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GLIMPSES OF THE HISTORY OF CHEMISTRY IN MEXICO

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ABSTRACT

The present article describes some aspects of the history of chemistry in Mexico. Some developments of interest of the Pre-Hispanic or Pre-Columbian Period are treated briefly. For the Colonial Period, the importance of the School of Mines of Mexico City, the discovery of vanadium and other contributions of Andrés Manuel Del Rio are discussed in detail. For more recent times, the work of Xorge Alejandro Dominguez in the area of natural products and the study of the ozone layer by Mario José Molina, Nobel Prize in Chemistry, are presented.

RESUMO

O presente artigo descreve alguns aspectos da história da química no México. Alguns desenvolvimentos interessantes do Período Pré-Hispânico ou Pré-Colombiano são mencionados de maneira sucinta. Para o período Colonial, são discutidos em detalhe a importância da Escola de Minas da Cidade do México, a descoberta do vanádio e outras contribuições de Andrés Manuel Del Rio. Para tempos mais recentes, as contribuições de Xorge Alejandro Dominguez na área de produtos naturais e de Mario José Molina, Prêmio Nobel em Química, ao estudo da camada de ozônio são tratados em detalhe.

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INTRODUCTION

Contrary to general belief in certain circles, many scientists that were born, lived or worked in Latin America, made important contributions to chemistry. Among them are Bartolomé de Medina who set up amalgamation as an industrial process in 1555 in Zacatecas, México; Carlos Siguenza y Góngora, Mexican astronomer and cosmographer, known especially for his studies of comets; Antonio de Ulloa, who was the first to take platinum to Europe; Fausto and Juan José Delhuyar, discoverers of tungsten; Andrés Manuel del Rio, discoverer of vanadium; José Caldas, Director of the Observatory of Bogotá, Nueva Granada (Colombia), who studied the variation of the boiling point of water with altitude and is better known for contributions in astronomy, mathematics and botany; José Luis Casaseca, founder of the Cuban Institute of Chemical Research in 1848; Alvaro Reynoso, father of modern sugar technology and Luis Frederico Leloir, Nobel Laureate in Chemistry. Significant contributions were also made by Horácio Damianovich in noble gas chemistry, Gustavo Fester, Xorge Alejandro Dominguez and Otto Gottlieb in natural products and Ernesto Giesbrecht in the chemistry of lanthanides.[1-28] In 1995 the Mexican Chemist Mario José Molina was awarded the Nobel Prize in Chemistry together with Paul Crutzen and F. Sherwood Rowland for their work on the ozone layer.

The history of Mexico is generally subdivided into four large periods. They are the following:

1. Prehistoric and Pre-Hispanic Period (Beginning -1517).
2. Period of Conquest and Colonization by the Spanish (1517-1810)
3. Period of the Struggle for the Independence and the Establishment of the Mexican State (1810-1910).
4. Period of Modern Mexico (1910-Present).

The present article presents some glimpses of the history of Chemistry in Mexico.

PRE-HISPANIC OR PRE-COLUMBIAN PERIOD

According to some, Latin America was and still is a scientific desert and and there was no such thing as Pre-Hispanic or Pre-Columbian science.[18] Nobody however can deny the existence of vast empirical knowledge in astronomy, agriculture, civil engineering, metallurgy, medicine, the art of embalming, and the chemistry of medicinal plants and dyes. Did the building of the pyramids, the calendaristics of the Aztecs and Mayas and the development of agriculture, water supply, irrigation and medicine, especially by the Incas, involve science?

AZTEC CALENDAR, SYMBOL OF PERIODIC ONDULATORY BEHAVIOR THE UNIVERSE AND TOKEN OF THE ETERNITY OF KNOWLEDGE.

THE AMAZING EQUINOX NATURAL SPECTACLE: THE SERPENT COMING DOWN THE PYRAMID. CHICHEN-ITZÁ, YUCATÁN, MEXICO.

At least seven metals, among them iron, gold, copper, lead, silver and tin were used in the Pre-Columbian Period. When Ferdinand Cortez asked the Aztecs from where they obtained their knives, they pointed to the sky (meteoritic iron of celestial origin). The Incas developed sophisticated smelting and alloying processes and their blast furnaces used the wind from the Andes. [19-28]

The use of medicinal plants by the Aztecs is well-documented and will be mentioned only in passing. Soon after the Conquest, many Spanish explorers and physicians spent years studying Aztec medicine. For details, we cite especially the work of Bernardo Ortiz de Montellano that spans more than three decades. [23,29]

Today there is vast interest in folk and traditional remedies throughout the world and the subject is treated by a new branch of science called ethnopharmacology.[30,31]

COLONIAL PERIOD

The Colonial Period is characterized by numerous scientific expeditions studying relief, fauna, flora, population and natural resources.

The Spanish founded more than thirty (30) universities and institutions of higher learning in the New World. The first university founded was the University of Santo Domingo (1535), followed by the University of Mexico (1551) and San Marcos, Lima (1551). We also mention the Colegio del Rosario, Bogotá, Colombia (1580), Colegio de Cordoba, Argentina (1613) and the University of Havana (1722). The Colegio de Minería of Mexico City was established in 1792 and the Cuban Institute of Chemical Research in 1848.

CATHEDRAL OF MEXICO.

Of course, the main motivation of all this scientific activity was the maximum exploration of all the resources available in the New World.[11-22]

For example, Francisco Fernandez, Medico de Camara at the Court of Philip II went to Mexico in 1570 and spent seven years studying Aztec medicine and medicinal plants. Notable contributions were made in all areas of science beginning with astronomy, cosmography and cartography and including agriculture, animal husbandry, botany, medicine, metallurgy and others.

José Celestino Mutis (1732-1808), Spanish physician and botanist, investigated the chincona forests of Colombia and collaborated with Juan José de Elhuyar in various aspects of mining.

Antonio de Ulloa, member of a distinguished Spanish family, was born in 1716 and died in 1795.He studied physics and mathematics and was a member of many scientific societies, including the Academy of Sciences of Paris and the Royal Society of London. He traveled widely in Europe and the Americas and occupied many important positions, including those of Frigate Captain, Commander of the Royal Squadron of the Spanish Armada, Governor of Huancavélica-Peru, Florida and Louisiana.[14,32]

In 1735, while a member of a scientific expedition sent by the Spanish and French governments to South America to measure the degree of meridian in Quito, close to the equator, he discovered platinum in the mines of Lavadero or wash gold in the district of Chocó, in the western part of present day Colombia.[14,32-36]

From the point of view of chemistry, the most important development is probably the establishment of the school of mines in Mexico and Colombia (Colegio de Minería, Mexico and Colegio del Rosario, in Santa Fe de Bogotá, Colombia).

