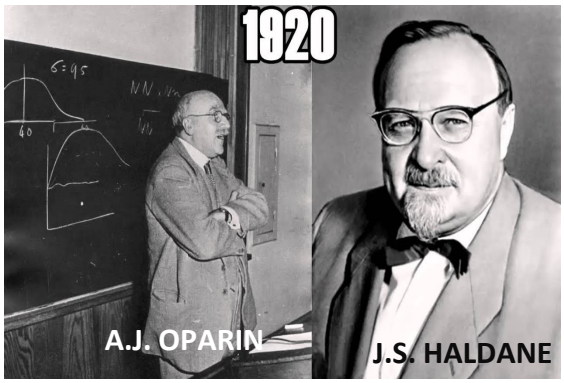
The origin of life remains one of the mankind's great unanswered questions and scientific thinking on this topic traces its history across years of controversy, although current models are perhaps no older than 150 years. Early views were wide-



ranging and often surprisingly prescient and a vast majority of these theories regarding the origin of life on Earth speculate that life began with some mixture of simple organic molecules that somehow became organized into self-replicating chemical entities. With discoveries in organic chemistry and biochemistry, **abiogenesis** (the evolution of life from inorganic substances) is studied through a combination of molecular biology, paleontology, astrobiology and biochemistry to deter-



mine how pre-life chemical reactions gave rise to life. Although the idea of **panspermia** (which postulates that life was transported from outer space to the early sterile Earth) cannot be completely discarded. Some hypothesis like the panspermia hypothesis alternatively suggests that microscopic life was distributed to the early Earth by space dust, meteoroids, asteroids and other small Solar System bodies and that life may exist throughout the Universe but doesn't explain its origin. .There is no single, generally accepted hypothesis for the origin of life.

While differing in the details, these hypotheses are based on the framework laid out by **Alexander Oparin** (in 1924) and by **J. B. S. Haldane** (in 1925), who postulated the molecular or chemical evolution theory of life. This theory suggest that first molecules constituting the earliest cells "were synthesized under natural conditions by a slow process of molecular evolution, and these molecules then organized into the first molecular system with properties with biological order. Oparin and Haldane suggested that the reducing atmosphere of the early Earth may composed primarily of methane (CH4), ammonia (NH3), water (H2O), hydrogen sulphide (H2S),carbon dioxide (CO2) or carbon monoxide (CO), and phosphate (PO43−), while molecular oxygen (O2) and ozone (O3) either rare or absent. And electrical activity of the atmosphere can produce certain small molecules (monomers) of life, such as amino acids.

In 1960, **Adenine** (a base present in DNA and RNA), was first isolated in abiogenic experiments from an aqueous solution of ammonia and HCN. In 1828, **Friedrich Wöhler** demonstrated that urea could be formed in high yield by heating ammonium cyanate "without the need of an animal kidney" representing the first synthesis of an organic compound from inorganic starting materials. In 1850 **Adolph Strecker** achieved the laboratory synthesis of alanine from a mixture of acetaldehyde, ammonia, and hydrogen cyanide. This was followed by the experiments of **Butlerov** showing that the treatment of formaldehyde with alkaline catalysts leads to the synthesis of sugars. By the end of the nineteenth century a large amount of research on organic synthesis had been performed, and led to the abiotic formation of fatty acids and sugars.

These experiments have helped significantly in finding the existence of life on earth and the historical evolution of thinking on the origin of life is intimately tied to developments of other fields, including chemistry, biology, geology, and astronomy.

"The complexity of the simplest known type of cell is so great that it is impossible to accept that such an object could have been thrown together suddenly by some kind of freakish, vastly improbable, event. Such an occurrence would be indistinguishable from a miracle."

