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Our staff will contact the Guest Editors in order to arrange future actions concerning manuscripts.
Bulletin of Micro and Nanoelectrotechnologies includes the specific research studies on:

- Microelectromechanical and nanoelectromechanical components;
- The typical micro and nanostructure of actuators, micromotors and sensors;
- The harvesting microsystems;
- The conventional and unconventional technologies on MEMS and NEMS;
- The theoretical and experimental studies on electric, magnetic or electromagnetic field with applications on micro and nano actuating and sensing effects;
- The design algorithms or procedures of MEMS and NEMS components;
- The applications of MEMS and NEMS in biology and in biomedical field;
- The new materials in MEMS and NEMS;
- The standardization and reliability preoccupations;
- The economic and financial analysis and evolutions of MEMS and NEMS specific markets.
Welcome to the BULLETIN of MICRO and NANOELECTROTECHNOLOGIES (BMNE)!

The 1-2/2018 number is dedicated to the IVth Research Communication Session of the Young Olympics of “Alexandru Proca” Center (September 2017). To this workshop, 11 papers were presented, and 12 members of the “Alexandru Proca” Center were included.

This number of BMNE represents the research scientific preoccupations of a new series of the members of Excellency Centre.

I selected a representative list of papers:

- **Microsensors monitoring devices regarding the rehabilitation process carried out after orthopedic surgeries of the lower limb** - Ana Maria Tudorache (age 17), Miruna Djoga (age 17) from International Theoretical High School of Informatics Bucharest;

- **Comprehensive introduction into the British medical history from ancient times to nineteenth century** - Andra Maria Ciutac (age 18), National Bilingual College “George Coşbuc” Bucharest;

- **Theoretical studies and experiments to the microsurgical aspects** - Carmen Popa (age 18), Andra Ciutac (age 18), National Bilingual College “George Coşbuc” Bucharest.

- **Microvibrorobots** - Cristian Alexandru Chira, Tehnological Metrology High School of Bucharest;

- **Biocombustion cells** - Robu Elena (age 17), National College of Informatics “Tudor Vianu” Bucharest;

- **Lipid studies with applications in MEMS and in the medicine transport** - Ulian Serghei (age 16) from International Theoretical High School of Informatics Bucharest and Andrei Ionescu (age 16), National College “Mihai Viteazul” Ploiesti;

- **Problem formula on the ciliary dynamic structure and the microelectromechanical unconventional system of liquid propulsion** - Constantin Alexandru (age 15), National College of Informatics “Tudor Vianu” Bucharest.

Also we present different images of the research competitions: INTEL-ISEF 2018 (Pittsburg - SUA).

Editor in Chief,
Mircea Ignat
“Alexandru Proca” Excellency Centre for the Youngsters Initiation in Scientific Research (CICST) – The participation to the INTEL-ISEF 2018 Olympiad of research projects

The open ceremony of ISEF 2018
The members of Romania research team on a time relaxation

The teams of “Alexandru Proca” Centre by the competition period

Elena Robu (age 18) and the stand of biocombustion cells research project
Andrei Ionescu and Ciprian Anghel on the competition period

Serghei Ulian and Andrei Ionescu finish the research project poster
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Lipidic Structures in Microelectromechanics and their Use as Medicine Transportation
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The first chapter *(The Blue Zone of the Planet Earth)* is an excellent introduction for the other chapters which are focused on the stored and sequestered carbon in coastal life forms, in the larger context of the ever increasing emission of carbon dioxide in the atmosphere.

The second chapter *(Biodiversity of the Blue Zone)* clearly presents the biodiversity of producer community and consumer community as well as decomposer community, with special emphasis on role of marine micro-organisms in the carbon cycle. A special chapter is devoted to blue carbon assessment with focus on remote sensing technology, including satellite/sensor as well as on chemical methods. The following chapter deals with the occurrence of carbon in different living beings. Chapter 4 focuses on blue carbon in floral community (mangroves, sea-grass and salt marsh grass as well seaweeds), whereas chapter 5 is focused on phytoplankton carbon stock with emphasis on a very interesting first question: „Artificial Enhancement of Phytoplankton: Bioremediation or Biodeterioration ?”. Chapter 6 *(Blue Carbon in Faunal Community)* focuses on bivalves and coral reefs with emphasis on a second very interesting question: coral reefs: a source or sink of carbon? One of the most exciting chapters is that on threats to blue carbon reservoir: natural and anthropogenic threats, several case studies being presented. The last chapter (but not the least !) „Road Map to Expand Blue Carbon Reservoir” discusses about both the conservation and policy approaches, two cases being presented (Gujarat and Indian Sundarbans). Each chapter has a reach bibliography and good and useful illustrations, the majority of illustrations (360) being in color.

*Ioan I. Ardelean*
The book *Electronic Waste-Recycling Techniques* belonging to the Series Topics in Mining, Metallurgy and Materials Engineering contains only 11 chapters, but it is very useful for academics, engineers, managers as well as dedicated students. As a whole the book presents the nature of electronic wastes and different ways to process and recycle these wastes (mainly metals, polymers and ceramics). After an inspired Foreword wrote by Professor Tomas Havlik (Slovak Republic) and a generous Introduction (chapter 1) wrote by the editors, the next chapter focuses on general aspects concerning the generation and management of electronic waste. The next chapter offers an introduction to all type of processes which are detailed each one in further dedicated chapters: Mechanical Processing; Leaching Processes; Hydrometallurgical Processing; Electrometallurgical Processing and Pyrometallurgical Processing. A separate chapter is dedicated to recycling of different types of batteries, so widespread wastes nowadays. It has to be noted the attention done on the role of microorganisms in the recycling of electronic waste (subchapters 3.3 Biotechnology; 5.3 Bioleaching and 9.2.3 Biohydrometallurgical processing), taking into account their advantages and disadvantages, as compared with (pure) physical and chemical processes. The style is clear, the bibliography rich and the illustrations rather generous (21b/w and 3 in color).

*Ioan I. Ardelean*
The book, *Frontiers in Wastewater Treatment and Modeling*, contains contributions presented at Frontiers International Conference on Wastewater Treatment which was held at the University of Palermo, Italy, 2017. The book belongs to Series Lecture Notes in Civil Engineering. This is a truly very comprehensive book containing 115 chapters! each chapter being reviewed by at least three members of the prestigious and large scientific committee of this meeting. The contributions to this book cover a lot of very interesting topics such as carbon, nitrogen (including anammox) and phosphorus removal/recovery, biomass acclimation and adapted inocula, respirometry, gene expression and other molecular analysis, the use of ultrasonic treatment and respirometry to improve waste treatment, different types of membrane bioreactors are also copiously presented, the comparison between activated sludge and granular sludge systems, recirculating systems focused on aquaria and on sustainable aquaculture. Many chapters deal with modeling of different processes performed in different type reactors and on the decrease/control/monitoring of greenhouse gases emission. The use of biofuel cells in the context of waste treatment and the use of microalgae are also illustrated in this comprehensive book together with the (hybrid) constructed wetland system. The book also contains contributions on microbial biofilms including those formed on mobile carriers, on antifouling strategies as well as on the treatment of particular wastes such as shipboard slop, ammonium-rich effluents produced by double-stage anaerobic digestion of food waste, urban wastewater with variable salinity, retrofitted wastewater treatment plant, industrial wastewater. The chapters are very well illustrated (355 b/w illustrations), written in a clear manner by true professionals in their fields, providing a rich bibliography. For sure, this book should be available to everyone involved in wastewater treatment!

*Ioan I. Ardelean*
This book belongs to the series _Grand Challenges in Biology and Biotechnology_ and contains 25 chapters. The book benefits from an useful Foreword wrote by Garabed Antranikian. After an introductory chapter on “Growth and metabolism of extremophilic microorganisms” the book focuses on specific extremophile microorganisms, on proteins and enzymes form extremophile microorganisms and on informatics approaches on this topic. When it comes to microorganisms, there are three chapters on Acidophilles (Ecophysiology and application of acidophilic sulfur-reducing microorganisms; The biofilm lifestyle of acidophilic metal/sulfur-oxidizing microorganisms; Acidophilic microbes: biology and applications), two chapters on cryophilles (Antimicrobial potential of cold-adapted bacteria and fungi from polar regions; Biodiversity, adaptation and biotechnological importance of bacteria occurring in cold climates) and on Thermophiles (Thermophiles as a promising source of exopolysaccharides with interesting properties; Technical developments for vegetable waste biomass degradation by thermophiles) and one chapter on alkaliphilic (Alkaliphilic microorganisms in biotechnology) and halophiles (Recent advances in the nitrogen metabolism in haloarchaea and its biotechnological applications). Special chapters are devoted to novel proteins from extremophiles, functional screening for the discovery of new extremophilic enzymes, lipolytic enzymes from psychro- and (hyper-)thermophile prokaryotes as well as from halophile Bacteria and Archaea, extremophile proteases, cold-active β-galactosidases and α-amylases from Archaea, proteins of DNA replication from extreme thermophiles, engineering of extremophilic phosphotriesterase-like lactonases and immobilization strategies for extremophile biocatalysis in biotechnology. There are also several chapters on the use of informatics (A systems biology view on bacterial response to temperature shift; Molecular dynamics simulations to study structure-function relationship in psychrophilic enzymes; A strategy for designing thermostable enzymes by reconstructing ancestral sequences possessed by ancient life). A special chapter is focused on a rather new topic for extremophiles “Experimental Microbial Evolution of Extremophiles”. The chapters are written very clear, with rather rich illustrations (56 b/w illustrations and 49 illustrations in colour) and very rich bibliography. In my opinion this book is essential for academics, biotechnologists, engineers, managers and students working/interested in this very promising field.
Comprehensive Introduction into the British Medical History from Ancient Times to the Nineteenth Century