The Delhuyar (de Elhuyar, D'Elhuyar) brothers Fausto and Juan José played a very important role. They traveled in many parts of Europe, studied and worked at the Seminary of Vergara where they discovered tungsten or wolfram in 1783.

POSTAGE STAMP FROM SPAIN COMEMORATING 200 YEARS FROM THE DISCOVERY OF TUNGSTEN OR WOLFRAM BY THE DELHUYAR BROTHERS

The older brother Juan José (1754-1796) went to Colombia in 1786, where among other things he founded the School of Mines of the Colegio del Rosario in Bogotá. He died in Colombia and members of his family are national heroes of the war of independence from Spain.

Fausto Delhuyar (1755-1833) spent more than 30 years in Mexico and upon his return to Spain occupied many important positions.

In 1788, by Royal Edict, Fausto de Elhuyar was appointed Director General of the Royal Assembly of Mines of Mexico. Soon after his arrival in Mexico City he supervised the construction of a chemical laboratory and assay furnaces.

Elhuyar en Viena, 1788.

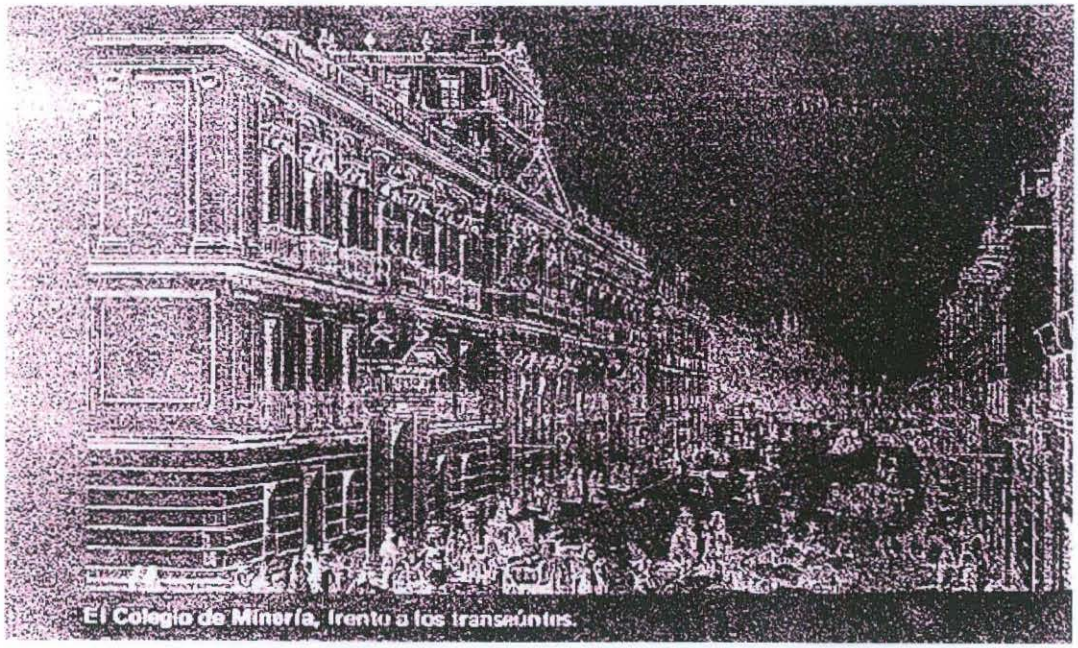
[illegible]

FAUSTO DE ELHUYAR (1755-1833)
DISVOVERER OF TUNGSTEN AND FOUNDER OF THE SCHOOL OF MINES OF MEXICO

JUAN JOSÉ DE ELHUYAR (1754-179)
DISCOVERER OF TUNGSTEN AND FOUNDER OF THE SCHOOL OF MINES OF BOGOTÁ, COLOMBIA

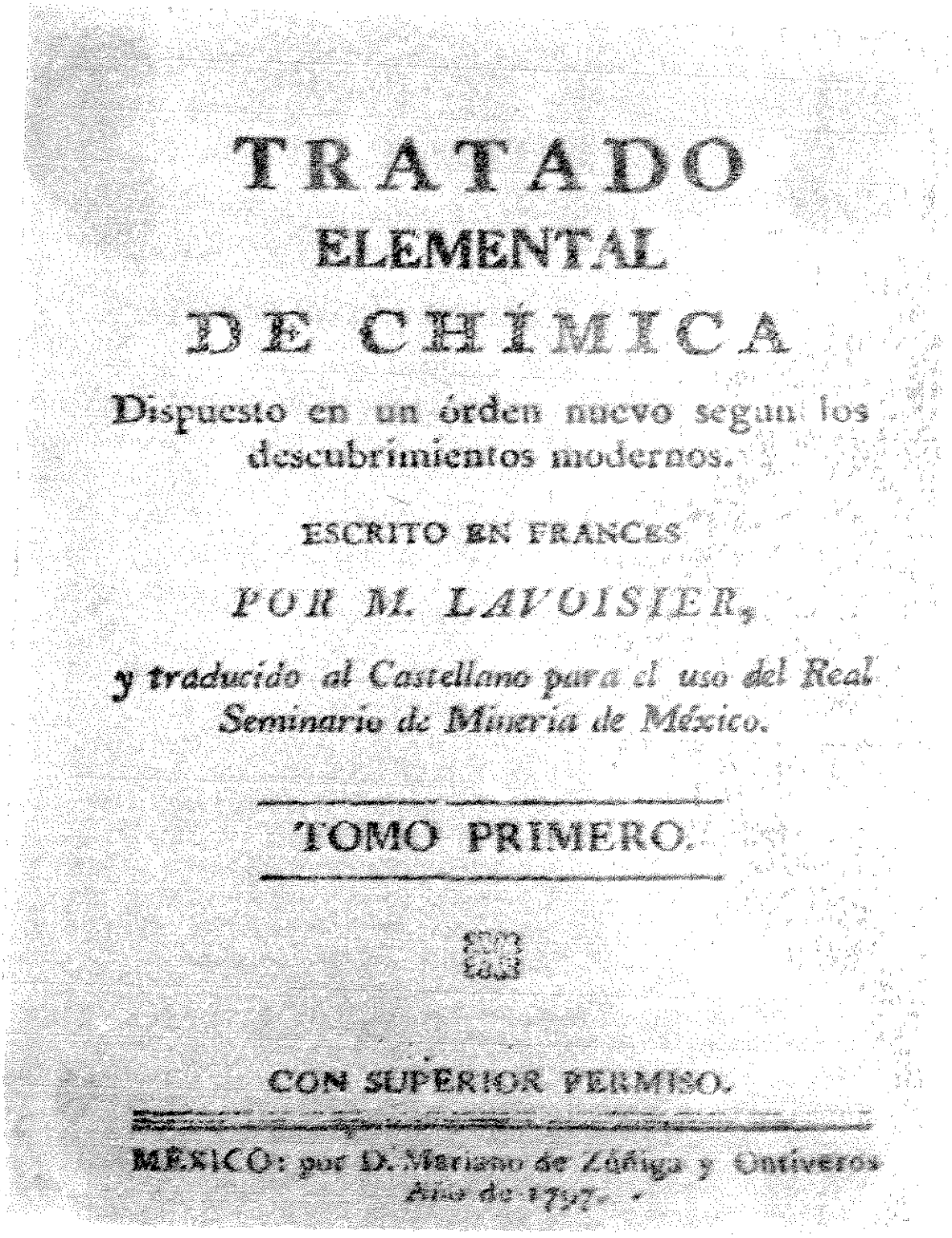
The Colegio de Mineria became a very respectable institution and during the time of Fausto de Elhuyar and Andrés Manuel del Rio was one of the best of its kind in the whole world.

