

HANS JOACHIM SCHUMACHER HOMAGE AT THE CENTENNIAL OF HIS BIRTH

Arvia, A. J.

Academia Nacional de Ciencias Exactas, Físicas y Naturales,
Avda. Marcelo T. de Alvear 1711, 4to. piso, Buenos Aires, Argentina
Fax:+54 221 4254642, E-mail: ajarvia@inifta.unlp.edu.ar

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*Dedicated to the memory of the late Prof. Hans J. Schumacher
on the occasion of his 100th birthday*

Hans Joachim Schumacher was born on September 23, 1904. The centennial of his birth is the right occasion to remember his outstanding personality, his scientific career, greatly acknowledged by the international community, and the profound influence he has exerted on our scientific community.

It is an honor to pay tribute to an academic figure like that of Prof. Schumacher, who was so deeply engaged in the advancement of science and in the training of young researchers.

Schumacher was born in Siegburg, in the Province of Rhineland, Germany. He started his studies at the *Realgymnasium* in Münster i/W, where he graduated at the age of 18. Between 1922 and 1925 he studied Chemistry, Physics, and Mathematics at the University of Münster i/W, where he got a degree in Chemistry in January 1925.

Schumacher used to say that at that time, as a new graduate, he had already faced the challenge of deciding his future work. He was then trying to find a way that would allow him to contribute to clarify the behavior of physicochemical systems about which both experimental and theoretical knowledge was insufficient. In order to understand his concern let us briefly remember the scenario of Physical Chemistry at different places, mainly in Germany, in the period that approximately comprises the second half of the 19th century and the first half of the 20th century. Let us consider each one of these distinguished scientists and their main area of expertise.

August Hortsmann (1842-1929), professor in Giessen and in Heidelberg. He is considered the founder of Chemical Thermodynamics. Through his work on the measurement of gas dissociation pressures and the second principle of Thermodynamics he demonstrated the application of the law of chemical equilibrium.

Cato Maximilian Guldberg (1836-1902) and Peter Waage (1833-1900), professors at the University of Christiania. They quantified the law of chemical equilibrium.

Josiah Willard Gibbs (1839-1903), professor at Yale University. He went deeper into the application of Thermodynamics to Chemistry. He enunciated the phase rule and put forward the equations that relate adsorption and interface tension, including electrically charged surfaces.

Johannes Diderik van der Waals (1837-1923), professor of Physics in Amsterdam. He derived the equation of state for real gases that allows calculating critical parameters of substances.

Jacobus Henricus van 't Hoff (1852-1911), professor in Amsterdam and in Berlin. His contributions include the development of the modern electrolyte solution theory. First Nobel Prize in Chemistry (1901).

Heike Kamerlingh Onnes (1853-1927). He established the cryogenic laboratory in Leyden, obtained liquid helium in 1907, and did research on critical phenomena and low temperatures. Nobel Prize in Physics (1913).

Wilhem Ostwald (1853-1932), professor in Riga and in Leipzig. He worked in different fields of Physical Chemistry, especially on the solution theory, catalysis, chemical equilibrium, and reaction rates. He spread a modern scientific approach to science through educational works. Nobel Prize in Chemistry (1909).

Svante Arrhenius (1859-1927), director of the Nobel Institute in Stockholm. His main contributions were the development of the electrolytic dissociation theory and the influence of temperature on chemical reaction rates and other physicochemical phenomena. Nobel Prize in Chemistry (1903).

Walther Hermann Nernst (1864-1941), professor in Göttingen and in Berlin. He developed the theory of galvanic batteries; he enunciated the third law of Thermodynamics; he studied the specific heat of solids at low temperatures; he enunciated the theory of chain reactions in Photochemistry. Nobel Prize in Chemistry (1920).

Fritz Haber (1868-1934), professor in Karlsruhe and in Berlin. He investigated ammonia synthesis whose results were applied to industrial processes; he investigated nitric oxide reactions by the electrical arc and also problems of Electrochemistry. Nobel Prize in Chemistry (1919).