Andra-Maria Ciutac
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“Alexandru Proca” Center for the Youngsters Initiation in Scientific Research in INCDIE ICPE-CA Bucharest

I. Introduction

The United Kingdom of Great Britain and Northern Ireland represented perhaps the most influential power in the development of Medicine and continues to be a leading force in this rather vast domain. Ever since the Middle Ages the U.K. is the place of breaking through discoveries and of setting ground concepts, defining as a whole the idea behind Medicine.

II. The Ancient Medicine

The Ancient times did not belong to the U.K.’s sphere of domination, Egypt, following Greece and the Roman Empire, being the precursors of today's modern medicine. Briefly described, some of their inventions, discoveries and ideologies are: in Egypt Medicine was viewed as the union of magic spells and psychotherapy, yet the Greeks were the first to analyse Medicine from a scientific approach- they summarised that an illness is always related to an imbalance within the body, concerning the four defining humours/elements:

Blood- Air, Phlegm- Water, Yellow bile- Fire, Black bile- Earth; without doubt one of the most famous doctors that lived during that period was Hippocrates (Fig. 1). In over 70 volumes, he approached subjects such as: the role of environment in health, prognoses, epilepsy, but to my view of a superior importance are the Ethics in Medicine introduced, that remain valid to this day. In the Roman Empire was contoured for the first time a career in Medicine for women. On one side there were the Midwives (obstetrices), caring for pregnant women, their unborn child and afterwards even the babies, while on the other side there existed the women doctors (medicae) concentrating mainly on gender related sicknesses.

III. The Middle Ages

Medieval times illustrated a black period in the history of Great Britain, with more than two thirds of the population of London and in total approx. two million people (equivalent to half of the population
of Britain) dying between 1348 and 1350 of plague. The Black Death entered the British territory in Weymouth, England and vastly spread. Then the germ theory was not known, thus the explanation of the pandemic was one of religious connotations: God wants to punish humans for their superficiality and sinfulness. Although, after some time has passed, affecting the entire Europe, physicians concluded, rightfully that the Black Death follows the principle of contagion. Even if doctors did not find a cure for this disease (only appeared after 700 years, in the 20th century), as if magic existed, the plague gradually stopped. While Church represented a massive source of manipulation and offered unjustified motives to what disease in general implied, it was also the only place the poor had a chance to be treated. During those times hiring a private physician was a luxury only afforded by few people of the upper class. However, clerics build over 500 hospitals in Great Britain by the end of 15th century, monks possessing elementary surgical and medical techniques and knowledge. Minor surgeries could yet be performed by barbers, them representing more a danger than a method of healing. Besides the sumer picture portrayed, inspirational doctors arose, one that I will be mentioning being Jack Arderne. He is known for "The Art of Medicine", one of his books, as well as curing multiple diseases and approving to anaesthetic (produced out of hemlocks or opium). His ethical view on Medicine resembles a strong socialist trend, considering that he should tax as much the rich, but operate free of charge for the poorer.

IV. The Renaissance and the Enlightenment

Facilitated by the British Industrial Revolution in 1688, this period is perhaps the most cherished and abundant in Medical discoveries of the U.K. Henry VIII founded the first organized form of practicing Medicine in England in 1518 out of six physicians initially, entitled: "Royal College of Physicians". This society brought certain standards in the practise of Medicine and if not respected, licensed doctors could risk imprisonment or even death. Concomitantly with the foundation on the first medical society of Great Britain, another philosophical and scientific movement appeared suggestively entitled empiricism. A condensed meaning of this trend is represented by the emphasises on sensory experience, more exactly experiments in the development of science. The father of this movement and a very important figure of that time is philosopher, scientist, jurist, orator and author Francis Bacon. Although, he has written over 50 works (divided in three categories: scientific, religious and juridic), he remains in history for "Novul Orgononum Scientiarium" ("The New Organon"). This Latin written work was published in 1620 and challenges Aristotel's syllogistic reasoning. The author proposes in exchange inductive reasoning, a premise that remains valid to this day. As a result of the new methodology, William Harvey (Fig. 2) managed to understand and describe the complexity of the circulatory system in 1603.

Further, he published "Exercitatio Anatomica de Motu Cordis et Sanguinis - Anatomical Treatise on the Movement of the Heart and Blood" (Fig. 3).
Following Harvey's anatomical discoveries, over the century many attempted to transfuse blood between species. One lucky experiment has proven to be the one of Richard Lower in 1667, when he transfused twice blood from a sheep to a divinity student named Arthur Coga. In 1661 Anglo-Irish "skeptical chemist" Robert Boyle has confronted once again an Aristotelian hypothesis, according to which the body balance is defined by four elements (explained briefly in The Ancient Medicine section above) and structured as an alternative an experimental theory of the elements, consequently transforming alchemy into a branch of scientific chemistry. During the same period, Thomas Willis published "Cerebri Anatome", thus presenting in detail the anatomy and irrigation of the brain. The English physician named ("The Circle of Willis") and was credited for the discovery of the vessels that supply blood to the cortex and surrounding areas. As an appraisal for William's Cowper work, another anatomist of that era, the bulbourethral glands- part of the men's reproductive- were also named after him. However, while Medicine evolved as a science, doctors were treating patients less emphatic, less humanly. This problem was first noticed by Thomas Sydenham (1624-1689), vividly referred as "The English Hippocrates". He reformed the Medical Ethics with the textbook called "Observationes Medicæ". Even if medical dynasties existed since the ancient times in the Roman Empire, the first of such kind on the British territory occurred at University of Edinburgh, where three generations of the Monro family (Fig. 4) succeeded to the Anatomy Chair in a little over 129 years. Under their strict directive, doctors such as William Shiper and John Morgan were educated. The two immigrated then to Northern America and founded University of Pennsylvania, currently one of the most prestigious worldwide. For the first time, surgeons had the same social status as physicians. From the most famous. I would like to mention Claudius Amyand, William Cheseldon and the Hunter brothers. Claudius Amyand, surgeon to George II, performed the first registered appendectomy in 1736. William Cheseldon was known for being able to succeed the lithotomy operation (Bladder stone removal) in only 45 seconds. The speed of the surgery was vital in the eighteenth century, as anaesthetics were not available. Also regarding two Edinburgh University educated doctors during Monro dynasty, the Hunter brothers solidified the speciality of obstetrics, developing several medical instruments, while also defining the necessity of investigation in pathology. A negative aspect of that rather blossoming period is the fact that many unqualified practitioners could easily be integrated in the system, thus harming the patients. A representative example of such "worm doctors" is ex-footman Joshua Spot Ward. He allegedly treated King George II for his dislocated thumb with a violent wrench, pill. Luckily the King's health improves and the charlatan was consistently rewarded. Ironically, when the Apothecaries Act was enhanced in 1748, Ward's pills were especially prohibited.
V. The nineteenth century

In the previous centuries doctors focused mainly on developing Medicine by understanding comprehensively the human body. However, this century represented a stepping stone into a rise in patient satisfaction by diminishing pain, as a result of analgesics and anaesthetics. There was a time when patients would rather die, than go through an entire surgery (that could last hours) conscientiously. This worry stopped as the pharmaceutical industry progressed, as it developed more alternatives to numb the pain. Approaching the 19th century, in 1799, laughing gas (nitrous oxide) was introduced by Humphrey Davy. As a result, on both sides of the Atlantic, laughing gas parties were being held. Yet, it took more than two decades for it actually to be treated as a medical application, rather than just a fun activity. In 1824, Henry Hickman a small town English doctor realised the potential of such a substance. The English and French doctors labeled him a crank and ignored his research on the topic. It was not until another twenty-five years later that the gas was universally accepted. This was made possible because of Horace Wells and William Thomas Morton, two American dentists. The last mentioned developed as well an inhaler that facilitated the circulation of the gas through the airways. Other such anaesthetics were discovered such as ether and chloroform. People were still skeptical about these inventions, while church played also a decisive role, delaying the approval of this medicine for a great mass of people. Queen Victoria accepted to be administered chloroform for her childbirth in 1857, thus influencing positively the perception of anaesthetics along the population.