Alexander von Humboldt, during his visit to Mexico, was impressed by the high quality of instruction and research done at the School of Mines, especially by Fausto de Elhuyar and Andrés Manuel del Rio.[14,37,38]



THE SCHOOL OF MINES OF MEXICO FROM AN ENGRAVING OF THE TIME

The first Spanish translation of Lavoisier's "*Traité Elementaire de Chimie*" was published in Mexico City in 1797 and used at the School of Mines.



TRATADO
ELEMENTAL
DE CHIMICA

Dispuesto en un órden nuevo segun los descubrimientos modernos.

ESCRITO EN FRANCES

POR M. LAVOISIER,

y traducido al Castellano para el uso del Real Seminario de Mineria de México.

TOMO PRIMERO.

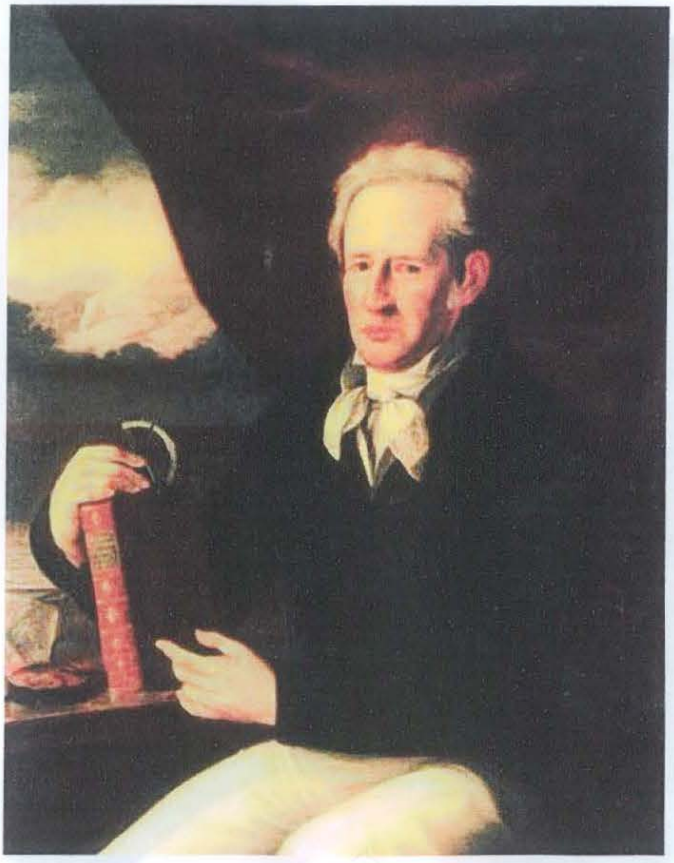
CON SUPERIOR PERMISO.

MEXICO: por D. Mariano de Zúñiga y Ontiveros.
Año de 1797.

ANDRÉS MANUEL DEL RIO, DISCOVERER OF VANADIUM

Andrés Manuel Del Rio was born in Madrid on November 10, 1764 and passed away in Mexico City on March 23, 1849. He studied mineralogy, geology, metallurgy and mining engineering at the Royal Academy of Mines of Almadén and the Patriotic Seminary of Vergara. It was at the School of Mines of Vergara that Fausto and Juan José Delhuyar discovered tungsten or wolfram in 1783.

After completing studies in Spain, Del Rio received a stipend from the Spanish Crown and in 1781 traveled to Paris and later to Freiberg, Chemnitz (Schemnitz) and other scientific centers throughout Europe. He returned to Spain more than a decade later, in 1793. In Paris, he studied chemistry with Darcet and acquired experience in porcelain and ceramics manufacturing and processing. In Chemnitz, Freiberg and various metallurgic centers in France, England and other European countries, Del Rio specialized in metallurgy and mining engineering. While in Freiberg, he was a devoted student of Abraham Gottlob Werner and became fascinated by mineralogy. [38]



**ANDRÉS MANUEL DEL RIO (1764-1849)
DIRECTOR OF THE SCHOOL OF MINES OF MEXICO
AND DISCOVERER OF VANADIUM.**

Soon after his return to Spain, at the invitation of Don Fausto Delhuyar, Andrés Manuel Del Rio went to Mexico City where he was appointed professor at the School of Mines (*Colegio de Minería*). He arrived in Mexico on December 18, 1794. There he lived and worked, with few interruptions, for almost half a century, until his death in 1849.

From 1820 to 1823 he represented Mexico as a deputy in the Spanish Cortes and from 1829 to 1832 he lived in exile in Philadelphia, United States. In 1820 he pleaded for Mexico's independence in the Cortes and in 1829, when the Mexican Government expelled the Spanish (although he was not included among them), he went to exile in Philadelphia, in solidarity with his fellow countrymen.