Arthur A. Noyes (1866-1936), professor at the Massachusetts Institute of Technology. He did experimental research on rate processes to establish the reaction order, including dissolution phenomena.

Henri Le Chatelier (1850-1936), professor in Paris. Among other subjects he studied the specific heat of gases at high temperatures and the application of the law of chemical equilibrium to explosive reactions. He enunciated his "law of reaction" that represents the effects of changes in temperature and pressure on equilibria.

Max Bodenstein (1871-1942), professor in Leipzig, Hannover, and Berlin. He was the first to study chemical kinetics and photochemistry. He designed the zero quartz spiral manometer, which was named after him. He also dealt with problems related to combustion, solar energy, and Electrochemistry in molten borates.

Irving Langmuir (1881-1957), researcher at the US General Electric laboratories. He dealt with the chemistry of surfaces and adsorption phenomena. Nobel Prize in Chemistry (1932).

Peter Debye (1884-1966). He was born in Holland and developed his scientific career in the USA. He worked on the theory of electrolyte solutions and on the determination of crystal structures by X-rays. Nobel Prize in Chemistry (1936).

This scenario in Physical Chemistry was consistent with Schumacher's concern about the way chemical phenomena were dealt with. In the study of these phenomena the focus was to a large extent on the stoichiometric behavior of the systems, but there was incipient knowledge about the kinetics of chemical processes and reaction mechanisms. The predominance of

thermodynamics was accompanied by advances in the structure of atoms and molecules, which served as a basis to start paying attention to the kinetics of phenomena, that is, to the significance of the time variable and out-of-equilibrium situations that prevail in natural phenomena. Schumacher's scientific work then decisively focused on the study of the kinetics and mechanism of chemical reactions, mainly in their gas phase.

In 1925, to advance in his knowledge and to go deeper in this field, Schumacher went to the University of Berlin. This University was famous worldwide for its level of excellence in exact sciences and especially for being one of the most advanced centers in the studies of chemical kinetics at that time. The director of the Institute of Physical Chemistry was professor Max Bodenstein, who is considered one of the fathers of this branch of Physical Chemistry.



Figure 1 .A portrait of Prof. Max Bodenstein

M. Bodenstein (Fig. 1) received H. J. Schumacher as a dissertator. It is worth pointing out that the position of dissertator, under the direction of a renowned scientist and at a place of scientific excellence, was coveted by young chemists and hard to obtain. Schumacher was deeply honored to have been selected for such a position.

Schumacher finished his dissertation in less than two years and passed the final exam, which at the time was an oral exam, with the highest grade. He was examined by W. E. Nernst on Physics, M. Bodenstein on Chemistry, F. Haber on Technology, and W. Kohler on Philosophy. On January 27, 1927 he got his Doctor of Philosophy degree and immediately started teaching.

At that time W. H. Nernst (Fig. 2) was the director of the Institute of Physics of the University of Berlin, which, as well as the Institute of Physical Chemistry of the same University, was known as one of the best in the world. There they were looking for an assistant with good knowledge of chemistry. Nernst, in agreement with Bodenstein, selected Schumacher to work on catalytic reactions at high temperatures.

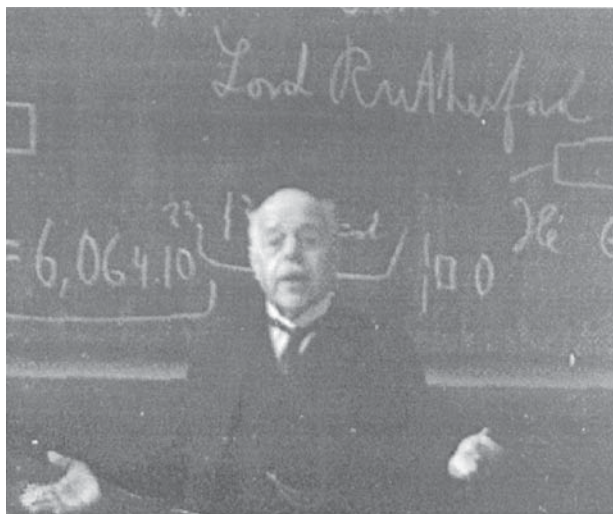


Figure 2. A portrait of Prof. Walther H. Nernst lecturing at the University of Berlin

