

125 years since the birth of the Romanian scientist ȘTEFAN PROCOPIU



prof.dr.ing. Florin Teodor TĂNĂSESCU

MOTTO: “*Progress is made at the expense of the persevering*” - Ștefan Procopiu (in a lecture given in 1939)

January 19, 2015, marks the 125th anniversary of the birth of the Romanian physicist Ștefan Procopiu, one of the outstanding personalities of world physics whose discoveries bear his name and represent great openings in modern physics. Ștefan Procopiu is not an exception, a meteoric case in Romanian physics, he is one of the great founders of the School of Physics in Iași represented by **Dragomir Hurmuzescu** (discharge of X-ray electrified bodies: Magnetism), **Ion Plăcinteanu** (prediction of the existence of negative protons in 1933, before Gramov and before L. de Broglie made the hypothesis on photons, the wave equation of a variable mass body and the determination of Dirac's equation for a particle of variable mass), **Horia Hulubei** (X-ray spectra for matter in gaseous state and multiple Compton scattering), **Constantin Mihul** (determination of the chemical composition of the representative gasolines from the Romanian oil by own spectroscopic methods), **Th. V. Ionescu** (physics of plasma and ionosphere, the first "stimulated" MASER type emission in 1946! Together with **C. Mihul** and before its invention in 1954). And the series of examples could continue with many of Ștefan Procopiu's students and his students' students, with meritorious achievements in Romanian and international science.

Today, when we talk about value, what it represents and what the man of value should be in the progress of society, when we need models that younger generations know less, their presentation, in addition to the invitation to be followed, is also a tribute that we electrical engineers pay with reverence and gratitude to those who developed Romanian physics and electrical engineering.

1. Biographical data

Born on January 19, 1890, in Bârlad, died on August 22, 1972, in Bucharest. Son of Emanoil Procopiu (civil servant at the City Hall and at the Tribunal) and of Ecaternia (Catinca), descendant of an old family of rice trees from Bălăbănești (Tasca Family).

1908-1912, Studies at the University of Iași, graduated with the mention very well (diploma in 1912).

1912, The calculation of the elementary magnetron starting from Planck's quantification (the first correct calculation).

1912, University of Iași (preparator).

1913-1918, assistant to Prof. Hurmuzescu at the University of Bucharest.

1918-1919, Satisfies his military service at the Bucharest Aeronautics Arsenal.

1919, the Prize of the Romanian Academy for the work “Perpetum mobile and the principles of allergy”.

1919-1924, "Adamache" scholarship in Paris, for his doctoral thesis. PhD supervisors: Gabriel Lippmann and after his death, Aymée Cotton.

1921, Discovery in the laboratories of the Sorbonne of the Procopius Phenomenon (the phenomenon of depolarization of light by colloidal suspensions). In 1939, the French physicists A. Boutaric and J. Breton defined the Procopius Phenomenon (unlike another phenomenon, the Procopius Effect which refers to the magnetic discontinuities produced in a wire of ferromagnetic material when an alternating current passes through it).

1924, on March 5, he defends in Paris his doctoral thesis: "On the electrical and magnetic birefringence of substances". Doctoral Committee: Aymée Cotton, Charles Fabry and H. Mouton. Returned to the country in 1925, full professor at the Department of "Gravity, Heat and Electricity" of the University of Iasi.

1929, The Procopius effect as a circular effect of the magnetization discontinuity that occurs when an alternating current passes through a ferromagnetic wire.
 1930, publishes the work "Magnetization of a ferromagnetic substance under the influence of an alternative field".
 1933, gives the inaugural lesson at the opening of the academic year, at the University of Iași, in front of King Carol II, the Conference "Chimeras in Sciences".
 1937-1941, First Dean of the Faculty of Sciences of the University of Iași.
 1946, He marries Mrs. Rodica Vasiliu Georgescu.
 1955, Full Member of the Romanian Academy.
 1962, He retires from the Department he headed at the University of Iași.
 1964, March 21, winner of the State Prize.
 1967, Doctor Honoris Causa of Gh. Asachi University of Iași. Order of the Romanian state: Crown of Romania (1938), Labor Order cl. III (1953), Labor Order cl. I (1960), Emeritus Scientist (1962), RSR Star cl. II (1965), Scientific Merit cl. I (1966), Steaua RSR cl. I (1970).