THE PHOTO THAT OPENS A NEW ERA FOR ASTROPHYSICS

BY-

Aditi Sharma

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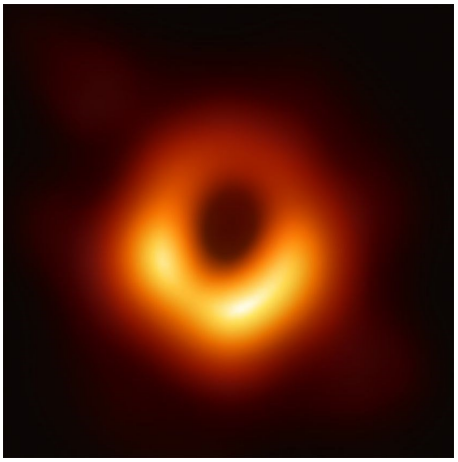
Department Of Chemistry

On 10 April 2019, a global team of astronomers led by Harvard Scientists using a global network of telescope called the **Event Horizon Telescope** captured the first ever picture of a supermassive black hole in the galaxy called M87.



A black hole is a region of space-time exhibiting strong gravitational effect so intense that particles and electromagnetic radiation like light cannot escape from inside. The general relativity proposed by Albert Einstein predicts that a sufficiently compact mass can deform space-time to form a Black hole. These are formed when a massive star collapsed under its own gravity.

The photo shows that the how a bright ring of superheated gases falling into the perfectly circular hole, which is the event horizon beyond which not even light, can escape. The ring of light is brighter than the brightness of all the stars in **Messier 87** combined, allowing astronomers here on Earth to see and capture it. The image aligns with expectations of what a black hole should look like based on Einstein's general theory of relativity and is a strong piece of evidence supporting the existence of black holes and helps verify general relativity.

Giant Elliptical Galaxy MESSIER 87

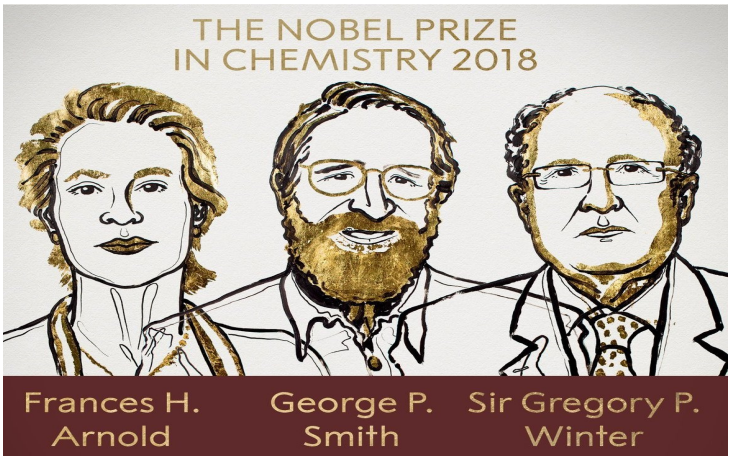
NOBEL PRIZE IN CHEMISTRY 2018

BY-

Mritul Kalita

2nd Semester

Department Of Chemistry



The Nobel prize in chemistry 2018 was awarded to **Frances H.Arnold, George P.Smith and Gregory P.Winter** for "**harnessing the power of evolution**" to develop enzymes and antibodies that have led to new biofuels and pharmaceuticals. Frances H. Arnold was awarded one half of the prize for **"the directed evolution of enzymes"** and the other half of the prize was awarded jointly to George P.Smith and Gregory P.Winter for **"the phage display of peptides and antibodies"**.

In 1993, Frances H.Arnold conducted the first directed evolution of enzymes (proteins) that catalyse chemical reactions. And she refined her methods to develop new catalysts which are used for eco-friendly manufacturing of chemical substance like drugs and production of renewable biofuels.

In 1985, George P.Smith developed an elegant method known as **Phage display** (which is the study of proteins, peptides and DNA interactions that uses bacteriophages to connect proteins with genetic information that encodes them) to develop new ways to evolve proteins. Gregory P.Winter used phage display for directed evolution of antibodies with aim of producing new pharmaceutical. The first one based on this method, **Adalimumab**, was approved in 2002 and used for rheumatoid, psoriasis and inflammatory bowel disease. Since then ,phage display have produced antibodies that can neutralize toxins, counteract autoimmune diseases and cure metastatic cancer