At the Colegio de Minería (School of Mines), Del Rio taught mineralogy, French, geology, mining engineering and metallurgy. He wrote nany textbooks, including *Artes de las Minas*, *Geometria Subterranea*, *Tratado de Vetas* (Treatise on Lodes or Mineral Veins) and *Elementos de Orictognosia* (Elements of Fossil Science and Mineralogy). He also translated various manuals, including the *New Mineral System of Berzelius, Textbook of Geology*, extracted from *Lethae Geognosticas* by Bronn and annotated, translated and commented Karsten'a Mineralogical Tables (*Tablas Mineralogicas de Karsten).*

Elementos de Orictognosia, by far the most important work, was first published in two volumes in Mexico in 1795 and 1805. The second expanded edition was divided in two parts, practical and theoretical. The practical part, that Del Rio considered more important and included the description of many minerals from Mexico was published in Philadelphia in 1832, during his exile in the United States. The second or theoretical part was published after his return to Mexico and a thorough revision in 1846. Alexander von Humboldt said that it was the best book on mineralogy in Spanish and Guyton de Morveau considered it the best book on mineralogy in all languages.[37,38]

On the more practical side, Del Rio developed a pump for draining water from mines, was the manager of the first formal iron and steel foundry of Latin America in Coalcomán, Michoacán, Mexico from 1805 to 1809, director of the Casa de Moneda (Public Mint), deputy in the Mining Tribunal and honorary councilman of Mexico City.

His main research interest was the study of minerals found in Mexico and in particular of vanadite , $PbCl_2.3Pb_3(VO_4)_2$. He published a large number of papers dealing with minerals and geology in the main European journals and also in scientific periodicals from Mexico and the United States.

It was in 1801, while analyzing the grey lead mineral vanadite from Zimpán, Hidalgo, Mexico that Andrés Manuel Del Rio discovered a new element that he first called *panchromium*, because of the many colors of its oxides and later *erythronium*, because of the characteristic red colors of its salts.[14,38,39]

On September 26, 1802 he communicated his discovery to Don Antonio Cabanilles (Cavanilles), who published it in the *Anales de Ciencias Naturales de*

Madrid in May of 1803 (Volume VI, Number 16). The discovery, as described by Del Rio himself in a footnote on page 6 of *Tablas Mineralogicas de Karsten* published in 1804 can be seen elsewhere. The subsequent controversy about who was really the discovere of vanadium has been treated in detail and it will not be discussed here.[14,38-42]

It is interesting to read the correspondence between Berzelius and Wöhler and the latter's lines to Liebig. They offer some astonishing clues about the side scenes and the development of science.[43]

Be it as it may, the discovery of vanadium can be considered an outstanding accomplishment for science in Mexico and Latin America. The next discovery of an element in a laboratory of the United States took place almost one and a quarter of a century later.

Andrés Manuel Del Rio' more than fifty years of service to science and to Mexico has been duly recognized. The highest prize awarded by the Chemical Society of Mexico bears his name.

PERIOD OF THE STRUGGLE FOR INDEPENDENCE AND THE ESTABLISHMENT OF THE MEXICAN STATE

For this turbulent period in the history of Mexico, we mention more as a curiosity, the contribution of two personalities, Ilarie Mitrea and Vicente de Ortigosa.[15,16,26]

Ilarie Mitrea was born in Rasinari near Sibiu, Transylvania, Romania in 1842. He was the son of a priest and studied medicine at the University of Vienna. He is one of the most interesting and erudite figures among the Romanian scholars of the nineteenth century. In addition to his profession as a physician, he was a passionate historian, anthropologist, archaeologist, ethnographer, linguist, naturalist and explorer and traveler of four continents. He counted among his friends persons like Titu Maiorescu, the notable literary critic and politician and Grigore Antipa, the famous Romanian biologist.[15]

Mitrea enrolled in the Austrian-Mexican Army after graduating from Medical School and went to Mexico in 1866. He stayed in Mexico for about two years. During this time he learned Spanish and Nahuátl (the language of the Aztecs) and in addition to performing his duties as an officer and physician in the Austrian-Mexican Army, he traveled extensively throughout Mexico, studied in depth various aspects of Mexican society and life and became a friend and helped the revolutionaries of Benito Juarez. Mitrea spent a long time in the region of Tabasco where he collected old pottery, weapons and many other artifacts that he later took to Europe. It appears that he also spent some time studying the culture of the Maya Indians near Palenque.

ILARIE MITREA (1842-1904)
ROMANIAN PHYSICIAN, NATURALIST AND EXPLORER OF FOUR CONTINENTS

Of considerable interest are Ilarie Mitrea's studies and observations concerning social and medical aspects of the Indians and Mestizos of Mexico. As a physician in a country ravaged by war, he had ample opportunity to do many comparative studies of the varying effects, morbidity and resistance to different illnesses by the local Mexican and Indian population and the European soldiers. He concluded, for example, that the Mexican and Indian soldiers were much less susceptible to septicemia (blood poisoning) than the Austrians.[15]

Like most of the other Romanians that took part in the installation of Maximilian as emperor of Mexico, Mitrea was not too convinced about the equity of the French and Austrian cause and when the opportunity arose, he helped the revolutionaries of Benito Juarez. On one occasion, in a cave near the town of San Diego, not far from Mexico City, Mitrea worked continuously for sixteen hours performing surgery on the wounded soldiers of Benito Juarez.

Ilarie Mitrea returned to Europe in April of 1867, two months before the tragic

execution of Maximilian by the Mexican revolutionaries in Queretaro. He published many of his impressions, reminiscences and studies from his stay in Mexico in the Romanian review Albina (The Bee) of Vienna. In 1869, he joined the Dutch Army as a physician and traveled to Indonesia, where he spent more than twenty years working as a physician on the Island of Borneo and doing natural studies and explorations. Many of his collections of a variety of artifacts, weapons, insects, animals, minerals and medicinal plants, never seen by other Europeans are still found today in the Ethnographic Museum of Vienna, Austria , the National Museum of Bucharest and the Museum of Giurgiu in Romania.

The Mexican chemist, Vicente de Ortigosa was probably the first scientist of the American Continent to obtain a doctoral degree in chemistry. He studied with Justus von Liebig in Germany at the University of Giessen. He was awarded the doctorate in 1842 and his research studies involved the formula and structure of nicotine. [16]

PERIOD OF MODERN MEXICO

During this period that spans the last and the present centuries two developments may be considered very important.

One is the development of the petrochemical industry (PEMEX) after the expropriation and nationalization of oil reserves in 1936.

The other is the identification of steroidal components in native Mexican plants that eventually led to the establishment of SYNTEX and a strong pharmaceutical industry that was the first world wide producer of steroidal materials such as progesterone, testosterone, estradiol and cortisone.

The industrial development, especially in these two areas resulted in a high demand for trained chemists and led to a substantial increase in chemical education and research. We cite particularly the Escuela Nacional de Quimica established in 1916 and the Facultad de Quimica of the National Autonomous University of Mexico – UNAM. [16,17,22,26]

We decided to describe and treat in detail the contributions of Xorge Alejandro Dominguez, Mexico's foremost organic chemist and Mario José Molina , 1995 Nobel Laureate in Chemistry.