2. Vocational training

Sees the light of day on January 19, 1935, in Bârlad, as the son of Emanoil Procopiu (small clerk at the Tribunal and at the City Hall) and Ecaterina (Catinca). Catinca came from an old family of razeși from the village of Bălăbănești (Tasca Family), a hearth of culture and history of Moldova through the people it gave. The primary school is in Bârlad, as well as the high school, at one of the well-known schools of Moldova: Gheorghe Roșca Codreanu High School, today Codreanu College. He finished high school as head of promotion, notable for his passion for mathematics and physics, for natural sciences, history, geography and foreign languages.

Gh. Roșca Codreanu High School was a school with a great tradition and great teachers, who gave well-known personalities in culture. and Romanian science. The school planted for the first time his passion for the branches of science and knowledge of the universe, the desire to know as much as possible about the meaning of reality and life. It should be noted that the period in which Ștefan Procopiu lived was one of the richest periods of discoveries in physics and electricity, fields that attracted him and stimulated his passion for new and innovation.

Bârlad was at the end of the 19th century and the beginning of the 20th century a city with a rich intellectual life: Vlahuță, Tonitza, Tutoveanu, Victor Ion Popa, Mihai Ralea, the physicist Ion Plăcinteanu, a scientific literary society "Stroe Beloescu" with a rich library, theater, all were a setting in which concerns for culture were dominant in a quiet city, free from other temptations. Ștefan Procopiu participates in events organized here, holds conferences, learns to give a paper and "speak and write" (it was a stimulating atmosphere for knowledge, which I also felt knowing during the holidays that, as a student at Sfântul Sava High School in Bucharest, I made them in Bârlad and found books that were missing in other large libraries).

A graduate of Codreanu High School, he continued his studies at the Faculty of Sciences of the University of Iași (1908-1912). Here he has the opportunity to know the courses of some great teachers, many of them trained in European schools. The dominant personality, which marked his career as a physicist, was the physics teacher Dragomir Hurmuzescu. Holder of a license and a doctorate taken at the Sorbonne under the guidance of Gabriel Lippmann, a Nobel Laureate, who through his work in the field of discharge of electrically charged bodies by X-rays, magnetism and the method of determining the ratio $\langle v \rangle$ between the unit electrostatic and magnetic, Hurmuzescu had become a well-known name in European physics. Ștefan Procopiu is attracted by Dragomir Hurmuzescu's conception of the organization of electrotechnical education in universities, an approximation of experiment and application physics and will become in the future, Hurmuzescu's closest collaborator in the organization of electrotechnical education in universities.

In 1919 he obtained the "Adamache" scholarship granted by the Romanian Academy and went to Paris, where at the Sorbonne he would have Gabriel Lippmann as doctoral supervisor, who had also conducted Dragomir Hurmuzescu's doctoral thesis, and after his disappearance Aymée Cotton. He defended his doctoral dissertation on March 5, 1924, with the theme "On the electric and magnetic birefringence of suspensions", which he defended before a commission composed of Aymée Cotton, Charles Fabry, H Mouton.

The period 1919–1924, which he spends in Paris, is a period in which, in parallel with the preparation of the thesis, he resumes a series of researches initiated since the last years of his studies, communicating in specialized journals and Comptes Rendues of the Paris Academy of Sciences.

3. Scientific work



*Acad. Ștefan Procopiu in his laboratory in Iași.
In the background, the painting of Dragomir Hurmuzescu, his teacher.*

From the first paper / 1 / published in the Scientific Annals of the University of Iași: "Variation of electromotive force due to electrolyte movement" (1912), to the last paper / 2 / published in 1972 in Comptes Rendues de l'Académie des Sciences de Paris 1921, entitled: "Optical dispersion of electrical birefringence and electrical dichroism of colloidal suspensions of vanadium pentoxide and benzopurpurine", is attributed to Ștefan Procopiu more than 172 articles published in specialized journals in the country and abroad: Scientific Annals of the University din Iași, Bulletin Scientifique de l'Académie Roumaine, Comptes Rendues de l'Académie de Science de Paris, Révue générale d'Electricité, Annales de Physique, Physikalische Zeitschrift, Journal des Sciences Physiques, Die Naturwissenschaften, Adamachi Scientific Journal, Kolloid Zeitschrift, Bul. Inst. Iași Polytechnic, Studies and Scientific Research of the Academy, Iași Branch. The research areas in which his research could be grouped could be: Magnetism of substances (this includes Bohr-Procopius Magnet, Magnetizing effect, Thin ferromagnetic blankets), Earth magnetism (maps of magnetism in Romania), Electro- and electromagnetic phenomena (light depolarization and birefringence), Metal – electrolyte potential, Other fields and Philosophy of science.