Schumacher often remembered the scientific environment in Berlin at that time. For instance, Nobel Prize winners such as W. H. Nernst, A. Einstein, M. Planck, E. Schrödinger, M. von Laue, F. Haber, O. Hahn, and other renowned scientists participated in the meetings held at the Institute. (Fig. 3).



Figure 3. Building in which the Physical Chemistry Laboratorium was installed at Bunsenstrasse since Nernst's times in 1905.

There was an exciting atmosphere there that promoted scientific excellence. "You learned a lot by just being there," used to say Schumacher, who enjoyed this great opportunity and grasped the teachings from such an extraordinary group of scientists (Fig. 4).

After working for a year with Nernst, Schumacher returned to the Institute of Physical Chemistry to work on chemical kinetics and photochemistry with the aid of many collaborators. The results of his investigations on halogen oxides, nitrogen pentoxide thermal decomposition, ozone thermal and photochemical decomposition, and a series of important observations on chain reactions and explosions caught the attention of the international scientific community. This



A. PICCARD - E. HENRIOT - P. EHRENFEST - E. HERZEN - T. DE DONDER - E. SCHROEDINGER - E. VERSCHAFFELT - W. PAULI - W. HEISENBERG - R. H. FOWLER - L. BRILLOUIN
 P. DEBYE - M. KNUDSEN - W. L. BRAGG - H.A. KRAMERS - P. A. M. DIRAC - A. H. COMPTON - L. DE BROGLIE - M. BORN - N. BOHR
 J. LANGMUR - M. PLANCK - MADAME CURIE - H.A. LORENTZ - A. EINSTEIN - P. LANGEVIN - C.E. GUYE - C.T.R. WILXON - O.W. RICHARDSON

Figure 4. A number of Nobel Prize distinguished scientists who often visited the University of Berlin in the 1900-1930 year period. Their names are included in the portrait taken during the Solvay Congress of 1927

was clear in 1929 when he was invited to speak about his work at the International Conference on Chemical Kinetics in Leningrad. Schumacher, who was 25 at the time, always considered this invitation as a great honor. His name as lecturer appeared on the program between the names of two renowned scientists, professor Cyril Norman Hinshelwood, from Great Britain, and professor Nickolai N. Semenov, from the Soviet Union. These two scientists shared the Nobel Prize in 1956. Years later, already with us, Schumacher proudly showed that invitation and told us: "I've kept it because it has meant to me a lot more than most of the appointments or diplomas I've received in my life. That invitation was my acceptance to the scientific world."

Such recognition materialized in 1929 when he received another invitation, now from professor Hugh S. Taylor, from Princeton University, United States of America, to work in heterogeneous catalysis as researcher of the Rockefeller Foundation. Princeton University was, as it is today, one of the most renowned in the United States of America and at that time H. S. Taylor was the highest authority in the field of catalysis.

In 1931 Schumacher returned to the Institute of Physical Chemistry of the University of Berlin to continue the work on halogen oxides, interhalogenated compounds, ozone chemistry, and especially fluorine chemistry. Some results of this work had a marked influence on the development of the theory of reaction mechanisms and on the determination of energy transfer between molecules. At that time he also went deeper into spectroscopic and structural studies of simple molecules and did systematic research on different types of chain reactions. The results of his work helped him understand fundamental aspects of chemical reactions that he correlated with the structures of the molecules in each process. Schumacher thus partly succeeded in meeting the expectations he had during his time at the university and at the beginning of his scientific research career. In 1932 he was appointed *Privatdozent* in Chemistry at the University of Berlin, and in 1933 he filled the chair of photochemistry.