MEXICO CITY. CRISTOPHER COLUMBUS SQUARE AND LA REFORMA BOULEVARD.

XORGE ALEJANDRO DOMINGUEZ, MEXICO'S FOREMOST ORGANIC CHEMIST

Xorge Alejandro Dominguez, Mexico foremost organic chemist was born in Orizaba, State of Veracruz, Mexico on November 12, 1926 and died of heart attack in Mexico Cityon May 26, 1991, only hours after he had been awarded by President Carlos Salinas de Gortari the *Lázaro Cárdenas Medal* for his contributions and dedication to the scientific advancement of Mexico. [8]

He attended primary and secondary school in his native city (*Escuela Primaria Cantonal* and *Escuela Secundaria Federal Obrera de Orizaba*). He continued his studies in Mexico City and obtained the Bachelor of Science Degree in Biological Chemistry from the Instituto Politécnico Nacional in 1950. In 1952 he obtained the Master of Science Degree from Harvard University and in 1964 he was awarded the Ph.D. Degree in Chemistry by the University of Texas. In 1970, Professor X.A. Dominguez received an Honorary Doctoral Degree from the Universidad Autónoma de Guadalajara.

PROF. X.A. DOMINGUEZ (1926-1991)
MEXICO'S FOREMOST ORGANIC CHEMIST

His first faculty appointment (1946-47) was in the National School of Biological Sciences of the National Polytechnic Institute in Mexico City. From 1948 until his death, he was Professor of Chemistry at the Instituto Tecnologico y de Estudios Superiores de Monterrey – ITESM, in Monterrey, Nuevo León, Mexico. From 1957 to 1991 he acted as Chairman of the Chemistry Department of ITESM. Prof. Dr. X.A. Dominguez was Visiting Professor at many universities in different countries, including Mexico, United States, Costa Rica, Guatemala, El Salvador, Nicaragua, Colombia and Argentina. [8]

Professor X.A. Dominguez had research interests that dealt mainly with the chemistry of natural products. He discovered, isolated and identified many new chemical substances from Mexican plants and organized many international symposia and conferences dealing with phytochemistry. He has published over 250 articles and several books dealing with this subject. During the 44 year period as professor and researcher at the Instituto Tecnologico y de Estudios Superiores de Monterrey, ITESM, he acted as research advisor of more than 200 students at the graduate and undergraduate levels. More than 100 graduate students completed their master's theses or doctoral dissertations under his supervision. [8]

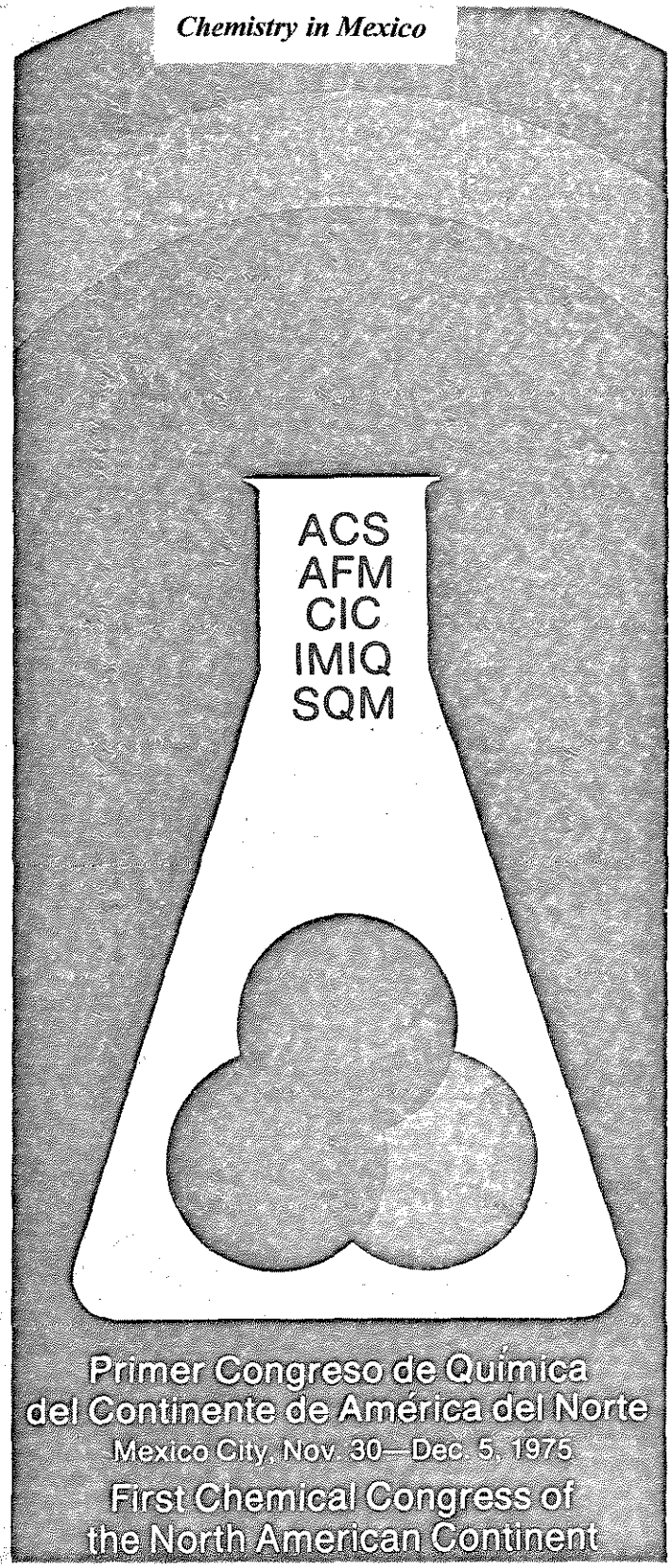
We (LGI) first met Prof. Dr. Xorge A. Dominguez in December of 1975 during the *First Chemical Congress of the North American Continent* in Mexico City. At the time he was already one of the most respected chemists in Mexico. Wherever he went, he was the center of attention, appreciation and esteem.

It is interesting to note that the *First Chemical Congress of the North American Continent* sponsored jointly by the American Chemical Society, Mexican Pharmaceutical Society, Chemical Institute of Canada, Mexican Institute of Chemical Engineering and the Mexican Chemical Society, of all cities of North America, took place in Mexico City and occurred more than a hundred years later after similar events in Europe.