Since his student years, in 1913, Dragomir Hurmuzescu published in the Bulletin Scientifique de l'Académie Roumaine de Science / 3 / the results of his research on the determination of molecular magnetic moment applying the quantum theory developed by Planck and Langevin's theory of magnetism. Procopius intuited the existence of stationary energy states of atoms and established the theoretical expression of the magnetic moment of the electron in relation to the value of universal constants. The value of the molecular magnetic moment, also called the theoretical magnet, is established by Ștefan Procopiu a few years before Bohr calculates this value and makes it known to the scientific world which takes it under the name Bohr's magnet. As an act of justice, later, the discovery of Ștefan Procopius will be known as the Bohr-Procopius Magnet. Already his scientific personality was beginning to take shape internationally.

In 1924, Ștefan Procopiu resuming this problem, published in France, in the Journal of Physics / 4 / the point of view on Bohr's Magneton.

About this discovery, Horia Hulubei said: "Ștefan Procopiu is the first to introduce quantization to the atom and who, on this occasion, was also the first to give a value for the magnetic moment to the atom, still in force today." It was not until a year later that Bohr quantified the atom to explain the spectra of hydrogen, and the unit of atomic magnetism is generally known as Bohr's magneton.

The period of doctoral preparation at the Sorbonne was a particularly fruitful period in terms of research conducted in parallel with the preparation of his doctoral thesis which had as its theme: "The study of electrical birefringence of suspensions" / 5 /.

In 1921, in the laboratories of Gabriel Lippmann from the Sorbonne, Ștefan Procopiu discovers a new optical phenomenon which consists in the longitudinal depolarization of light by suspensions and colloids, a discovery presented at the meeting of the Academy of Sciences in Paris on August 8, 1931/6 /. It was a laboratory practice to present to the scientific community the outstanding results. In 1930, this phenomenon was named by Professor A. Butaric, THE PROCOPY PHENOMENON.

The pages of the volumes containing the scientific reports of the most famous physicists frequently mentioned the name of Ștefan Procopiu: On an electro and magnetic optical phenomenon that keeps metallic

powders in suspension (1922), Variation of mercury arc spectra with emission conditions (1922), The aspect of the arc and its spectrum in vacuum metals (1923), The arc spectra between metals (1924), The influence of mechanical actions and alternating current on magnetization discontinuities (1927), The electrokinetic potential of metals and the electromotive force of motion (1930), Demagnetization of iron and nickel in alternating field (1933), On the ideal magnetization of an iron crystal (1934), Discontinuities of magnetization in alternative field (1937), Cementation of iron studied with the dissolution potential of iron immersed in acidified water (1940).

Other journals such as: *Journal de Physique*, *Physikalische Zeitschrift*, *Annales de Physique*, *Scientific Annals of the University of Iasi*, *Journal de Chimie Physique* publish his works. The war interrupts the publication of some works by Ștefan Procopiu, but they are published in Romanian magazines.

A research direction developed by Ștefan Procopiu, of wide scientific interest and extended over a long period of time, was also that of terrestrial magnetism starting from the observation that Iași is a region with certain magnetic anomalies which required the development of a wide program of experiments carried out for several years, with data enrichment from year to year, which allowed the lifting of magnetic maps, important for clarifying this phenomenon. The measurement program extends to the area of Moldova and Bessarabia, and its collaborators Gh. Vasiliu, N. Calinicenco, N. Florescu are attracted to the works.

The first work on this issue appears in 1931/7 / and presents the elements of terrestrial magnetism in Iași at this time, followed by a series of works on magnetic measurements in Moldova and Bessarabia in 1933/8 /, the determination of magnetic elements and a first attempt, in 1935, for making magnetic maps for Romania / 9 /.