A substance that was used in large quantities for pain relief in ancient times and continued to be popular ever since is opium (Fig. 6).

![Opium undamaged plant](Fig. 6. Opium undamaged plant)

However, the nineteenth century brought the understanding of what chemical compounds produce the dream-like state. These compounds were named narcotics (after Narcos, the God of Sleep) and from them two were separated as individual substances: morphine and codeine. Medical instruments have also seen an abrupt development during this hundred years. For example, English surgeon John Hutchinson assembled a spirometer- measuring the vital capacity of the lungs. The hypodermic syringe was introduced by Alexander Wood of the Edinburgh medical school. Although, the invention of the thermometer dates as early as sixteenth century, Italian Galileo Galilei being the inventor, a more refined version belongs to Sir Thomas Clifford Allbutt of Northern England. Only 15.25 cm in length, the instrument produced accurate, yet fast results. The first entirely anti-septic surgery was performed by Englishman Joseph Lister in March 1865. Yet, another antisepctic breakthrough occurred at Glasgow Royal Infirmary, where 11-year old James Greenlees was brought, after he was ran over by a cart. The event took place in the summer of 1865 and the boy's leg was saved by a bandage with carbolic acid and tin foil. Afterwards, carbolic spray was commercialised for the every hospital in
Great Britain. This era in U.K. did not lack a serious epidemic, this time the disease killing hundreds of thousands of people being cholera. It came initially through India and then through Azerbaijan. The illness was investigated by British doctor John Snow. He realised the connection between the disease and contributing factors such as transmission through contaminated water. During his lifetime, he was not credited for his work, but years after, when the Germ Theory by Louis Pasteur (Fig. 7) was released, his hypothesis was eventually approved. Charles Darwin preferred in his youth years to travel around the world, understanding the similarities, but also the differences in between species, all to his father's disappointment. Following his return to England, after his prolonged voyages and research, he started stating the conclusions he has gathered in "On the Origins of the Species". Summarised, the book describes how species change or evolve, according to the principle of natural selection.

In the nineteenth century childbed fever was common due to the lack of hygiene. Poverty and giving birth at home accentuated the risk even further. The first to understand the pathology and to deny the myth of “The curse of Eve” was Hungarian doctor Ignaz Semmelweis (Fig. 8). Throughout the continent, it was believed that childbed fever was caused by miasma - an infectious vapour. In Vienna Lying Hospital there were two obstetric wards: no.1 - more than 10% of mothers died, while no.2 - 3.9% of others dies. The first ward was managed by medical students and the second by careful and clean midwives. Semmelweis supposed that there exists a connection between the clean environment and less deaths, but did not form a theory until one of his friends, also a doctor dies shortly being in contact with blood of a sick person, then developing the same symptoms. He called the substances harming people “putrid particles”. After testing different chemical compounds aiming to kill this particles, he soon discovered lime chloride. He implemented a procedure in the first ward, where this disinfectant was used. Soon after the mortality rate dropped to 1.27%. Although his merits were only recognised on an international level 30 years after at meeting of the Academy of Medicine in Paris.

Soon after the discovery of Pasteur, Koch was the first to link micro-organisms with a disease. He created in his home laboratory “pure cultures”, under the principles formulated by his former teacher biologist Jakob Henle and then observed the evolution. Thus, he discovered the bacillus that causes tuberculosis and accidentally even discovered anthrax.

As in each period, another epidemic of great proportions took place worldwide. This time it was caused by a virus in different animals’ saliva, such as squirrels or rats. Initially people affected would show signs of painful headaches and vomiting. In the end, people would get exhausted, enter coma and eventually die. This disease is regarded as Rabies. A severe outbreak took place between 1806 and 1935 in France in the region Pasteur was born. Afterwards, because his community was affected by this pathology he investigated upon it in 1880. Although, he stated that the progression of Rabies is fast and damages the nervous system, he failed to indicate the exact microorganism. Yet, he discovered a method of safely vaccinating the population.
Joseph Listen (Fig. 9) was the first to perform an antiseptic surgery in 1860. He even used carbolic acid and tin foil post operative, fact that reduced the mortality rates up to 5%. He became then famous for his carbolic spray able to “destroy germs in the air”, despite the Queens disapproval.

![Fig. 9. Joseph Listen](image)

VI. Conclusions

I hope you enjoyed the short time travel through the medical history starting from Antiquity until the nineteenth century, the foundation of modern Medicine. While in Ancient times Medicine was viewed more mystique, making use of gods and healers, the last discussed era finds its fundamentals in science, even if sometimes is rudimental.

Another fascinating subject and theme analysed is the one of false reflection: when the entire society bases itself on a wrong perception, but universally accepted principle. It was proven that this misperceptions had a tremendously negative impact, holding back Medicine for over two centuries. This problem of reason was first observed by philosopher and scientist Francis Bacon (Fig. 10), founder of empiricism.

![Fig. 10. Francis Bacon, founder of empiricism](image)

VII. References

1. A History of Medicine, 1992, GlobalHelp, Dr. Jenny Sutcliffe, Nancy Duin;
2. Papers of Bertram Coghill Alan Windle (1858-1929), Professor of Anatomy at Josiah Mason College and then University of Birmingham;
3. Papers of Richard Hill Norris (1830-1916), Professor of Physiology, Queen's College, Birmingham;

VIII. Biography

Andra-Maria Ciutac is a former student of the National Bilingual College "George Cosbuc" Bucharest and member of “Alexandru Proca” Center for the Youngsters Initiation in Scientific Research in INCDIE ICPE-CA Bucharest. Currently, she continues her studies at The University of Manchester, UK.
Biocombustion Cells with Photosynthesizing Microorganisms

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Abstract - The paper presents a study on the utilization of Combustion Cells with a biological component represented by photosynthesizing microorganisms as a harvesting source and other possible uses.

Index Terms - combustion cells, harvesting, photosynthesizing microorganisms.

I. INTRODUCTION

In our world, energy is one of the most coveted resources on which our daily lives depend. A statistic shows that in June 2017, we had used around 375,000,000 MW, of which 304,000,000 MW were obtained from non-regenerable resources [1], accounting to 81% of the total usage.

Biocombustion cells as a harvesting source could prove a solution to apparatus which require a small quantity of current. They could also prove to be a valuable tool in teaching sciences in an interdisciplinary way. The aim of this paper is to optimize and study the properties of Biocombustion cells that use photosynthesizing microorganisms as a “fuel”.

II. MATERIALS AND METHODS

A. Biological aspects

The species utilized in the experiments were Chlorella sorokiniana spec. nov., eukaryote microalgae, and Synechocystis PCC 6803, a cyanobacteria. They were all incubated in BG11 medium, at a constant temperature of 25°C, 220 rpm agitations and constant 2000 lux illumination. All the experiments were performed in standard conditions of temperature and pressure.

To select possible colonies that might be effective in the future combustion cells we checked their dehydrogenase activity. The principle of the experiment is that we will put into contact with an artificial electron acceptor, in this case resazurin, with live microorganism colonies, that are actively metabolic. As the resazurin is reduced it will change its colour from dark blue, in the oxidised form, to pink, in the reduced form.

It is expected that the colonies which reduce the resazurin faster will also function in the combustion cell.

Fig. 1. Photograph of a microscopic slide from the Chlorella sorokiniana used in the experiments, coloured with Victoria blau 0.1% solution

For this experiment we used colonies of Chlorella sorokiniana, which were obtained through decimal delutions and had been incubated for three weeks. We added 1 mL on the Petri dish, where we had the colony and spread it evenly over the surface, then resealed the dish and incubated it at light waiting for the colony to reduce the artificial electron acceptor.

Fig. 2. Colony with resazurin after 5 minutes
B. The biocombustion cell

Biocombustion cells are modelled after the model of a combustion cell, the difference being the utilization of a biological component, in the case of this paper photosynthesizing microorganisms. In the anodic compartment, we have an oxidation reaction, following which the electrons are given to the anode, while in the cathodic compartment; the electrons are used in the reduction reaction. Between the two compartments there has to be either a semipermeable membrane (as in Prototype I) or a salt bridge (Prototype III), through which protons will migrate from the anodic compartment to the cathodic compartment.

In the anodic compartment we introduced the photosynthesizing microorganisms which will donate electrons to an artificial acceptor, represented by 2, 6 – dichlorophenolindophenol, which is initially blue, in the oxidised state, but will become colourless as it is reduced. We also added a redox mediator, 2, 6 – dimethoxybenzoquinone (2, 6 - DMBQ), which will facilitate the taking of electrons from inside the cell and transport them through diffusion to the exterior of the cell to the artificial electron acceptor. 2, 6- dicholorphenolindophenol usually cannot permeate through biological membranes.