Source– www.nobelprize.org/prizes/chemistry/2018/prize-announcement/l

THE CHEMISTRY OF BRAIN

BY-

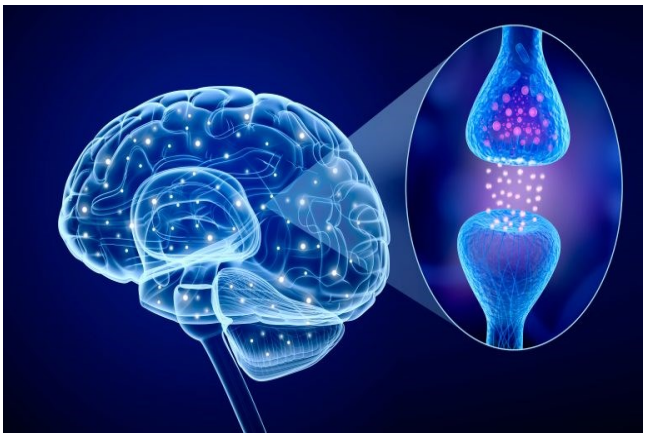
Jyotshna Hujuri

2nd Semester

Department Of Chemistry

Sources-https://technologyadvice.com/blog/information-technology/activate-chemicals-gamify-happiness-nicole-lazzaro/

The brain is the most complex organ in a vertebrate's body. The brain communicates with itself by transmitting chemicals from one neuron, or nerve, to the other and this regular, rapid-fire messaging plays a big role in how you feel and function each day. The brain consists of billions of neurons and each neuron is connected by **synapses** (a junction between two nerve cells, consisting of a minute gap across which impulses pass by diffusion of a neurotransmitter) to several thousand other neurons. These neurons use chemicals to communicate with each other.



Through extensive research in these topics, it is known that all the feelings and emotions that people experience are produced through chemical changes in the brain. Emotions, such as happiness, sadness, grief, and stress occurred due to some complex reactions of these chemicals in our brain. These "**chemical communicators**", or "**neurotransmitters**", are the "words" that make up the language of the brain and the entire nervous system. These neurotransmitter chemicals are classified into two basic categories: **Excitatory**, meaning they stimulate brain activity, and **Inhibitory**, meaning they have a more calming effect. These neurotransmitters released (when one neuron gets activated) are accepted on **receptors** (special receiving sites) on the surface of other nearby neurons thus transferring the information but they follow a kind of **"lock and key"** system, that is, certain keys work only in certain locks. In a split second, any one neuron may be receiving many chemical messages, both positive and negative (stop and go), from the other neurons surrounding it and these neurotransmitters may be "competing" to get the neuron to respond in different ways, or they may work together to produce a certain effect.

Few of the main neurotransmitters are:

Dopamine: Mostly associated with the ability to experience pleasure and pain. They also affect processes that control movement and emotional response. Recent research have found that it act as a 'motivation' stimulator, as it increases the person's motivation to repeat an action even when not associated with a pleasurable feeling.

Glutamate: Known as the brain's 'on switch' or "excitatory neurotransmitter". It is responsible for sending signal between two neurons and also plays an important role in learning and memory.

GABA (gamma-aminobutyric acid): Its only purpose is to slow things down, dampen and inhibit nervous activity.

Serotonin: This simple molecule affects person's overall state of mind, how they feel about themselves and the external world at a point in time.

Endorphins: It is responsible for masking pain or discomfort, which explains their association with the "fight or flight" response.

These neurotransmitters in our brain can easily gets imbalanced which will in turn affect our whole body. These Imbalances in neurotransmitters are present in many conditions, including schizophrenia, depression, bipolar disorder, autism, and Parkinson's disease and its causes can sometimes be out of our hands such as genetic inheritance. Thus, maintaining a balance in these brain chemicals and hormones, is a key to feeling a balanced mood and it can be maintained to some extent through a balanced diet, limited stress, and exercise.

FACT

Austrian scientist named **Otto Loewi** discovered the first neurotransmitter in 1921 about which he had a dream. He used two frog hearts dipped in saline solution and discovered that when he slows down one heart, the other heart also slow down after some time. He called this chemical **"Vagusstoff"** which we know now as **"Acetylcholine"**.

DISCOVERIES THAT CHANGED THE WORLD

Everything that help make our life better today is due to the discoveries and inventions of the scientists. These discoveries changed the early world and gave us the world we know today.