The measurements continue in the period 1936-1939 when the declination of the horizontal component / 10 / is highlighted and in the period when new magnetic maps are erected (1940), studies of earth magnetism in Romania (1941-1947). Every year new information is added that contributes to the enrichment of a database containing scientific information of maximum importance, respectively the secular variations (1950). The tracking of magnetism in time allows Ștefan Procopiu to draw the conclusion that the magnetic moment of the earth begins to increase, an observation he communicates in *Geophysical Research Washington* / 11 /.

The culmination of the efforts made by Ștefan Procopiu and his collaborators (T. Tutovan, Gh. Vasiliu, N. Florescu, N. Calinicenco, E. Ionescu, C. Păpușoi) during more than 100 years, led to the creation of magnetic maps of Romania from 1850–1954 and the magnetic elements of Bucharest (1712–1954) and of Iași (1828–1951) / 12 /. Ștefan Procopiu's researches in the field of terrestrial magnetism and the erection of magnetic maps during 1895–1954, in addition to their scientific value, they have a great topical character, allowing scientific predictions on some geomagnetism phenomena. As a result of his research, he found that from 1932 onwards the magnetic moment of the globe began to increase, after falling continuously for 100 years, the results communicated in response to controversies spread over several decades and led to 500 years period of this variation.

His research in the field of ferromagnetism (since 1930) led him to discover a new phenomenon, called in 1951, the Procopius Effect, an effect that will be used later in the construction of computers (the American Roman Storski). Studying the Barkhausen Effect, which consists in the passage of an alternating current through wires of ferromagnetic material, discovers a circular effect of the magnetization discontinuity that occurs when an alternating current passes through magnetic ferromagnetic wires, an effect that will know in the world of physics 13–15 /.

Ion Agarbiceanu said in 1956/20, p.84 / that the Procopius Effect opened a new and interesting path for all those who use the phenomenon of polarization as a method of nature research. Lesser known but scientifically important works: Ionic nature of scintillation spectra, the atomic nature of arc spectra, the theoretical justification for the fact that the ultraviolet emission of the sun is more intense than that predicted by Planck's Law as a result of recombination of metal ions (1923).

Ștefan Procopiu's activity after 1950 is just as rich. In 1951 he resumed the study of the Barkhausen effect, circular to wires through which an alternating current passes, determines the magnetic moment of the electron from electrical conductivity at high frequencies, in a gas discharge under the influence of a continuous magnetic field (1954), increasing the earth's magnetic moment (Washington 1954), determination of the value of Bohr magneton by a resonance method in ionized air (1957), optical dispersion of electrical birefringence of colloidal benzopurpurine suspensions (Paris 1972). There are many works by academician Ștefan Procopiu which, although they have a narrower circulation, have scientific importance and justify the inclination to pay more attention to them: the ionic nature of scintillation spectra, the atomic nature of arc spectra, the theoretical justification of ultraviolet emission of the sun is more intense than that predicted by Planck's Law as a result of recombination of metal ions (1923).

Receiving in 1957 the work that Stefan Procopiu had published on the magnet, Constantin Nenițescu wrote to him: "I received your work on the magnet and I was happier than if I had done it; I am proud and happy that you were able to publish this beautiful research abroad, so that we can have something to be proud of" / 20, p 86 /.

Academician Eugen Bădărău said about his work that: "his works are recognized abroad and cited in almost all treatises", and authors such as Bruhat, Ollivieri, Gamelin, Holfbauer, Koch, Bouasse, give great space to research by Stefan Procopiu.

4. Teacher and man of culture

Endowed with a special pedagogical talent, with a special clarity and elegance in presenting problems, the courses held were modern, scientifically substantiated and followed with interest by students. The phenomenon, the theory and the experiment, were the factors that, continuing the tradition grounded by its predecessor, professor Dragomir Hurmuzescu, he tried to continue. His books / 16-19 / are distinguished by the clarity and logic of information transfer, by the simplicity of formulating phenomena that become easily accessible to the student. I remember that during my doctorate in Iasi, visiting him and offering me his book on Thermodynamics, I hurried to see the presentation of the principle of energy conservation, how he finds the most appropriate formulation to make sense of a principle of physics, not simple understandable. And the fact, as the plastic says, that nature plays the role of an accountant who keeps a clear account between what he gives and what he receives, made me understand that the hardest thing is to simply present a complex thing!