When the electrical circuit is closed, electrons at the anode will pass through the cathode through an external circuit [2]. When it is open, electrons accumulate at the anode where they will determine a modification of the electric potential, as is the case in the determinations in this paper. In the experiments we have not identified the primary source of electrons, the 2, 6-dichlorophenolindophenol being reduced, most likely, by the reduced cofactors of the microbial metabolisms.

III. EXPERIMENTS

The experiments that were done for this paper can be grouped in four categories depending on their purpose.

a) Preparing the cultures

The cultures utilized in the experiments were prepared using two methods: using an inoculation loop or through decimal dilutions. The cultures of *Chlorella sorokiniana* were inoculated from a solid medium to another solid medium.

For the first method we must begin by sterilizing the inoculation loop by heat, first the tip, then we maintain it obliquely in the flame and before utilization we must heat it until it reddens. We need to work at about 5 cm from de flame and cool the loop in the agar gel, so as not to kill the cells. We sample the culture through motions of radiation, then on a new Petri dish, using similar motion we make a line. We close the dish, turn it at 90° then repeat this for two more times. Another possibility would be to use “zig-zag” motions to inoculate a new cell. Finally we can seal the dishes, writing on the lid, the date of the inoculation and the species before putting them in an incubator.

The second method is done inside a sterile microbiology hood, which has been sterilised by UV light for 15 to 20 minutes before working. We need to add 0.9 mL of physiological serum (or culture serum) inside the tubes, before adding 0.1 mL of culture in the first tube. We close it, and then shake the mixture to make sure it is homogenized, before using a pipette to collect 0.1 mL of mixture and add it to the next tube. We continue to do this until the concentration that we want is obtained. After this we add the contents of each tube in a separate Petri dish making sure
it is applied evenly on the surface, starting with the most dilute solution. We let them dry in the hood for about 5 minutes before sealing them and putting them in the incubator. Before closing the hood, we must wipe it with a sterilizing solution.

![Fig. 5. Sterile hood, with the UV lights turned on](image)

**Fig. 5. Sterile hood, with the UV lights turned on**

![Fig. 6. Cultures inoculated though decimal dilutions after three weeks of incubation](image)

**Fig. 6. Cultures inoculated though decimal dilutions after three weeks of incubation**

### b) Preparing the combustion cell

While deciding on what type of cell we would use for further experiment we worked with three prototypes.

Prototype I consisted of: a combustion cells with two compartments separated by two electrodes made from carbon, with a diameter of about 12.34 cm² and a semipermeable membrane. In the experiments that used this prototype we mostly used cultures of *Chlorella sorokiniana*. To measure the voltage, we used a multimeter, model FLUKE 287 RMS Multimeter.

In the first experiment we used 20 mL of physiological serum in the cathodic compartment and 20 mL of the microalgae culture in the anodic. At about 20 cm from the combustion cell we set a Due to the model of the cell the contact with the multimeter is not firm, and the initial readings of the voltage were not conclusive. After remaking the circuit we observed a stabilization of the signal and an increase of the voltage with 0.58 mV in 11 min.

![Fig. 7. Combustion cell with carbon electrodes](image)

**Fig. 7. Combustion cell with carbon electrodes**

![Fig. 8. Combustion cell connected to the multimeter](image)

**Fig. 8. Combustion cell connected to the multimeter**

![Fig. 9. Interior of the anodic compartment, with oxygen bubbles formed during photosynthesis.](image)

**Fig. 9. Interior of the anodic compartment, with oxygen bubbles formed during photosynthesis.**

![Fig. 10. Evolution of the voltage of the Biocombustion cell](image)

**Fig. 10. Evolution of the voltage of the Biocombustion cell**

In another experiment we used a quantity of around 30 mL of culture, observing a small increase of the voltage. After adding another 30 mL of culture we could observe an increase in the voltage for 5 minutes before evolving in a gradual decrease.
Fig. 11. Evolution of the voltage after adding 30 mL of culture

Fig. 12. Evolution of the voltage in a cell with 20 μL of 2, 6-dichlorophenolindophenol

In another experiment we used 20 mL of culture in one compartment and 20 mL of serum in the cathodic compartment before adding 20 μL of 2, 6-dichlorophenolindophenol in the anodic compartment. At intervals of 10 minutes we alternate the illumination of the cell, between periods of complete darkness and normal illumination. At the moment when the culture is exposed to light after 10 minutes, there is an increase in the voltage signal, followed by a small decrease.

Prototype II consisted of a Petri dish, with 25 mL of culture and two electrodes, one from copper and the other from aluminum, separated by filter paper. Due to the surface tension, the culture spilled in time from the cell, creating an unstable signal.

Prototype III consisted of two Berzelius glasses, as the compartments, a salt bridge, consisting of a plastic tube filled with freshly prepared agar, two platinum electrodes and a multimeter. For these experiments we used cultures of Synechocystis PCC 6803.

Fig. 13. Prototype II

The first step was sterilizing the platinum electrodes, by submerging them in a solution of H₂SO₄, with a 98% concentration, then washing them with distilled water. The glasses were also washed with distilled water and let it dry while we prepared the agar for the salt bridge. To make the agar, we prepared 100 mL of saturated solution of potassium chloride and distilled water, to which we add 1.58 g of agar. We heated the mixture for a few minutes, before placing it in the plastic tube and letting it cool in a water bath.

After we added 20 mL of culture in a glass, and 20 mL of physiological serum in the other, we add 10 μL of 2, 6 - dichlorophenolindophenol to each compartment. We measure the voltage for a few minutes and at 24 minutes we add 10 μL of 2, 6 – DMBQ to the anodic chamber. As a result we can observe a sudden decrease of the voltage before it begins increasing again.

Fig. 14. Prototype III

Fig. 15. Evolution of voltage before and after adding 10 μL of 2, 6 – DMBQ
c) Measuring the intensity of the current

For this experiment we used Prototype III, along with a box of resistance and an additional multimeter (ESCORT ELC-132Q). To measure the intensity and power of the current we used the circuit diagram in Fig. 17, and used one multimeter to measure the voltage and the other to measure the intensity. Before measuring the evolution of the intensity for different external resistances, we found the internal resistance of the cell as 6.83 kΩ at a frequency of 120 kHz. We used the formula shown below to calculate the intensity and power of the current for external resistances of 10 Ω, 100 Ω and 1000 Ω.

\[ I = \frac{U}{R_{int} + R_{circ}} \]

\[ R_{circ} = \text{external resistance}; \]
\[ R_{int} = \text{resistance of the combustion cell}; \]
\[ P = U \cdot I. \]

\[ \text{Fig. 16. Circuit Diagram} \]

\[ \text{Fig. 17. Resistance box and the two multimeters (when we add 10μL of 2, 6 - DMBQ)} \]

\[ \text{Fig. 18. Intensity of the current for an external resistance of} \]
\[ \text{10 Ω} \]

\[ \text{Fig. 19. Power of the current for an external resistance of} \]
\[ \text{10 Ω} \]

\[ \text{c) The utilization of the cell with diode properties} \]

In this experiment we tried to test the possibility of using the Biocombustion cell as a diode. [3]. We utilized a circuit similar to that of Fig. 20. When we planned the scheme, we took into account the positioning of an ammeter (mA) and a voltmeter (V), with the polarities so as not to indicate wrong values. We used a source of direct current with a variable voltage (S\text{CC}) and a box of resistances, so we could adjust the voltage and the currents in the domain: 0-16 V DC, with a resolution of 10 mV and 0-1A with a resolution of 1mA.

In the first experiment, we used the box of tension but the results were inconclusive. In another attempt we eliminated the resistance box, and registered the voltage of the source, the voltage indicated by the voltmeter and the intensity indicated by the ammeter. In the anodic compartment we added 20 mL of *Synechocystis* culture and in the other 20 mL of physiological serum. Following this experiment, we observed that there was a thermal effect on the cell’s compartments, which in turn possibly killed the microorganisms.
Fig. 20. Diagram of circuit

![Diagram of circuit](image)

Fig. 21. Evolution of the intensity depending on the voltage indicated by the voltmeter

![Graph](image)

**IV. CONCLUSIONS**

Following the experiments the following conclusions can be drawn:

a) The dehydrogenase activity of *Chlorella sorokiniana*, indicated by its reducing of resazurin. This demonstrates that it can interact with an artificial electron acceptor and that it can be used in the anodic chamber of the combustion cell.

b) Both *Chlorella sorokiniana* and *Synechocystis*, thanks to their metabolism, can serve as sources of electrons to the artificial electron acceptor (2, 6- dichlorophenolindophenol). Thanks to the action of 2, 6 -dimethoxybenzoquinone, we could observe its influence on the voltage of the cell.

c) Light has an influence on the voltage of the cell, as shown by the experiments where we alternated the exposure to light with periods of darkness.

d) The source can have a diode effect on sources of direct current, but there is a possibility of the culture being killed by the thermic effect of the experiment.