At the age of 30, Schumacher was appointed full professor and director of the Institute of Physical Chemistry of the University of Frankfurt am Main, which was then considered as the most modern institute in Germany in this field. Schumacher was entrusted with starting up this new Institute and was assisted by both German and foreign collaborators. He thus started a very productive activity investigating hydrocarbon photohalogenation reactions, determining kinetic parameters for reactions between halogens and organic radicals, the initial stages and mechanisms of photosensitive reactions, and particularly fluorine chemistry. For the latter subject, mention should be made of the determination of the dissociation energy of the fluorine molecule, which was of much interest in the subsequent development of the chemistry of this element.

In 1937 Schumacher was elected dean of the School of Exact and Natural Sciences of the University of Frankfurt am Main. At that time he wrote the book *Chemische Gasreaktionen*, which was published in Germany in 1938. This work makes a systematic presentation of the papers on gas-phase reactions investigated so far, among them a large number of Schumacher's own papers. This book has been recognized as a classic work in the field and as such was reproduced in the United States of America in 1944.

In Germany, Schumacher also participated actively in the management of scientific societies. He was vice-president of the German Society of Chemists and member of the board of directors of the German Bunsen Society. He worked as advisor of the Army and the Air Force, and of industrial companies as well. Among the latter we can mention his permanent collaboration with IG Farben and with the Office for Industry Development. These activities gave him the opportunity to increase and deepen his scientific and professional knowledge, as well as his experience in the management, organization, and administration of companies. The intelligent, hard and successful work done in all these years earned him personal recognition. As he himself admitted with joy and nostalgia, "up to that point (in my life) I think my career was brilliant."

From then on a new stage begins. In 1944, just before the end of World War II, the Institute of Physical Chemistry of the University of Frankfurt, which Schumacher directed, was totally destroyed by an air raid, and in the following days the situation in Frankfurt became very difficult. Then, in 1946, he accepted an invitation to work in France. This did not last long since in October 1947 the Argentine Embassy in Germany offered him a contract to work as technical advisor of *Dirección General de Fabricaciones Militares* (General Directorate of Military Industries) in our country. Then Schumacher decided to move to Argentina.

Shortly after his arrival, Schumacher did not know whether to pursue his scientific and teaching career or dedicate himself to the advisory tasks he had already started. The first was the easiest choice since he felt the need to work in scientific research and higher education. He wanted to resume the activity of training researchers that he had accomplished successfully in Germany. This brought him to the National University of La Plata in 1948, where he was hired to direct the Advanced Scientific Research Institute "Dr. Carlos A. Sagastume" of the School of Chemistry and Pharmacy (Figs. 5 and 6).

Let us see now what the scenario of Physical Chemistry was in our country, especially in La Plata, since the founding of the University up to Schumacher's arrival to evaluate the challenge he had accepted.

In order to fully appreciate Schumacher's work in Argentina it is important to make a brief review of Physical Chemistry in our country in the last 75 years of the 19th century and in the first half of the 20th century.



Figure 5. Corridor and main entrance to the Laboratory of Chemical Kinetics at the Advanced Scientific Research Institute “Prof. Dr. Carlos A. Sagastume”, Faculty of Chemistry and Pharmacy, National University of La Plata.