According to me, these are the two discoveries that shaped the modern world:

Historical first pressure steel reactor used for ammonia production by Haber in 1921

BY-

PRITAM BORO

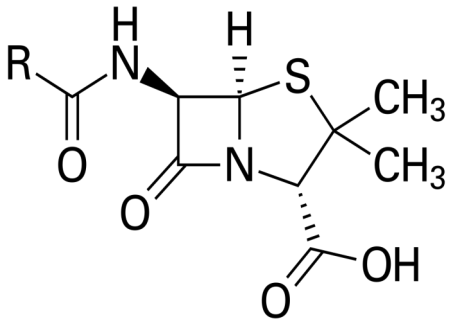
2ND SEMESTER

DEPARTMENT OF CHEMISTRY

SOURCE- https://www.acs.org/content/acs/en/education/whatischemistry/landmarks/flemingpenicillin.html

PENICILLIN,THE WONDER DRUG

The introduction of penicillin in 1940s,which began the era of antibiotic, is considered as the one of the greatest advancement in therapeutic medicine. Before it introduction, trivial injuries like a simple cut getting infected could result in death due to blood poisoning. In 1928, **Alexander Fleming** discovered Penicillin but in spite his best effort he was unable to extract a stable form of penicillin.



PENICILLIN

It was **Howard Florey, Ernst Chain and their colleagues** at Oxford university who turned penicillin from a laboratory curiosity into a life saving drug. Due to World War II,the production of penicillin was severely affected but later full scale production of penicillin took off by 1944 due to contribution of Chemical engineer **Margaret Hutchinson Rousseau** (first female member of American institute of Chemical engineering).

Penicillin is widely used as natural broad-spectrum antibiotic. It is used against pneumonia, influenza, sepsis, gonorrhoea, meningitis and other serious infection.

FRITZ HABER

HABER-BOSCH PROCESS

Nitrogen plays a very important role in many industries as well as agriculture. And throughout 19th century, the demand for nitrogenous compound like nitrates and ammonia is met by mining **niter** (mineral form of KNO3) deposits. But by 20th century, these reserves couldn't satisfy future demands. In spite of air having about 70 percent of nitrogen gas, it couldn't be used by human as it is extremely stable and doesn't react.

In 1909-1910,**Fritz Haber** and **Carl Bosch** changed all this when they combined atmospheric nitrogen and oxygen into liquid ammonia which can be converted into nitrates as source of fertilizers and munitions. Haber and Bosch were awarded Nobel prizes in 1918 and 1931 respectively for their work.

Their discoveries were the single most important reason for **population explosion** from 1.6 billion in 1900 to 7.71 billion today. It is found that today about 80 percent of nitrogen in our body comes from the Haber-Bosch process.

THE FUEL OF FUTURE

BY-

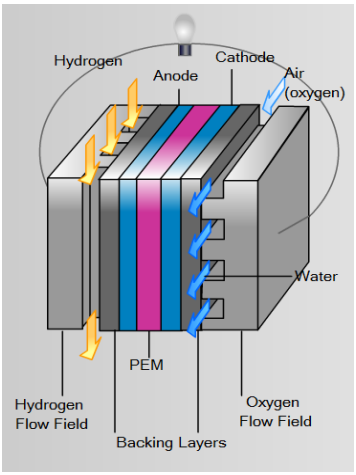
Bittu Kumar Yadav

4th Semester

Department of Chemistrty

Source- https://cosmosmagazine.com/technology/hydrogen-fuel-is-back-in-the-picture

With the ever needing use of fuel by human for developments and day-to-day life has resulted in the depletion of the naturally occurring fossil fuel reserves. These reserves have been extensively exploited to meet the fuel requirement of this generation, thus creating concerns for the availability of fossil fuel in future. As the race to find energy sources to replace our dwindling fossil fuel supplies continues apace, hydrogen is likely to play a crucial role in the future. Scientists have argued that sustainable, carbon-free methods of large-scale hydrogen production are the best way to prepare for our looming fossil-fuel free future.