The first principle shows that the energy of nature transforms from one form to another, but it is neither lost nor created and will be the basis of all phenomena.

Through his writings, or through his lectures, he proves to the reader or listener a high knowledge of the modern problems of science. Ștefan Procopiu is the author of articles on the history and philosophy of science, the presentation of the most modern problems that troubled the world of science in those years. Publishes or lectures on magneton, aspects of electricity development. "From Roentgen Rays to Gamma Rays", "Propagation of Electric Waves", "Is the Universe Eternal and Infinite?", "Julius Robert Meyer", "The Enigma of Earth Magnetism", are conferences published in mostly in Adamache Magazine. Each of these papers could be the subject of broader presentations of the ideas that emerge from them. A fragmented presentation, according to the author of these lines, would be an adventure, which is why I recommend to the reader an extensive review of these existing works in the Adamache Scientific Journal.

Gentle in his dealings with people, he showed great combativeness when he had to defend a conviction, an idea he believed in (he was not without harassment for much of the period 1944–1956 but knew how to go through it with dignity).

Like Dragomir Hurmuzescu, he believed and fought for the development of the concept of approaching the technique of "pure physics", an idea that did not exist in those years in universities, the development of that new concept of organizing electrotechnical education promoted by Dragomir Hurmuzescu in Iasi by creating institutes Electrotechnics and Chemistry at the University of Iași, the development of applied physics in universities, able to train engineers in these top fields, which was attacked by "Polytechnics" who asked to be the only ones to train specialists for technology, engineering. In an intervention "Are we serious?" / 20 / Procopiu invites Universities and Polytechnics to an open competition: "I have no doubt that there will come a time when the University Technical Institutes and Polytechnics will meet in the only serious, moral and useful field, in the field of competition and original production, in inventions. and in works that serve the development of the country's industries on a national basis". It's as if 100 years haven't passed!

The intellectual world of Iași considered Ștefan Procopiu not only the physicist who brilliantly continued the traditions of Dragomir Hurmuzescu, but also the one who discovered new phenomena that entered the patrimony of world physics, not only the teacher who, with talent, formed numerous generations of physicists and engineers (he also taught physics at the Polytechnic of Iasi, and for a long time he was also Dean of the Faculty of Electrical Engineering, continuator of the School of Electricity and the Electrotechnical Institute created by Dragomir Hurmuzescu in Iasi, the first form of higher education in electricity), but also the man of culture passionate about books, theater, music and painting. His friends confess his passion for: Goethe, Voltaire, Anatol France, Molière, Paul Valéry, Shakespeare. He liked Rembrandt's painting, El Greco, but also those of Luchian and Tonitza. Theater was another passion, being in the National Theater Committee, where the beloved writer Ionel Teodoreanu was director in those years, he was known for his contribution in establishing the theater's repertoire, in maintaining the

quality of performances. He liked philosophy, sharing the same passion with Mrs. Rodica Procopiu, his wife, the distinguished philosophy teacher I had the chance to meet and talk to him, during a visit to Professor Stefan Procopiu, in Iasi. He was an active contributor to the magazine "Notes from Iasi" and believed, like Will Durand, a pioneer of mechanical engineering, that science gives us knowledge, but that philosophy is the only thing that can give us wisdom. He argued that "science should be friendly to technology", a concept that is still very relevant today, which can suggest problems and borrow work procedures. "The technical arts, which do not use scientific discoveries, quickly become very sterile, and today the difference between science and technology is almost inappreciable, difficult to distinguish where one ends and the other begins, anticipating a situation we live in today when science and technology should be more closely and correctly understood. "

From the activity of lecturer of Ștefan Procopiu I would like to refer to one of the conferences, the one held at the opening of the academic year in Iași (1933) in which he, the youngest professor, had to give this conference in front of King Carol II, participant at this event.