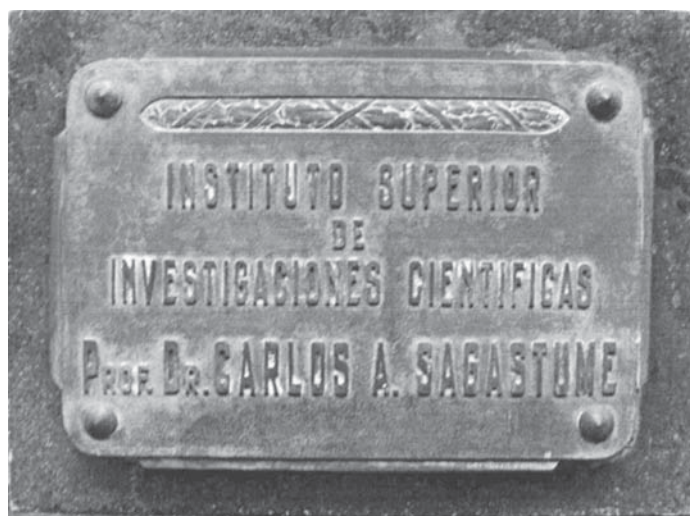


Figure 6. Plaque at the entrance of the Advanced Scientific Research Institute “Prof. Dr. Carlos A. Sagastume”, Faculty of Chemistry and Pharmacy, National University of La Plata.

Between 1820 and 1830 the University of Buenos Aires was founded (1821); the Society of Physical and Mathematical Sciences was established, and its president at that time was the Military Engineer Felipe Senillosa. The first science publication, *La Abeja Argentina*, appeared; its message was in line with Linneo’s phrase: “Bees build honeycombs and make honey from sweet fruit and the nectar of flowers.”

Dr. Pedro Carta Molina and Dr. Octavio F. Mosotti, both from the University of Modena, arrived in the Río de la Plata area around 1830. The latter gained recognition as of 1847 after his returning to the University of Modena for first establishing an equation for the molecular

polarizability. Later this relationship was confirmed by R. Clausius, and since then it is generally known as the Mosotti-Clausius molar polarization equation.

The stay of P. Carta Molina and O. F. Mosotti in Argentina, although relatively short, was instrumental in the development of experimental science at the Santo Domingo Convent, including experiences on electricity.

Between 1860 and 1870, when Juan María Gutiérrez was rector of the University of Buenos Aires (1861), the National Academy of Sciences from Córdoba (1868) and the National Academy of Exact, Physical and Natural Sciences (1869) were set up.

Between 1870 and 1900 the Buenos Aires Science Association and the Argentine Science Society were founded; the studies of Chemistry were promoted by Miguel Puiggari, Pedro N. Arata, and Juan J. J. Kyle, among the most renowned scientists. Later, the *Bulletin of the Academy of Sciences*, the *Science Annals*, the *Scientific Stimulus*, with the collaboration of Estanislao S. Zeballos and Justo R. Dillon, and the *Annals of the Argentine Science Society* were published. The latter publication would become the forerunner of the others. This is a time that marked a change in the local development of Chemistry since under the aegis of the Argentine Science Society, the Argentine Chemistry Association was set up in 1912. The first president of the new Association was Enrique Herrero Ducloux (1912-14), who was immediately succeeded by Horacio Damianovich (1914-1920). He was a doctor in Chemistry from the University of Buenos Aires who made pioneering works on the chemistry of inert gases.

All these events happened in Argentina when in the European continent the scientists mentioned above in our first scenario gave a new orientation to Chemistry, a discipline that started to come gradually closer to the area of physico-mathematical sciences. These ideas began then to permeate the syllabuses at the Universities of Buenos Aires and La Plata.

Let us come back to 1897, when at the University of Buenos Aires the Chemistry doctorate carrier started. Shortly after, in 1903, the first course on Physical Chemistry was included in the curriculum at the University of Buenos Aires. The first graduate was Dr. Enrique Herrero Ducloux.