**V. ACKNOWLEDGMENTS**

I want to thank my mentors, Ioan Ardelean, from the Romanian Academy’s Institute of Biology of Bucharest, and Mircea Ignat, of the National Institute for R&D in Electrical Engineering ICPE-CA Bucharest (INCDIE ICPE-CA), for their support, guidance and materials offered.

As well I would like to mention my class teachers, Simona Vasilescu and Corina Dobrescu, for their positive responses and appreciation towards my research theme.

**VI. REFERENCES**


**VII. BIOGRAPHY**

**Elena Robu** is a student in the last year of National College of Informatics “Tudor Vianu” Bucharest and member of “Alexandru Proca” Center for the Youngsters Initiation in Scientific Research in INCDIE ICPE-CA Bucharest since 2017.
Abstract - It is considered a biologic study of motility or movement, at least of the Flagelate (Flagellata) class, and of the Rizopode class (Rhizopoda), with the aid of a flagellum, which will include several case studies according to the classification of the Flagelates general orders [1].

Index Terms - rehabilitation, strap-on spring structure, spring system, hand, fingers.

I. BIOLOGICAL STRUCTURE

General characterization – the common morphological character is the presence of one or more flagellums (flagellum = small whip) attached to different points of his body. Flagella were discovered 260 years ago (1696) by J. Harris, who found and studied Euglena. Euglena virdis is an animal found in lakes with a length of 0.1 - 0.2 mm. His body is elongated, navicular, and sharp at both ends. One end is extended with a long and thin flagellum. He body is covered with a thin membrane and because of this, the shape of the body of the euglena does not deform. A red spot called stigma is visible at the front end; it is photosensitive and acts as an "eye" or organ of orientation. Near the stigma is the root of the flagellum with opening at the anterior extremity. The root of flagellum is bifurcated and each branch ends with a small, round corpuscle called basal corpus or belfaroplast. In the rest of the euglena's body are found green chromatifsors, so chloroplasts are the ones that give the green color of this animal.

II. MOTION EXPLANATION

The movement of the flagellum starts at its base and spreads to the top. The basal corpuscle is the center of the movement. Flagellums are filamentous cytoplasmic structures, emerging at the cell surface, representing specific movement organisms in liquid environments. They perform wave propagation from the bottom to the top in one plane. There are two fundamental effects of flagellar and ciliary activity: Propulsion of locomotor cells into the liquid medium and entrainment of a liquid on the surface of the tissue. The flagellum is moving helical, training the body forward. So, the animal moves actively with the flagellum at speeds of up to 20-60 μm/s.

III. DYNAMIC SCHEME

The stationary wave is the physical phenomenon resulting from overlapping two waves of the same frequency in the same direction. By interfering with the two waves, a constant wave structure is obtained over time. Waves that interfere to create a stationary wave can be of any kind: mechanical, sonic, optical, electromagnetic etc. Places where the resulting oscillation has minimal amplitude are called nodes, and those with maximum amplitude are called antinodes. The progressive waves distribute energy from a point source in a surrounding area. Move energy in the form of vibrant particles or fields. The movement of particles is a series of compressions and splinters. Transverse vibrations – vibrations are perpendicular to wave movement - so if the wave moves horizontally, the vibrations will be up and down below. The flagellum executes a continuous progressive wave motion.

IV. IDENTIFICATION OF ELECTROMECHANICAL MICRO ACTUATIONS SIMILAR TO THE FLAGELLAR MOVEMENT

Drive systems must interact with the three types of synthetic fibril structures:

a. The elastic structure-fully flexible;
b. The rigid structure;

Fig. 1. Movement of the flagellum
The hybrid structure - composed of rigid parts and articulations.

V. IDENTIFICATION OF POSSIBLE ELECTROMECHANICAL MICRO ACTUATIONS

Following a SWOT analysis the DC motor proved to be the best option to execute the progressive movement.

<table>
<thead>
<tr>
<th>Voltage(V)</th>
<th>Amperage(A)</th>
<th>Rotation(rpm)</th>
<th>Power(U*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2V</td>
<td>0.025</td>
<td>200</td>
<td>0.05W</td>
</tr>
<tr>
<td>4V</td>
<td>0.022</td>
<td>600</td>
<td>0.08W</td>
</tr>
<tr>
<td>6V</td>
<td>0.021</td>
<td>2200</td>
<td>0.12W</td>
</tr>
<tr>
<td>8V</td>
<td>0.022</td>
<td>4800</td>
<td>0.18W</td>
</tr>
<tr>
<td>10V</td>
<td>0.023</td>
<td>5500</td>
<td>0.23W</td>
</tr>
<tr>
<td>12V</td>
<td>0.022</td>
<td>6300</td>
<td>0.26W</td>
</tr>
<tr>
<td>14V</td>
<td>0.022</td>
<td>6700</td>
<td>0.30W</td>
</tr>
<tr>
<td>16V</td>
<td>0.022</td>
<td>7000</td>
<td>0.34W</td>
</tr>
<tr>
<td>18V</td>
<td>0.022</td>
<td>7800</td>
<td>0.38W</td>
</tr>
<tr>
<td>20V</td>
<td>0.021</td>
<td>8100</td>
<td>0.43W</td>
</tr>
<tr>
<td>22V</td>
<td>0.022</td>
<td>8600</td>
<td>0.49W</td>
</tr>
<tr>
<td>24V</td>
<td>0.024</td>
<td>9200</td>
<td>0.54W</td>
</tr>
</tbody>
</table>

VI. REALIZATION OF EXPERIMENTAL MODELS OF FLAGELLAR MICROROBOTS

The experiment consisted of attachment of the fibril on the DC motor, various attempts were made to achieve a progressive motion of the fibril. By attaching flexible fibrils to the motor spindle and setting up 3 axle clamps.

As a result of this experiment it was found that little change is needed in terms of malleability of the fibril. In order to achieve progressive sinusoidal motion using the rotation of the DC motor, a stiff or less curved fiber is needed.

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VIII. BIOGRAPHY

Constantin Alexandru is student of National College of Informatics “Tudor Vianu” Bucharest and member of “Alexandru Proca” Center for the Youngsters Initiation in Scientific Research in INCDIE ICPE-CA Bucharest since 2017.
Electric Smart Grid and Possible Developments for a Smart Grid

Andrei Petru Pricope

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Abstract - To begin, this paper is describing certain traits an electric grid must possess in order to be considered “smart”, with the use of digital systems as one of the fundamental ones. Next, the experiments made to better understand the forces and phenomena that appear in an electric network. An important part of the paper, which is still in progress, is represented by the utilization of genetic algorithms and artificial neural network to boost the capabilities of the network.

Index Terms - smart grid, electric grid, artificial neural network, genetic algorithms.

I. INTRODUCTION

A common element of most definition of the “smart grid” concept is the use of digital processing and communication devices. At the current time, there are three ways we can make an electric grid "smarter": by improving the existing infrastructure, by adding new digital technology to the grid or by reforming the economic processes that revolve around the electric grid, opening up new development opportunities.

In Fig.1 is exemplified a simple model for a smart grid, which includes the basic electric grid, enhanced by the digital systems and communication infrastructure. These enhancements can come in the form of smart monitoring devices that improve communication between user and provider or in the form of improvements in the command systems.

II. ADVANTAGES AND DISADVANTAGES OF A SMART GRID

A smart grid comes with the following advantages:
- a more efficient delivery of electricity;
- faster reset after eventual network failure;
- lower maintenance costs;
- diminished overload during peak hours;
- a more efficient integration of renewable energy sources from within the network;
- improved security.

A smart grid does, however, not come without disadvantages. Its use of digital processing systems will open the grid to cybernetic threats, requiring important improvements in cyber-security. The smart grid will also consist of millions of devices: control stations, computers, electric lanes and many other types of equipment. Before all this could be implemented, they will first have to be tested, refined and fitted, which could easily take 10 years to do.

III. SOFTWARE

An important part of future smart grids is the software, which has to be able to make quick judgments, based on the information stored in the data base and on newly received information, regarding:
- the safety of the electric lanes;
- components asociated with the lanes;
- consumers.

This software has to take into account the following demands:
- safety;
- the quality of the delivered electrical energy;
- future improvements;
- the economic efficiency of the investments;
- additional requirements imposed by the environmental impact.