The most abundant source of Hydrogen on Earth is the water Bodies. Thus breaking of the water molecules to produce Hydrogen and Oxygen by electricity seems like a far better idea as no environmentally harmful product is obtained. But simple electrolysis of water requires huge amount of electricity to produce useful amount of hydrogen, thus cannot be used commercially to produce hydrogen. Extensive research in this area result in formation of **fuel cells**, these are devices that convert **chemical potential energy** (energy stored in molecular bonds) **into electrical energy**. The products of the reaction in the cell are water, electricity, and heat. This is a big improvement over internal combustion engines, coal burning power plants, and nuclear power plants, all of which produce harmful by-products. Hydrogen Fuel cell consists of a **PEM (Proton Exchange Membrane)** cell which uses hydrogen gas (H2) and oxygen gas (O2) as fuel. In hydrogen fuel cell, hydrogen is passed though the anode and oxygen from air is passed through the cathode. At the anode, hydrogen molecule splits into protons and electrons and the proton passed through the PEM while the electron is forced through a circuit generating current and excess heat. At the cathode, the protons, electrons and oxygen combine to produce water molecules. These cells are very clean with their **only by-product being electricity and water.**

The first references to hydrogen fuel cells appeared in 1838, when Physicist **William Grove** wrote about the development of his first crude fuel cells. Subsequent developments in 20th century by several scientists, lead to the first commercial use of the fuel cells during **Project Gemini** (NASA's Second human spaceflight program). By 1991, the first hydrogen fuel cell automobile was developed. And with further development, the dream of a fossil fuel free world is coming closer. With new storage technologies, problems with hydrogen storage and transportation have become minimal. Japan has already made that commitment and intends to use the 2020 Tokyo Olympics to showcase the technology with thousands of hydrogen fuel cell vehicles, a network of filling stations and a hydrogen-powered athlete's village.

Achievements By Our Students

- **Pritam Debnath**, student having Chemistry Major (4th Semester) received 1st Prize in **Oral Presentation of SCIENCE CONCLAVE 2018**, organized by Royal School of Applied and Pure Science, in association with ASTEC, IASST and Royal Global University, held from 15-16 November 2018.
- **Manash Jyoti Sarmah** and **Payal Ambastha** cleared **JAM-2018** and **JAM-2019** respectively.
- **Subham Mallick** student of 2nd Semester, a member of **NORTH EASTERN CHRONICLES**, reached semi-final in the **INDIA'S GOT TALENT-2018**.
- **Abhik Bordoloi** was selected in **NIUS** (**National Initiative on Undergraduate Science**) 2017 batch and he has been working in a research project since 2017.

DUHITA

A column dedicated to women achievers in the field of science and technology

Asima Chatterjee

India's first woman Doctorate of Science.

Asima Chatterjee born on 23rd September 1917 was the first women to get Doctorate in science in British India.

Education

She completed her graduation with honor's in chemistry from Scottish church College of the University of Calcutta. After graduation she received her master's degree in organic chemistry from University of Calcutta in 1938 and doctoral degree in 1944

Academic Work And Career

Chatterjee's research concentrated in natural chemistry and developed anti- culvusive, anti-malarial and chemotherapy drugs. Her most successful and a epileptic drug was **Ayush-56**.She researched alkaloids for more than 40 years which is used in chemotherapy to prevent multiplication of cancer cells. She also chemically analyzed Cumarins from bael tree and brought to light it's medicinal properties. Later she became the founding head of Department of chemistry at Lady Brabourne College of the University of Calcutta.

Achievements and Awards

1962-Prem chand Roychand scholar of the University of Calcutta

1961- Shanti Swarup Bhatnagar prize

1975-Padma Bhushan and became the first female scientist to be elected as the General President of the Indian Science Congress Association.

FACT

Edavaleth Kakkat Janaki Ammal , the First Indian woman botanist.

BY-

Borosha Bharali

4th Semester

Department of Chemistry

EDITOR'S MESSAGE

"DHATU" takes immense pleasure in publishing the Volume III, Issue I of our Departmental Newsletter " BOSON". The main aim of this newsletter is to give an opportunity to the students to report some trending news and interesting discoveries in the field of science .We wish that someday this newsletter gets developed into a scientific journal with your support.

Published on 14 June 2019

Regards,

Abhik Bordoloi