Professor Xorge A. Dominguez was a very educated and erudite man, a scientist aware of his social responsibility and a patriot. He firmly believed that the main purpose of a true scientist was the search for truth and its application to the improvement of conditions of man. He was also a great educator. Like all good teachers, he believed in the power of example and thought that a teacher can teach the most by his example.[8]

According to many of his students and collaborators, who used to call him "Doctor", Prof. X.A. Dominguez was not only a professor, educator, chairman, co-worker, researcher, but also a guide , source of inspiration and example, father, friend and a lot more. Many recollect their peripatetic walks with him on the various floors of the Chemistry Building, then to the Post Office, Administration Building, Library of ITESM, etc. and back to his office. During these journeys or peregrinations with him they learned about a lot of things while accompanying the teacher. The knowledge gained could be philosophy, chemistry, politics, a new chapter of the history of Mexico, world history or about the poverty oath of the true scientist. Sometimes he would tell a lot of jokes. His office was a true "Temple of Entropy": mountains of books, journals, articles, papers and all kind of other things (cosas). There, almost in a strike of magic , he also found what he was looking for.[8]

Professor Xorge A. Dominguez was preoccupied with the teaching of science at all levels. He was the author of more than 35 chemistry books aimed for secondary school and university instruction. Among them we cite Fundamentos y Problemas de Quimica Orgánica, Limusa-Wiley, 1970; Fitoquimica, Limusa-Wiley, 1975; Quimica Orgánica Fundamental, Limusa 1980; Quimica Orgánica Experimental, Limusa 1982 and Cromatografia en Papel y Capa Delgada, OEA, Washington, 1975. He also translated about a dozen books dealing with chemistry or other areas of science, mainly from English.



COVER PAGE OF THE PROGRAM OF THE FIRST CHEMICAL CONGRESS OF THE NORTH AMERICAN CONTINENT
Mexico City, Nov. 30 – Dec. 5, 1975.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AIR MAIL

58

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May 9, 1991

Prof. Dr. Lavinel G. Ionsescu
Instituto de Química - Depto. Fisicoquímica
Universidad Federal de Rio Grande do Sul
Porto Alegre - Brasil

Dear Prof. Dr. Ionescu:

This answers your letter of April 20 with your invitation to be a member of the Editorial Board of the new Southern Brazilian Journal of Chemistry.

I did not receive your first letter. Now I have read carefully the copy enclosed and I gladly accept the distintion to colaborate with you for the next two years. So I am ready to do my duties.

With best wishes,

PROF. DR. XORGE A. DOMINGUEZ
Chairman Chemistry Department

'ycl.

Professor X.A. Dominguez was widely respected in the scientific community. He was a member of the Mexican Chemical Society, American Chemical Society, Swiss Chemical Society, Phytochemical Society of America, National Academy of Scientific Research of Mexico and a fellow of the Royal Chemical Society. He was President of the Northeast Section of the Sociedad de Quimica de México from 1976 to 1978 and gave many invited lectures throughout Europe and the Americas.

He received many awards for excellence in teaching or research in chemistry. Among them we cite the *Romulo Garza Prize for Research* in 1974 and *for Teaching* in 1975, *National Scientific Prize Luis Elizondo* in 1976, *National Education Award* in 1982, *Andrés Manuel Del Rio Award in Chemistry* in 1985, *National Chemical and Pharmaceutical Sciences Award* in 1986 and the *Lázaro Cárdenas Medal* in 1991.

He was regional Editor (1970-1972) and Editor in Chief of the *Revista Latinoaricana de Química* from 1972 to 1991 and member of the Editorial Board of other journals and periodicals including *Revista de la Sociedad Química de México* and *Revista Iberoamericana de Educación Química*.

Prof. Xorge A. Dominguez was Member of the Editorial Board of the *Southern Brazilian Journal of Chemistry* and he gave us valuable advice during the initial stages of this Journal. He was always ready to help, collaborate and fulfill his responsibilities.

MARIO JOSÉ MOLINA, 1995 NOBEL PRIZE IN CHEMISTRY

Mario José Molina was born in Mexico City on March 19, 1943. His father, Roberto Molina Pasquel was a lawyer, a faculty member of the Universidad Nacional Autonoma de México-UNAM and also served as Ambassador of Mexico to Ethiopia, Australia and the Philippines.

He attended elementary school in Mexico City and at the age of eleven went to a boarding school in Switzerland. At the time, according to what Professor M.J. Molina states in his autobiography, he had already decided to become a research chemist. [44]

In 1960 he enrolled in the Chemical Engineering Program of the National University of Mexico-UNAM and in 1965 he obtained the Bachelor Degree in Chemical Engineering.

MARIO JOSÉ MOLINA, 1995 NOBEL LAUREATE IN CHEMISTRY

Mario José Molina spent almost two years (1965-1966) doing graduate studies at the University of Freiburg, Germany, doing research in the kinetics of polymerizations. During his stay in Europe, he also spent some time in Paris studying mathematics and became thoroughly convinced to obtain a good background in mathematics, physics and physical chemistry.

In 1968 he went to the University of California at Berkeley-UCB in order to pursue graduate studies in physical chemistry. His research advisor was Prof. George C. Pimentel, a well known scientist, who studied molecular dynamics with chemical lasers and also was a pioneer in matrix isolation techniques used in the elucidation of molecular structure and bonding of transient species. In 1972, Mario José Molina completed his Ph.D. Degree in Physical Chemistry. His research work involved the investigation of the distribution of internal energy in the products of chemical and photochemical reactions. He summarizes his experience at the University of California at Berkeley as follows:

"My years at Berkeley have been some of the best of my life. I arrived there just after the era of the free-speech movement. I had the opportunity to explore many areas and to engage in exciting scientific research in an intellectually stimulating environment. It was also during this time that I had my first experience dealing with the impact of science and technology on society. I remember that I was dismayed by the fact that high-power chemical lasers were being developed elsewhere as weapons; I wanted to be involved with research that was useful to society, but not for potentially harmful purposes." [44]