Two years later the University of La Plata was founded on the basis of the innovating ideas of Joaquín V. González, and the Schools of Chemistry and Pharmacy, and of Physical Sciences were set up. The director of the former was E. Herrero Ducloux; the School of Physical Sciences was directed by Emil H. Bose, a renowned physicist from the University of Göttingen. The first research papers on Physical Chemistry developed in our country come from the latter school from the University of La Plata; they were published in well-known foreign and local journals. Among the latter the *Annals of the Argentine Chemical Association* and *Contributions to the Study of Physical and Mathematical Sciences* from the National University of La Plata should be mentioned. In 1923 around 60 papers had been published on frontier Chemistry and Physics subjects related to material properties, the theory of dissolutions, colloidal state, dielectric constant, electrical birefracton, reversible permeability phenomena, Tyndall effect, light diffusion, optical, atomic and molecular spectroscopy, Raman effect (after 1928), excitation potentials of atoms, critical potentials of molecules, the fine structure of spectra, and optical constants of materials. The authors of these papers were, in La Plata, Ramón Loyarte, Teófilo Isnardi, José B. Collo, Enrique Gaviola, Ricardo Gans, Héctor Isnardi, Enrique Loedel, Rafael Grinfeld, Hilario Magliano, Adolfo T. Williams, and in Buenos Aires, Guido Beck, Rodolfo Busch, Enrique E. Galloni and Heriberto Puente, among others.

Between 1940 and 1950, Physical Chemistry was a discipline included in the curricula for Ph. D. courses on Chemistry and Physics at the Universities of Buenos Aires and La Plata. Schumacher's work when he arrived in the country was then, as is described below, to launch research in this area of knowledge and project it throughout the country.

The Advanced Scientific Research Institute "Carlos A. Sagastume" at the School of Chemistry and Pharmacy of the University of La Plata had started operating in the 1920s. In the period 1920-1948, this Institute was a place where some faculty members, when they were free from their teaching assignments, developed some work oriented to problems of mainly applied interest. At that time they did not work on a full-time basis. There was no special payment for research nor grants or fellowships. The Institute premises and its facilities were very inadequate and the available equipment extremely limited.

On his arrival Schumacher found something that he once described humorously as "absolute emptiness." And taking this as a starting point he set out to organize a scientific research institute. He admitted that faced with that emptiness, he was lucky enough to meet a group of young people who were qualified, motivated and determined to work hard. Their implacable and profound idealism was instrumental in overcoming difficult situations derived from the scarcity of resources. Schumacher was fully aware of the poverty in which the University lived.

However, with his optimistic view, always ready to face difficulties, from the very beginning he put his trust and decision in materializing the idea of organizing a true scientific research center. The School's authorities offered him their support, meager as it was due to the limited resources available. But in spite of these drawbacks the institute started up and shortly after the most important task—the training of its members and scientific production—was well underway. Thus, the first communications from the Institute soon started to appear in scientific journals in Argentina and abroad.

Schumacher's efforts to increase the training of researchers quickly attracted a large number of dissertators that soon filled the capacity of the Institute's laboratories. In a few years he had efficient collaborators and assistants who learned from his experience. Ten years after the Institute had started functioning, with inadequate resources, there was a team of young, enthusiastic, and qualified scientists. The motivation for scientific work was deeply rooted in them. This led to the opening of new lines of research where anyone could try to continue their scientific development.

Schumacher promoted subject heterogeneity within the Institute because he believed in training science researchers with an informed mind open to the advancement of science, capable of analyzing experimental data and interpreting them without a blinkered attitude. He showed a wide interest in the promotion of people and deep respect for the intellectual freedom of each one of his collaborators. His only concern was excellency in scientific production through peers' recognition, a fundamental issue for the recognition of researchers and the Institute.

All this had created a hard-working and pleasant atmosphere. The Institute had become a second home for many of its members, who could be found there working during the day, at night, over the weekend, on holidays and vacations. To paraphrase our Nobel Prize Bernardo Houssay, researching was for all of them great fun, that is enjoyable work, it was the cheapest of entertainment.

There was a friendly atmosphere at that time. There was always a reason to make a toast—the passing of a dissertation, a birthday, a farewell or homecoming party. This was natural,

I think, because of the small number of people at the Institute and a spirit of competitiveness delimited by friendship values (Fig. 7).



Figure 7. Prof. H. J. Schumacher and Prof. A. F. Trotman-Dickenson from the University of Edinburgh, a visitor to the Advanced Scientific Research Institute, prepared to enjoy a barbecue party at the University Club in M. B. Gonnet, a place at the outskirts of La Plata city, 1963.