Choosing as subject "HIMERS IN SCIENCES", Ștefan Procopiu uses this opportunity to sensitize the world, implicitly the king, on the role of science in the development of society, as well as "chimeras in sciences" have led to advances showing that astrology, alchemy and atom, chimeras at some point, they led to the development of society and its progress. Scientific foundation, poetry, knowledge, philosophy, the art of discourse, how it "sneaks into the king" things that should be in his attention, the organization in life, supporting development, how the international prestige of the scientific work affects the state, unproductive human thinking political to science are ideas of this discourse. As for the training of the engineer, he argues that "progress requires the training of the creative engineer who in unexpected cases knows how to handle himself." If pure science reaches fundamental results that bring order to chaos and the law for foresight, it is done only with great difficulty, often relying on false ideas and pursuing unachievable things.

Chimeras, astrology, perpetuum mobile, the atom led to the development of astronomy and knowledge of the universe, perpetuum mobile to the principles of thermodynamics, to the law of conservation of energy. "And the chimera of perpetual motion cannot be prevented from stimulating the imagination beforehand, at least when it comes to the whole universe."

Alchemy, the art of turning "vulgar bodies into gold" led to their attempts to show chemistry, the taste for transforming bodies from one another. The atom is again a field in which from speculation and chimera, knowledge is reached. What Ștefan Procopiu intuited and predicted in 1933 proved to be abundant in our years! He concludes his lecture by anticipating the complex problems that the future will pose to the scientist "knowledge becomes complicated and new problems constantly arise; Newton, says Ștefan Procopiu, said that at the end of his life he considered himself a child who, walking on the shores of the ocean of the unknown, found a shell more beautiful than the others, but that the infinite shore of the Ocean remains with an infinite number of shells. . The conclusion of this conference was clear: With these shells that we have to find, we are building civilization and progress / 20 /.

Valuable works on the life and work of Ștefan Procopiu, were published by V. Tutovan / 22 /, Cezar Buda / 23, 24 /, as well as in a work and rich in information work published by Teodora Cornelia Cristofor, edited by Ed. Palace of Culture, Iasi / 20 /.

5. Conclusions

In the history of Romanian science and culture, Ștefan Procopiu is one of the people that our country can be proud of through his contribution to the development of physics and the treasure of knowledge of the world. Trained in the Romanian school, able to take what is good from others and to be a scientist in France and in his country, Ștefan Procopiu continued in Iași the scientific openings of the Iași school of physics / 25 / (Teodor Stamati, Stefan Micle, Dragomir Hurmuzescu) and contributed to the formation of other valuable physicists: teachers Toma Farcaș, Gheorghe Vasiliu, Vasile Petrescu, Vasile Tutovan, Ilie Bursuc, Valer Pop, Constantin Păpușoi.

In the history of physics, Ștefan Procopiu remains through 3 fundamental discoveries: the magnet (Bohr – Procopius Magnet), the Procopius Phenomenon and the Procopius Effect, but also through others mentioned in the paper and important through the applications that followed their publication (magnetization, thin layers, processes electrophoresis with application to paint deposition technologies, terrestrial magnetism and maps). Dragomir Hurmuzescu's tradition continues, contributing to the increase of the prestige of the Romanian physics school. He said: knowledge is acquired through study, but the facts found and experiences are the levers that fix the knowledge.

Teacher and man of culture, supporter of Dragomir Hurmuzescu / 21 / in the establishment of the School of Electricity from Iași and of the Electrotechnical Institute in the University of Iași, of the development of applied physics, Ștefan Procopiu leaves us a work that we have the obligation to know and to we capitalize on it. Today, when we talk about value, what it represents and what the man of value should be in the progress of society, when we need models that younger generations have less and know less about those that would exist, their presentation in addition to the invitation to be followed, it is also a tribute that we electrical engineers pay with reverence and gratitude to those who have developed Romanian physics and electrical engineering.

Ștefan Procopiu remains as academician Cristofor Simionescu remarks: “We will not say new things stating that academician Ștefan Procopiu is the greatest physicist that our people have given so far, great personality of Romanian science and culture, who remarkable achievements name, in the grounded conquests of physics worldwide”/ 20, p. 100 /.