IV. CONSIDERATION OF SIMILITUDE

Every real electric network has a matching model-network, which is able to imitate both the static and dynamic phenomena. In the real network
all measurements are related to a base voltage (U_{br}) and to a base power (S_{br}) as follows:
- base voltage \( U_{br} \)
- base intensity \( I_{br} \)
- base power \( S_{br} = U_{br}I_{br} \)
- base impedance \( Z_{br} = \frac{U_{br}^2}{S_{br}} \)
- base admittance \( Y_{br} = \frac{1}{Z_{br}} \)

For the model network similar values are defined:
- model voltage \( U_{bm} \)
- model intensity \( I_{bm} \)
- model power \( S_{bm} = U_{bm}I_{bm} \)
- model impedance \( Z_{bm} = \frac{U_{bm}^2}{S_{bm}} \)
- model admittance \( Y_{bm} = \frac{1}{Z_{bm}} \)

The first criterion of similitude is that of the conservation of phase and the absolute value of the impedance [1]:

\[
\frac{Z_r}{Z_{br}} = \frac{Z_m}{Z_{bm}}
\]

\[
\frac{R_r + jX_r}{Z_{br}} = \frac{R_m + jX_m}{Z_{bm}}
\]

From these result the following dependencies [1]:

\[
R_m = \frac{Z_{bm}R_r}{Z_{br}}
\]

\[
L_m = \frac{\omega_r Z_{br} L_r}{Z_{bm}}
\]

\[
C_m = \frac{\omega_m Z_{bm}}{Z_{br} C_r}
\]

\[
C_m = \omega_m Z_{bm} C_r / \omega_r Z_{br}
\]

The second criterion is that of the conservation of the oscillation [1]:

\[
\delta_r = \frac{R_r}{L_r}
\]

\[
\delta_m = \frac{R_m}{L_m}
\]

\[
\omega_{or}^2 = \frac{1}{L_r C_r}
\]

\[
\omega_{om}^2 = \frac{1}{L_m C_m}
\]

\[
\omega_{er}^2 = \omega_{or}^2 - \delta_r^2
\]

V. EXPERIMENTS

In Fig. 2 is represented, at scale, an electric grid with consumers. This model on which the simulations were made. Using the criteria identified in Chapter IV.

![Fig. 2. Electric grid simulation model](image)

One of the phenomena that were simulated is that of how the voltage varies while in deforming regime, which can be easily observed in Fig. 3 and Fig. 4.

![Fig. 3. Voltage in deforming regime](image)

![Fig. 4. Voltage in deforming regime](image)
These aberrations of the sine curve can cause damage in devices that require such a voltage [3]. Another phenomenon studied and simulated was the commutator ripple [3], which appears when a circuit is connected or disconnected, and consists of unusually high voltages for very short periods, known as recovery voltage. It is underlined in Fig. 5 and Fig. 6.

In the graphics below it can be observed that the recovery voltage is about 10% higher than the voltage in stationary regime.

![Fig. 5 Simulation of the commutator ripple effect](image1)

![Fig. 6. Simulation of the commutator ripple effect](image2)

To prevent damages to the connected equipment, a protection system must be installed to capture the surplus of energy.

**VI. GENETIC ALGORITHMS**

"An interesting concept on which the smart grid could develop is the genetic algorithm, which represents a group of computational models inspired by the process of natural selection. These algorithms codify possible solutions to specific problems in a chromosomal-type structure and then apply recombination operators, so as to keep the useful data" [6].

Here, genetic algorithms can be used to optimize decision functions based on the history of the grid and past decisions.

First, there will be chosen a random population of components (chromosomes) of the smart grid, then the structures of which these components are part are evaluated, allocating criteria (named reproductive facilities) which highlight the more important components and how they evolve, signaling them as possible developments.

Two problems could actually be resolved through this mechanism:

- the highlight of more viable components that would improve the overall capabilities of the grid;
- the discovery of obsolete equipment that needs to be replaced with newer technologies in order to avoid damage to the grid

The identified genetic algorithm will help keep track of numeros parameters of the grid, including: voltage, amperage, frequency and losses (chapter in progress).

![Fig. 7. The genetic algorithm application model](image3)

In Fig. 7 it is shown how genetic algorithms could be used to develop a system that would help determine the most viable elements of the network: the components will act as chromosomes, while the history of the grid will act as evolution theory, regulating creating the algorithm, which will in turn regulate the behavior of the network.

**VII. ARTIFICIAL NEURAL NETWORKS**

"An artificial neural network is an automatic system, comprised of a very large number of simple units, called artificial neurons (perceptrons or sigmoids)" [7]. These systems excel in areas associated with detection of features.
Artificial neural networks have a different approach to problems, compared to standard computers, which use algorithms (a set of instructions—steps—on how to finish a task) and are not capable of finding a solution to a problem when there are unknown variables. An artificial neural network processes information in a way similar to the way the human brain does, learning by example. The obvious advantage is that an artificial neural network is able to solve unexpected problems based on previous examples. The disadvantages of a neural network are its unpredictability and the fragility of its learning process, which, if done wrong, could lead to derangements. To balance out these disadvantages, an artificial neural network could be used together with a classic computer.

In Fig. 8 there is an example on how the neurons are divided in layers, the signal travelling from the input neurons, through the hidden layer, to the output neurons. Modern neural network have somewhere between several thousands to several million connections between their neurons, having the computational power of a worm’s brain.

The objective of artificial neural networks is to find solutions to a given problem in a way similar to a human brain would. The most advanced such networks are the dynamic ones, as they are capable of creating new connections between units (chapter in progress).

What we plan to do further with this project is to make the system store data for each experiment carried out, which will be accessible in a Cloud database. This data will come along with pieces of information such as age and other details related to the patient’s medical history. Our goal is to create an algorithm that will analyze different sets of data by comparison with already existing data—an algorithm capable of identifying gait traits that are common in patients with various common traits.

VIII. CONCLUSIONS

A digital system would help improve the reliability and efficiency of the electric network. An artificial neural network system that could monitor and control an electric network is in development.

Simulations made on a model network help prevent problems to functioning networks.

The project is still in development.

IX. REFERENCES


VI. BIOGRAPHY

Andrei Petru Pricope was born on 29th of July, 2000, and is a student in the 11th grade at the National College of Informatics “Tudor Vianu” Bucharest and member of “Alexandru Proca” Center for the Youngsters Initiation in Scientific Research in INCDIE ICPE-CA Bucharest. He started working on the paper in the winter of 2016 and has won a mention at “RoSEF” in the summer of 2016.
Lipidic Structures in Microelectromechanics and Their Use as Medicine Transportation

* Cristian Andrei Ionescu, ** Serghei Ulian
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Abstract - This worksheet has an abstract nature through its context, and it concerns itself analyzing the mechanism of movement in Biology with applications in microelectromechanics and a possible procedure that would enable the deliverance of drugs straight into the damaged cells. This project analyzes the theoretical aspect of cytoplasmic movement and presents a possible collection of miniaturized motors, correlating with the study of cytoplasmic movement. All of these theoretical procedures are to be realized with help of the main component of the cell membrane, the phospholipids.

Index Terms – microelectromechanics, medicine transportation, lipidic bylayer, cytoplasmic movement.

I. RESEARCH THESIS
- knowing the microelectromechanics and thermodynamics of the biological lipid layers (for example, from the cellular membrane), we proposed a theoretical and experimental research looking for their use in the MEMS domain;
- we estimate some objectives of the project which do not consume all the applicative domain: electrostatic micro motors; microelectromechanics landmarks such as micro and Nano supports for guidance; electrostatic micro or Nano actuators;
- theme writing will be looking forward onto the following aspects:
  - theoretical aspects for thermodynamics and microelectromechanical characteristics of lipids (theoretical modulation, equations for describing different phenomena),
  - experimental models and methods for finding out specific parameters; Micro torques, electrostatic tensions, micro and Nano forces, friction micro torques and superficial tensions, micro and Nano movements,
  - transport of drugs using liposomes.

II. INTRODUCTION
The cell is the building, structural and functional block of all the living organisms. Every cell has in their surroundings a cellular membrane with many unusual characteristics. One of the most relevant to our project of the cellular membrane is her capacity to control all the switches between electrical charged ions.

The cellular membrane is the “wall” which surrounds the cell. It is made up by a lipidic bilayer. The lipids from this bilayer are phospholipids (75%), cholesterol and glycolipids. The most common phospholipids are phosphatidylcholine or lecithin (Fig. 1) and Phosphatidylethanolamine (Fig. 2).

![Fig. 1. Phosphatidylcholine](image1)

![Fig. 2. Phosphatidylethanolamine](image2)

![Fig. 3. Lipidic Structures in Microelectromechanics and Their Use as Medicine Transportation](image3)
In the pictures above are lipids used in experiments seen at microscope Veeco.

Every single molecule has the aspect of a nail with a hydrophilic end (as its name says it is attracted toward the aqueous substance) and a hydrophobic end (repels aqueous substances). These endings represent the poles of the phospholipids. The hydrophilic end is the positive pole and the hydrophobic end is the negative pole (Fig. 5).

The lipidal bilayer is a good isolating substance, its conductance on its surface has a value of only $g_{pure} = 10^{-13} \Omega^{-1} m^{-2}$.