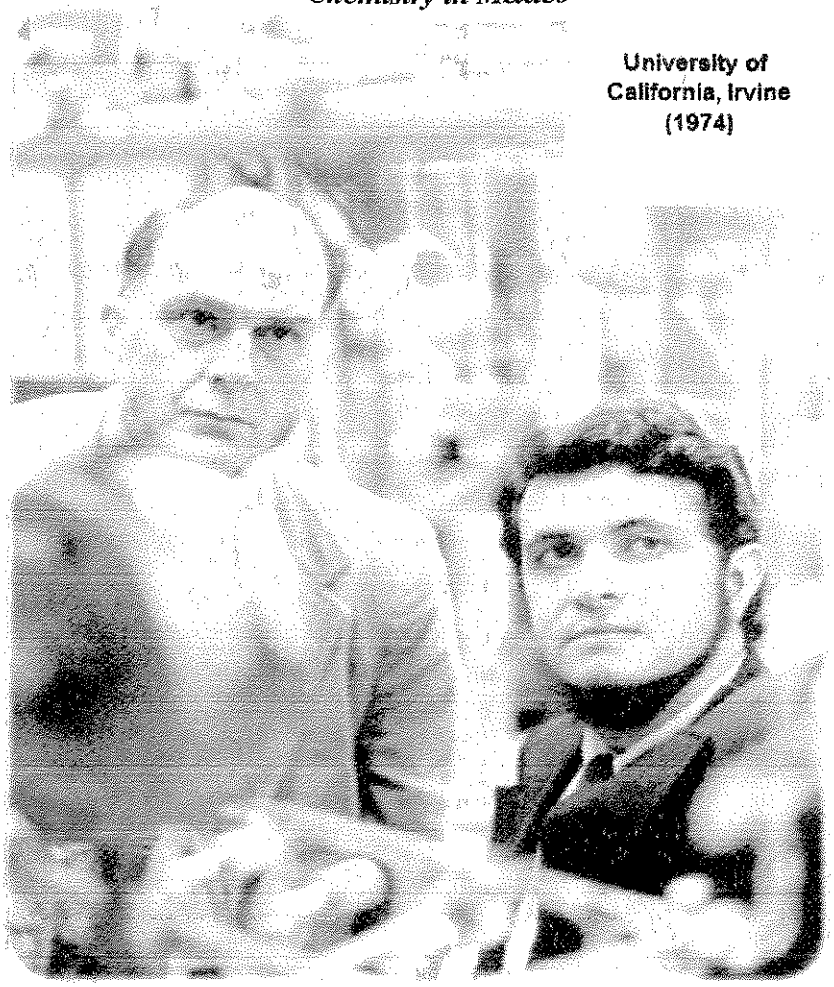
In the fall of 1973, Mario J. Molina joined the group of Professor F. Sherwood Rowland at the University of California at Irvine-UCI, as a Postdoctoral Fellow. It was there that he together with F. Sherwood Rowland developed the Chlorofluorocarbons (CFCs) - Ozone Depletion Theory that later was recognized as a major contribution to science and led to the award of the Nobel Prize in Chemistry in 1995 together with Paul J. Crutzen.

Prof. Dr. Mario José Molina had faculty positions at the Universidad Nacional Autónoma de México-UNAM (1967-68), University of California at Irvine (1975-1982), Massachusetts Institute of Tecnhology (1989-2005), University of California at San Diego and the Center for Atmospheric Sciences of the Scripps Institute of Oceanography (2005-Present).

From 1982 to 1989, Prof. Dr. Mario J. Molina held a non-academic position at the Jet Propulsion Laboratory-JPL in Pasadena, California. His research group at JPL studied the chemistry of stratospheric clouds over Antarctica.

At the present, beside the faculty position at the University of California, San Diego, Prof. Molina also directs a research center in Mexico City that deals with strategic studies in energy and the environment.

The Chlorofluorocarbons (CFCs) – Ozone Depletion Theory involved at first a systematic search for the processes that might destroy the CFCs in the lower atmosphere. However, nothing appeared to affect them. At sufficiently high altitudes, the CFCs were destroyed by solar radiation. Chlorine atoms produced by the decomposition of the CFCs can catalytically destroy ozone.



F. SHERWOOD ROWLAND AND MARIO J. MOLINA IN IRVINE, CALIFORNIA IN 1974.

The role of nitrogen of natural origin in the control of ozone levels in the stratosphere was elucidated by Paul J. Crutzen. What preoccupied Molina and Rowland was the large quantity of CFCs released in the atmosphere by industrial processes, when compared to naturally existing amounts of nitrogen oxides. Mario J. Molina and F. Sherwood Rowland became alarmed at the possibility that continues emission of CFCs into the atmosphere would cause depletion of the Earth's stratospheric ozone layers. Their findings were published in an article that appeared in *Science* on June 28, 1974.[45] The ozone depletion was confirmed by Joseph C. Farman of the Halley Bay Station of the British Antarctic Survey in 1984. The ozone depletion (ozone hole) over Antarctica was documented by Nimbus satellite data in 1986 and many satellite images in the years that followed.

In 1987, the Montreal Protocol, signed by 56 countries agreed to 50% cuts in CFCs use and production. M.J. Molina's feelings about his contribution are summarized as follows in his Nobel Autobiography.[44]

"When I first chose the project to investigate the fate of chlorofluorocarbons in the atmosphere, it was simply out of scientific curiosity. I did not consider at that time the environmental consequences of what Sherry and I had set out to study. I

am heartened and humbled that I was able to do something that not only contributed to our understanding of atmospheric chemistry, but also had a profound impact on the global environment.

One of the very rewarding aspects of my work has been the interaction with a superb group of colleagues and friends in the atmospheric sciences community. I truly value these friendships, many of which go back 20 years or more, and which I expect to continue for many more years to come. I feel that this Nobel Prize represents recognition for the excellent work that has been done by my colleagues and friends in the atmospheric chemistry community on the stratospheric ozone depletion issue."

Besides the 1995 Nobel Prize in Chemistry awarded to him jointly with F. Sherwood Rowland and Paul J. Crutzen, Prof. Dr. Mario J. Molina received many prizes and awards. He is a member of the Pontificial Academy of Science, U.S. National Academy of Sciences, National College of Mexico and received honorary degrees from about twenty universities from different countries.

His current work is related to air quality and global climate changes. Of particular interest is the improvement of air quality in rapidly growing cities, like Mexico City and the investigation of the chemical properties of atmospheric particles and their effect on clouds and climate.

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REFERENCES

1. M. Roche, *Science, 194*, 806 (1976).
2. G. Weinberg, *Interciencia, 3(2)*, 72 (1978).
3. L. G. Ionescu, Editor "*Anais do 2° Simpósio de História e Filosofia da Ciência – Proceedings of the Second Symposium on Philosophy and History of Science*", Sociedade Brasileira de Química – Regional do Rio Grande do Sul, Editora Químico Pampeano, Viamão, RS, Brasil, 1990, 76 pp.
4. L. G. Ionescu and J.A. Schufle, "José Luis Casaseca – Founder of the Cuban Institute of Research", *J. Chem. Educ., 55*, 583 (1978).