BIBLIOGRAPHY

/ 1 / Ștefan Procopiu: Variation of the electromotive force by the movement of the electrolyte. In *Annales Scientifique de L’Universite de Iassy*, 1912, 7, pp. 224–234

/ 2 / Ștefan Procopiu: Optical dispersion of electric birefringence and electric dichroism of colloidal suspensions of vanadium pentoxide and benzopurpurine, *Comptes rendues de l’Academie des Sciences de Paris*, 271, 1972, pp. 339-341

/ 3 / Ștefan Procopiu: Determination of molecular magnetic moment by Planck's theory. In the *Bulletin of the Romanian Society of Sciences*, 2. 1934, pg. 29

/ 4 / Ștefan Procopiu: Sur le magneton de Bohr. In *Journal de Physique*, 1924, pg 130

/ 5 / Ștefan Procopiu: Sur la biréfringence électrique des suspensions. PhD thesis Masson, Paris, 1924

/ 6 / Ștefan Procopiu: Depolarization of light by liquids holding crystalline particles in suspension. In *Comptes rendues de l’Académie des Sciences de Paris*, 1921, 173, pp. 409–411

/ 7 / Ștefan Procopiu: Les elements du magnetisme terrestre à Iassy en 1931. *Bull Scientifique de l’Académie Roumaine*, 14, 1931, p 235-242

/ 8 / Ștefan Procopiu: Magnetic Measurements in Moldova and Bessarabia. *Bull Scientific of the Romanian Academy*, 16, 1933, pp. 33-38

/ 9 / Ștefan Procopiu: Determination of Magnetic Elements in Romania and Magnetic Map of Romania, *Scientific Annals of the University of Iassy*, 21, 1935, p 270–302

/ 10 / Ștefan Procopiu: Magnetic measurements in 1938. The declination and the horizontal component. *Proceedings of the Romanian Academy of Sciences* 3, 1939, pp. 284-292

/ 11 / Ștefan Procopiu: The Earth's magnetic moment began to grow *Journal Geophysical Research*, Washigton, 1955, pp. 60, 115

/ 12 / Ștefan Procopiu: The Magnetic Maps of Romania 1850–1954. The magnetic elements of Bucharest from 1712–1854 and Iassy from 1821–19051. The critical century variations of Romania. *Bul Inst Politehnic Iasi V*, 1959, 1-2, pp. 161–175

/ 13 / Ștefan Procopiu: Experimental research on the Barkhausen phenomenon. *Scientific Annals of the University of Iassy*, 16, 1929, pp. 352-374

/ 14 / Ștefan Procopiu and T. Farcaș: Relationships between Magnetization Discontinuities and Magnetization Intensity. *Scientific Annals of the University of Iassy*, 16, 1929, pp. 344-351

/ 15 / Ștefan Procopiu: On the internal Barkhausen effect. *Bull Scientifique de l’Académie Roumaine*, 1932, 15, pp. 84-86

/ 16 / Ștefan Procopiu: Introduction to electricity and magnetism. Vol I, Iași, 1929

/ 17 / Ștefan Procopiu: Introduction to electricity and magnetism. Vol I, Edition II, Iași, 1938

/ 18 / Ștefan Procopiu: Electricity and Magnetism, Vol I, Iași, 1939

/ 19 / Ștefan Procopiu: Thermodynamics, Iași, 1948

/ 20 / Teodora Cornelia Cristofor (Editor): Ștefan Procopiu: Documentary confessions. Palace of Culture Publishing House, Iași, 2012. Ștefan Procopiu: Are we serious? p. 200-203

/ 21 / Tănăsescu Florin Teodor: Dragomir Hurmuzescu as he was. In *Electrotechnics*, 1999, vol. 47, no. 11-12, pp. 27-47

- / 22 / V Tutovan: Ștefan Procopiu. Selected works. Ed. Academiei Românei, Bucharest, 1979
- /23 / Cezar Buda: The life and work of the scientist Ștefan Procopiu, Ed. Chemarea, Iași, 1993
- /24 / Cezar Buda: The life and work of the scientist Ștefan Procopiu, Ed II revised and completed, Ediura
Universitatii Al. I. Cuza, Iași, 2007
- /25 / Gh. Popa: Physicists and Physics at Alexandru Ioan Cuza University, Conference held at the Days of
Al. I. Cuza, Iași, oct. 2012