The electrical capacity can be calculated like this: we take 2 conductors (solutions) made up from salts in water. The 2 conductors are separated by an isolator, the lipidal bilayer (see above). Like this we can separate an electric charge $q$ and apply an electrical potential $V$ on the surface of the membrane. The membrane has the electrical capacity defined as: $C = q/V$. And knowing the thickness of the lipidal bilayer ($6 \times 10^{-9} m$), we obtain the electrical capacity of the membrane per surface unit: $c = C/S = 10^{-2} Fm^{-2}$.

**TABLE I.** The characteristics and parameters of the cell

<table>
<thead>
<tr>
<th>Characteristic/Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Superficial tension</td>
<td>- the lipids in cellular structure 0.1-2 dyne/cm; - artificial lipids 9-12 dyne/cm; - the lipids after the extraction from the cellular membrane 9dyne/cm.</td>
</tr>
<tr>
<td>2. The lipid layer’s thickness</td>
<td>7 - 10 nm</td>
</tr>
<tr>
<td>3. The surface electric potential (the value in mV of the electrostatic field at the outside of the cell)</td>
<td>8.5 – 38mV. In the tissues so through the cellular membrane the electric field is in the domain $10^7 – 10^1$ V/cm.</td>
</tr>
<tr>
<td>4. The electrical capacity of the cellular membrane (thickness 10 nm)</td>
<td>$C = 10^{13} F$</td>
</tr>
<tr>
<td>5. The dimension of the cell</td>
<td>$10^4 – 10^6 m$</td>
</tr>
</tbody>
</table>


I. Diculescu Gh. Benga s.a, "Biologie celulara"
The calculation for estimating the lipidic layer’s permittivity considering the spherical model of the cell with the outside lipid layer it results the next modeling as shown in Fig. 7.

And so the cylindrical surface it is in the next domain:

<table>
<thead>
<tr>
<th>Diameter (Radius) [m]</th>
<th>Resulting the spherical surface [m²]</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10^{-3}(10^{-10})$</td>
<td>$4.186 \times 10^{-3}$</td>
<td></td>
</tr>
<tr>
<td>$10^{-6}(10^{-6})$</td>
<td>$4.186 \times 10^{-6}$</td>
<td></td>
</tr>
</tbody>
</table>

Obs. measurement units:

$1 \text{ nm} = 10^{-9} \text{ m}, 1 \mu\text{m} = 10^{-6} \text{ m}, 1 \AA = 10^{-10} \text{ m}.$

where the formula of the spherical surface is

$$S = \frac{4}{3} \pi r^3$$  \hspace{1cm} (1)

~10nm

The calculation relation of the spherical condenser on which we assimilate with the model of the lipid is:

$$C_s = \varepsilon \frac{R_1 R_2}{R_2 - R_1}$$  \hspace{1cm} (2)

where $R_1 = R_2 - 10 \text{ nm},$ and $R_2$ maximum outside radius (see also fig 1) $\sim 10^{-4} - 10^{-6} \text{ m}.$

And the absolute permittivity:

$$\varepsilon = \varepsilon_0 \cdot \varepsilon_r$$  \hspace{1cm} (3)

With the void permittivity:

$$\varepsilon_0 = 8.885 \times 10^{-12} \text{ F/m}$$

and $\varepsilon_r$ - relative permittivity of the lipid layer which we want to estimate.

It results a permittivity domain:

<table>
<thead>
<tr>
<th>$R_2$</th>
<th>$R_1$</th>
<th>$\varepsilon_r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10^{-7}$</td>
<td>0,9999$\times$10^{-4}</td>
<td>0,0112</td>
</tr>
<tr>
<td>$10^{-6}$</td>
<td>0,99$\times$10^{-6}</td>
<td>11,3</td>
</tr>
</tbody>
</table>

Fig. 8. DSL diagram (the environment, the polydispersity and the potential of the liposome population)

IV. MICROELECTROMECHANICS AND ELECTROMECHANIC MODELS

In this chapter we will talk about devices about some mechanical and electromechanical devices which are using the electrostatic property of the liposomes.

To understand the structure of these devices we have to remember an important property of the lipids: they form micellae in aqueous substances.

When the concentration of water is larger than the concentration of phospholipids as those in the figure 9. On the other hand, when the concentration of water is smaller than the concentration of phospholipids we will obtain micellae as in the figure 10.
The first device we will talk about is a micro-actuator used as a micro-bearing device. The device will have a carbon ax in the middle surrounded by aqueous substance. The aqueous substance is used to obtain the correct orientation of the lipidic bilayer which forms the next substrate of the micro-bearing device and to obtain the movement of the micro-device we will put some electrodes in the emd of the lipidic bilayer. They (the electrodes) will be connected to an electrostatic machine which helps us to use the electrostatic properties of the liposomes and obtain the movement of the micro-bearing device. The micro-actuator will contain 7 such micro-bearing devices (Fig. 11, Fig. 12).

Another device is a linear engine (Fig. 13). The linear engine has the same structures as the one described above. It will have an ax made out of carbon, the lipids (this time they are not in a fluid bilayer) and the aqueous substance. Using some electrodes we can obtain the movement of the device. This micro-actuator can be used as a switcher or as a drug carrier.

V. BIONIC STUDY

The substance used at the transportation of the ions, special method in the study of membrane, are called ionophores. Their diversity consists in the type of ions they transport. They are necessary for the transport of ions through the cell membrane.

One of the most useful ionophores is Valinomycin, this is a cyclic dodecadepsipeptide (it contains 12 chains of amino-acids). This ionophore is used for the transportation of the K+ ion and forms a complex with the molar report 1:1. With the help of the ion of potassium it will create some electrical potentials on the cellular membrane.

Another ionophore is Nigericin, it is a carboxyl acid also soluble in lipids as Valinomycin. It can transport three kinds of ions: K+, Na+ si H+. Due to the proprieties of transporting ions it is used used to balance a chemical gradient without affecting the potential of the cellular membrane.

And the last ionophore that we are going to talk about is Gramicidina. This ionophore has the property to form pores on the membrane allowing the transportation of monovalent cations. And so it can dissipate the potential of the chemical components and electrochemical potential.

Also for the protons transportation there are used some uncoupling agents. In general, they are weak acids with delocalized electrical charge in an orbital system π. Some examples are presented in the following formula (Fig. 14, Fig.15, Fig. 16).
VI. LIPIDS AS SUPPORT TRANSPORTING DRUGS

The medication delivery with the help of the lipids is a new concept which is very promising. The delivery system of drugs with the help of lipids is applicable to drugs what are soluble in aqueous solutions, so this type of transport is being extended on the majority of existing treatments nowadays.

The advantages of liposomes as support for transporting drugs:
- they can raise the drug efficacy and the therapeutical effect of the drug;
- they are healthier, flexible, biocompatible, non-immunogenic;
- they use ligands to reach the destination faster;
- they reduce the medication toxicity;
- they can encapsulate hydrophilic and hydrophobic medication.

Transport routes either oral, dermal, ocular, intranasal, transdermal, vaginal, but our favorite method is the mouth ingestion because it is non-invasive and much cheaper and has fewer side effects than an injection.

The main factors for this branch of our project are:
- solubility;
- dispersion;
- digestion;
- absorption.

Efficient absorption of the drug by intestinal mucosal cells is the ultimate goal of any formulations based on this type of delivery.

A liposome is a vesicle-type spherical colloidal to size (from 20 nm to 10 μm) composed of a bilayer of surfactant molecules (phospholipids). These surfactant molecules orient their hydrophilic side outwards and inwards from hydrophobic, hydrophilic creating a central cavity delimited by a hydrophobic membrane. Unilamellar vesicles are formed when certain form the liposome double layer and multilamellar vesicles are formed when several concentric bilayer form the liposome.

VII. COMPUTER PROGRAM

We wrote a program that helps us to calculate the lipid forces we use in microactuators.

This program first reads the values of the electrical loads in the phospholipid arm (hydrophilic and hydrophobic ends) and the distances between them.

Also it reads the fluid / void permittivity data and the angle of the lipid arms (depending on the lipid culture we use).

Finally, if we want the program, we can generate a multiple graph (a Matlab script) depending on the phospholipid culture we use.

Below we will attach screenshots of the program (calculations and graphs).
IX. REFERENCES

[6] Hsu Tai-Ran, “MEMS and microsystems”, Publisher Wiley;
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[12] Hina Shrestha, Rajni Bala, and Sandeep Arora;
[13] Chitkara College of Pharmacy, Chitkara University, Chandigarh-Patiala National Highway, Rajpura, Patiala, Punjab 140401, India;
[19] CSH Perspectives - Cold Harbor Perspectives in Biology. Lipid Polymorphisms and Membrane Shape;

X. BIOGRAPHIES

Serghei Ulian, is a student in the 11th grade in the International Theoretical High School of Informatics Bucharest and member of “Alexandru Proca” Center for the Youngsters Initiation in Scientific Research in INCIDE ICPE-CA Bucharest. He started this project last year with his middle-school colleague, Ionescu Andrei Cristian.