5. L. G. Ionescu and J. A.Schufle, "Alvaro Raynoso – Father of the Cuban Sugar Technology" *N. Mex. J. Science, 21(1)*, 41 (1981).
6. L. G. Ionescu, R.A. Yunes and J.A., Schufle, "Horacio Damianovich, Argentine Pionner in Nobel Gas Chemistry ",., *J. Chem. Educ 59*, 304 (1982).
7. L. G. Ionescu, R.A. Yunes and J.A. Schufle, "Latin American Contribuitions to Chemistry. VI Gustavo Fester, Argentina's Formost Natural Products Chemistry" *N. Mex. Highlands Univ. J., 4(1)*, 32 (1983).
8. L. G. Ionescu, "Xorge Alejandro Dominguez, Mexico's Formost Organic Chemistry", *South. Braz. J. Chem., 2*, 1 (1994).
9. L. G. Ionescu and C. A. Perazzolo, "Luis Frederico Leloir – South America's Only Nobel Laureate in Chemistry", *South. Braz. J. Chem., 3*, 1 (1995).
10. L.G. Ionescu, *South. Braz. J. Chem., 4*, 1 (1996).
11. R. Osorio O. "Historia de la Quimica en Colombia", Publ. Geol. Esp., Ingeminas, Bogotá, Colombia, 1982.
12. M.Bargalló, "La Amalgamación de los Minerales de Plata em Hispanoamérica Colonial"Compañia Fundidora de Fierro y Acero de Monterrey, Mexico, 1969.
13. M. Bargalló, "La Mineria y Metalurgia em la América Española durante la Epoca Colonial", Fondo de Cultura Económica, Mexico, D.F., 1955.
14. M.E. Weeks," Discovery of the Elements", Published by the Journal of Chemical Education, Easton, Pa., USA, 1945.
15. L. G. Ionescu, "Romanians in the History of Mexico", in *America Almanach*, Union and League of Romanian American Societies, Inc., P. Lucaci, Ed., Cleveland, Ohio, USA, pp 156-162.
16. J. A. Chamizo, *Rev. Soc. Quim. Mex., 48*, 165-171 (2004).
17. J. A. Chamizo, A. Garritz and M. Kleiche Dray, in "Proceedings 6TH International Conference on the History of Chemistry", European Association for Chemical and Molecular Sciences, Leuven, Belgium, August 28 – September 1, 2007.
18. A. F. Chalmers, "What is This Thing Called Science", Open University Press, Milton Keynes, 1985.
19. J. Bond, "Pre-Columbian Chemistry: A Descriptive Chemistry and Technology From Natural Resources", Tufts University Press, Medford, Ma., USA, 1993.
20. F. A. Encina, "Historia de Chile", Editorial Ercilla, Santiago, Chile, 1985.
21. J. A. Del Busto, "Historia General del Perú Antiguo" Ed. Studium, Lima, Perú, 1970.
22. A. Garritz, Ed., "Química en México. Ayer, Hoy y Mañana", Facultad de Química, Universidad Nacional Autonóma de México – UNAM, México, DF, 1991.
23. B. Ortiz de Montellano, "Aztec Medicine, Health and Nutrition" Rutgers University Press, Picataway, NJ, USA, 1990.
24. T. de la Selva, "De la Química a la Alquimia" La Ciencia desde México, No 118, Secretaria de Educación Publica – SEP, Fondo de la Cultura Económica,

Consejo Nacional de Ciencia y Tecnologia, Mexico, DF, 1993.
25. A. Romo de Vivar, "Química, Universo, Tierra y Vida" La Ciencia desde México, No 51, Secretaria de Educación Publica – SEP, Fondo de la Cultura Económica, Consejo Nacional de Ciencia y Tecnologia, Mexico, DF, 1988.
26. J. A. Chamizo, *Química Mexicana*, Conaculta, Tercer Milenio, México, DF, 2003.
27. L. G. Ionescu and P. C. P. das Neves, Chemical Alloys and Minerals Ocurring Naturally in Meteorites, *South. Braz. J. Chem*, 9(10), 47-62 (2001).
28. R. P. Foster, Editor, "History of Gold Production", Biological Society of Zimbabwe, Rhodesia, Balkema, Rotterdam, Netherland, 1984.
29. B. Ortiz de Montellano, "Empirical Aztec Medicine,", *Science, 188*, 215-220 (1975).
30. http:/www.mexicolore.co.uk
31. V. Navarro and M.L. Villareal, *J. Ethnopharmacology, 53(3)*, 143-147 (1996).
32. L.G. Ionescu, "Antonio de Ulloa, Discoverer of Platinum", *South. Braz. J. Chem., 6(7).* 1-6 (1998).
33. J. Jorge and J.A. De Ulloa, "*Relación Histórica del Viaje a la América meridional hecho de Orden de S. Mag. para Medir Alguns Grados del Meridiano Terrestre Y Venir por Ellos em Conocioimento de la Verdadera Figura Y Magnitud de la Tierra , com Otras Observaciones Astronómicas y Físicas*", Antonio Marin, Madrid, 1748.
34. J. Jorge and J.A. De Ulloa, "*A Voyage to South America*", Vols. 1,2, Lockyer Davis, London, 1772.
35. C.M. La Condamine, "*Relation abregeé d'un voyage fait dans l'interieur de l'Amérique Meridionale* ", Paris1745.
36. A. Phelps, "*Louisiana, a Record of Expansion*", Houghton, Mifflin and Company, Boston, MA, USA, 1993.
37. A. von Humboldt . "*Essai Politique sur le Royame de la Nouvelle Espagne*", Schoell, Paris, 1811.
38. L. G. Ionescu, "Andrés Manuel del Rio, Discoverer of Vanadium", *South. Braz. J. Chem., 5(5),* 1-6 (1997).
39. A. M. Del Rio, "*Tablas Mineralogicas de Karsten*", Mexico, 1804.
40. A. Cabanilles, *Anal.Cienc. Nat. Madrid,6*, 16 (1803).
41. A .von Humboldt, *Gilb. Ann., 18*, 118 (1804).
42. H. V. Collet-Descotils, *Ann. Chim. Phys., 1(53)*, 268 (1805).
43. O. Wallach, "Briefenwechsel zwischen J. Berzelius und F. Wöhler", Vols. 1,2, Verlag Wilhelm Engelmann, Leipzig, 1901.
44. M. Molina, Autobiography, The Nobel Foundation, 2006.
45. M. Molina and F. Sherwood Rowland, "Stratospheric Sink for Chlorofluoromethanes: Chlorine Atoms Catalyzed Destruction of Ozone", *Nature, 249*, 810-813 (197).