In this atmosphere, the number and scientific rating of the papers earned the Institute great prestige in the national and international scientific community. It should be noticed that at this first stage of the Institute development, due to the lack of adequate support, both its director and collaborators had to face very difficult times. Great personal effort had to be made to keep the Institute running and produce quality publications, which were referenced by other authors in their work.

A significant change occurred in 1958 with the founding of the National Research Council (CONICET) through an initiative of the National Academy of Exact, Physical and Natural Sciences.

This new body established different grant and fellowship patterns, and shortly after started the Research Career giving the people working in science the possibility of being hired on a full-time basis and with suitable compensation. With this drive CONICET anticipated the full-time jobs of professors at the universities.

The actions started by the CONICET were a true moral and economic support to the scientific system. Funds were used to buy modern laboratory equipment, consolidate and improve the staff positions and renew hopes for the near future. At the same time, other local and foreign institutions contributed to this process by establishing fellowships, especially for training new graduates in foreign countries, buying instruments, books, giving grants for special projects, etc. The connections and the recognition of Schumacher's scientific career at major scientific research and promotion centers in the world allowed selecting the most suitable places for the training of graduate students.

In 1965, the National University of La Plata started the construction of the building that currently houses the Institute (INIFTA). This work was the starting point of the construction of all the buildings of the School of Exact Sciences on the site that goes from the School of Agronomy to 64th street. Unfortunately, work was discontinued after the construction of the present building of the Institute and the overall project was eventually cancelled. Moreover, the Institute building was not finished and had to be partly completed with CONICET's aid so that it could be used. The new building allowed incorporating a larger number of fellows from Argentine and foreign universities. Mention should also be made of the strong support given by the university authorities at that time, when Dr. Danilo Vucetich was president of the National University of La Plata.

As of 1970, the Advanced Scientific Research Institute changed its name to the present one, Research Institute of Theoretical and Applied Physical Chemistry (INIFTA) (Fig. 8). This was the beginning of a new working stage through the agreement between the National University of La Plata, CONICET and CIC (Scientific Research Commission) of the Province of Buenos Aires. This agreement contributed to the Institute operation and maintenance.



Figure 8. *The new building of INIFTA, Instituto de Investigaciones Fisicoquímicas Teóricas y Aplicadas, at the premises of the National University of La Plata, inaugurated in 1975, run by the University and the National Science Research Council.*

Schumacher was the director of the Institute up to 1973, a time when confusion and irrationality darkened the future of scientific research and led to conflicting situations. Under these circumstances, Schumacher was asked to leave his position as director of the Institute. When he left he was convinced that in spite of existing difficulties his work would survive. He deeply believed that the strength of the institution was in the work of the researchers he had helped grow and develop. Luckily, in 1976 the Institute started working again as provided for in the inter-institutional agreement, properly overcoming the situation it had gone through.

Schumacher was author and co-author of about 300 scientific papers that were published in specialized journals mainly in Germany, Argentina, United States of America, and Great Britain. Half of those papers were written at the Institute in La Plata.

Many distinctions and awards were bestowed upon him in our country and abroad for his contribution to science, of which the following should be particularly mentioned: Member of the

National Academy of Exact, Physical and Natural Sciences; Member of the Academy of Sciences of Braunschweig; Emeritus Professor of the National University of La Plata; Honorary Doctor of the University of Buenos Aires; “First Class Order of Merit” from the Federal Republic of Germany; “Bunge and Born Foundation Award”; “Enrique Herrero Ducloux Award” from the National Academy of Exact, Physical and Natural Sciences; “Severo Vaccaro Award” from the Vaccaro Foundation; “Latin American Award in Chemistry” (province of Santa Fe); Republic of Argentina “National Government Science Award”; and “Konex Platinum Award”.