He lives in Bucharest in the school’s dormitory and he has top-marks and practice volleyball at Dinamo Bucharest.

Cristian Andrei Ionescu, is a student in the 11th grade in the Mihai Viteazul High-School from Ploiesti and member of “Alexandru Proca” Center for the Youngsters Initiation in Scientific Research in INCIDE ICPE-CA Bucharest. He started this project last year with his middle-school colleague, Ulian Serghei.
Preparation of a Formatted Technical Paper for the Bulletin of Micro and Nanoelectrotechnologies

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Abstract - This document is itself an example of the desired layout (inclusive of this abstract) and can be used as a template. The document contains information regarding desktop publishing format, type sizes, and typefaces. Style rules are provided explaining how to handle equations, units, figures, tables, abbreviations, and acronyms. Sections are also devoted to the preparation of acknowledgments, references, and authors’ biographies. The abstract is limited to 150 words and cannot contain equations, figures, tables, or references. It should concisely state what was done, how it was done, principal results, and their significance.

Index Terms - The author shall provide up to 10 keywords (in alphabetical order) to help identify the major topics of the paper and to be enough referenced.

I. INTRODUCTION

This document provides an example of the desired layout for a published MNE technical paper and can be used as a Microsoft Word template. It contains information regarding desktop publishing format, type sizes, and typefaces. Style rules are provided explaining how to handle equations, units, figures, tables, abbreviations, and acronyms. Sections are also devoted to the preparation of acknowledgments, references, and authors’ biographies. The paper title should be in Times New Roman 20 uppercase and lowercase letters, not all uppercase. Author name is Times New Roman 12, institution and contact address (E-mail) are Times New Roman 10.

II. TECHNICAL WORK PREPARATION

Please use automatic language check for your spelling. Additionally, be sure your sentences are complete and that there is continuity within your paragraphs. Check the numbering of your graphics (figures and tables) and make sure that all appropriate references are included.

A. Template

This document may be used as a template for preparing your technical paper. When you open the file, select "Page Layout" from the "View" menu (View | Page Layout), which allows you to see the footnotes. You may then type over sections of the document, cut and paste into it (Edit | Paste Special | Unformatted Text), and/or use markup styles. The pull-down style menu is at the left of the Formatting Toolbar at the top of your Word window (for example, the style at this point in the document is "Text"). Highlight a section that you want to designate with a certain style, and then select the appropriate name on the style menu.

B. Format

If you choose not to use this document as a template, prepare your technical work in single-spaced, double-column format, on paper A4 (21x29.7 centimeters). Set top, bottom margins and right margins to 15 millimeters and left margins to about 20 millimeters. Do not violate margins (i.e., text, tables, figures, and equations may not extend into the margins).

C. Typefaces and Sizes

Please use a Times New Roman font. (See your software’s “Help” section if you do not know how to embed fonts.) Table I is a sample of the appropriate type sizes and styles to use.

<table>
<thead>
<tr>
<th>Micromotor Code</th>
<th>b [mm]</th>
<th>a [mm]</th>
<th>h [mm]</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPR33</td>
<td>33</td>
<td>25</td>
<td>20</td>
<td>PZT 5</td>
</tr>
<tr>
<td>MPR27</td>
<td>27</td>
<td>18</td>
<td>9</td>
<td>PZT 5</td>
</tr>
<tr>
<td>MPR15</td>
<td>16</td>
<td>10</td>
<td>10</td>
<td>PZT 5</td>
</tr>
</tbody>
</table>

D. Section Headings

A primary section heading is enumerated by a Roman numeral followed by a period and is centred above the text.

A primary heading should be in capital letters and bolded. The standard text format is considered times new roman 12.

The paper title should be in times new roman 20 uppercase and lowercase letters, not all uppercase.

Author name is set to times new roman 12, institution and contact address (E-mail) are set to times new roman 10.

Financial support should be acknowledged below the author name and institution. Example: This work was supported in part by the U.K. Department of Defence under Grant TX123.

A secondary section heading is enumerated by a capital letter followed by a period and is flush
left above the section. The first letter of each important starting word is capitalized and the heading italicized.

Tertiary and quaternary sections are accepted only in special cases, so usually must be avoided in order to keep a clear article structure. If required, a tertiary and quaternary section heading must be italicized and enumerated by adding an Arabic numeral after each letter.

**E. Figures and Tables**

Figure axis labels are often a source of confusion. Try to use words rather than symbols. As an example, write the quantity "Torque," or "Torque, \( M \)," not just "\( M \)." Put units in parentheses. Do not label axes only with units. As in Fig. 1, write "Torque (cNm)" not just "(cNm)". Do not label axes with a ratio of quantities and units. For example, write "Current (A)," not "Current/A." Figure labels should be legible, approximately 10-point type.

Large figures and tables may span both columns, but may not extend into the page margins. Figure captions should be below the figures; table captions should be above the tables. Do not put captions in "text boxes" linked to the figures. Do not put borders around your figures.

All figures and tables must be in place in the text centered and written with times new roman 10. Use the abbreviation "Fig. 1" in sentence and for each figure name. Each table must be defined as „TABLE 1”, with capital letters and roman numbers.

Digitize your tables and figures. To insert images in Word, use: Insert | Picture | From File.

**F. Numbering**

Please number reference citations consecutively in square brackets [1]. The sentence punctuation follows the brackets [2]. Multiple references [2], [3] are each numbered with separate brackets [1]-[3]. Refer simply to the reference number, as in [3]. Do not use "Ref. [3]" or "reference [3]" except at the beginning of a sentence: "Reference [3] shows....".

Number footnotes separately with superscripts (Insert | Footnote). Place the actual footnote at the bottom of the column in which it is cited. Do not put footnotes in the reference list. Use letters for table footnotes.

Check that all figures and tables are numbered correctly. Use Arabic numerals for tables and Roman numerals for tables.

Appendix figures and tables should be numbered consecutively with the figures and tables appearing in the rest of the paper. They should not have their own numbering system.

**G. Units**

Metric units are preferred in light of their global readership and the inherent convenience of these units in many fields. In particular, the use of the International System of Units ("Système International d'Unités" or SI Units) is advocated. This system includes a subsystem of units based on the meter, kilogram, second, and ampere (MKSA). British units may be used as secondary units (in parentheses). An exception is when British units are used as identifiers in trade, such as 3.5-inch disk drive.

**H. Abbreviations and Acronyms**

Define less common abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Standard abbreviations such as SI, CGS, AC, DC, and rms do not have to be defined. Do not use abbreviations in the title unless they are unavoidable.

**I. Math and Equations**

Use either the Microsoft Equation Editor or the MathType commercial add-on for MS Word for all math objects in your paper (Insert | Object | Create New | Microsoft Equation or MathType Equation). "Float over text" should not be selected.

To make your equations more compact, you may use the solidus ( / ), the exp function, or appropriate exponents. Italicize symbols for quantities and variables. Use a long dash for a minus sign or after the definition of constants and
variables. Use parentheses to avoid ambiguities in denominators.

The number of each equation must be consecutively added in parentheses and arranged at the right margin, as in (1). Be sure that the symbols in your equation have been defined before the equation appears or immediately following. Don’t use "Eq. (1)" abbreviation instead of "equation (1)", in a sentence.

\[ L_m = \frac{m}{A^2} \]  

(1)

with \( m \) - mechanical mass, \( A \) - force factor, \( L_m \) - electromechanical inductance.

**III. ACKNOWLEDGMENT**

The following is an example of an acknowledgment.

The authors gratefully acknowledge the contributions of Mircea Ignat and Puflea Ioan for their work on the original version of this document.

**IV. APPENDIX**

Appendixes, if needed, appear after the acknowledgment.

**V. REFERENCES**

References are important to the reader; therefore, each citation must be complete and correct. There is no editorial check on references, only the format Times new roman 10 must be considered.


**VI. BIOGRAPHIES**

A technical biography for each author must be included. It should begin with the author's name (as it appears in the byline). Please do try to finish the two last columns on the last page at the same height. The following is an example of the text of a technical biography:

*Mircea Ignat* was born in Bucharest on March 4, 1953. He graduated at 1977 and he received Ph.D. degrees in electrical engineering from Bucharest Polytechnic University in 1999.

His employment experience included the National Institute for Research and Development in Electrical Engineering ICPE-CA, Micro and Nano- Electromechanical Department and he is the coordinator of “Alexandru Proca” Center for the Youngsters Initiation in Scientific Research in INCDIE ICPE-CA Bucharest.

The research preoccupation include: the synchronous generators and the high speed electric machines. He is member of IEEE.