The Institute had a strong influence on the history of Physical Chemistry in Argentina. Through its researchers, its activities extended to other universities in Argentina, America, Europe and the developing world. The Institute was at all times a meeting place for scientists. It was the venue of numerous scientific meetings and in its premises many scientific associations related to different specialties were established, some of which later became international associations. All these activities were the result of close national and international scientific cooperation through agreements, programs, and projects with other universities, research centers and groups. In recognition to this outstanding performance INIFTA was the first Argentine center to be incorporated as Associate Member to the Scheme at Centers of Excellence from the Third World Academy of Sciences founded 40 years ago in Trieste, Italy, as a result of the initiative of Nobel Prize Abdus Salam. Years later, in 1997, the “Luis Federico Leloir Award” from the Secretariat for Science and Technology was granted to the Institute for its international cooperation activities.



Figure 9. Portrait of Prof. H. J. Schumacher at INIFTA after his retirement.

Already retired, Schumacher used to come regularly to the Institute, although his visits were not so frequent as his health deteriorated. His presence at that time reflected the joy of the accomplished duty, without nostalgia for old days. He took the difficult moments of life as a Spartan, it was an eventuality of fate that he accepted as proof of the moral order compatible with the Lutheran vision of faith. All of us who enjoyed his company for many years, appreciate his wisdom and determination to face problems, his perseverance, his incurable optimism, his recognition and promotion of excellence, his intellectual honesty. I personally remember talking

with him about very different subjects, sometimes for long hours. He was always ready to accept suggestions, expressing himself with the respect of a true friend, with a categorical openness typical of his German lineage and, above all, showing deep respect for the other person's freedom. This was the man who we affectionately called "Prof," who left unforgettable memories in many of his collaborators. And I have the honor and the privilege of having been one of them!

**Annual list of Professor H. J. Schumacher scientific papers and book,
including co-authors' names**

1927

Das Verhalten des Sauerstoffs bei der Reaktion zwischen Kohlenoxyd und Chlor.
Schumacher, H. J., *Zeitschrift für Physikalische Chemie*, **1927**, 129, 241.

1928

Bromphosgen. I. Die thermische Zerfall. Eine Wandreaktion erster Ordnung.
Schumacher, H. J., *Zeitschrift für Physikalische Chemie*, **1928**, 135, 85.

Über das Bromphosgen, II. Mitteil.: Seine Darstellung und seine Eigenschaften.
Schumacher, H. J. ; Lenher, S., *Berichte der Deutschen Chemischen Gesellschaft*, **1928**, 61, 1671.

Über die Reaktion zwischen Stickstoffpentoxyd und Ozon.
Schumacher, H. J.; Sprenger, G., *Zeitschrift für Physikalische Chemie*, **1928**, 136, 77.

Der thermische Ozonzerfall bei kleinen Drucken.
Riesenfeld, E. H. ; Schumacher, H. J., *Zeitschrift für Physikalische Chemie A*, **1928**, 138, 268.

Über the Existenz eines Bromoxydes.
Lewis, B.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie A*, **1928**, 138, 464.

1929

Nitrylchlorid: Bildung und Thermischen Zerfall.
Schumacher, H. J.; Sprenger, G., *Zeitschrift für Elektrochemie*, **1929**, 9, 653.

Die Darstellung und Eigenschaften des Nitrylchlorids.
Schumacher, H. J.; Sprenger, G., *Zeitschrift für anorganische und allgemeine Chemie*, **1929**, 182, 139.

Über den Mechanismus der photochemischen Zersetzung von Chlormonoxyd sowie der chlorsensibilisierten Ozonzerersetzung.
Schumacher, H. J.; Wagner, C., *Zeitschrift für Physikalische Chemie B*, **1929**, 5, 149.

Die thermische Reaktion zwischen Chlor und Ozon.

Bodenstein, M.; Padelt, E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1929**, *5*, 209.

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Bodenstein, M.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1929**, *5*, 233.

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Schumacher, H. J.; Stieger, G., *Zeitschrift für anorganische und allgemeine Chemie*, **1929**, *184*, 272.

1930

Die thermische Reaktion zwischen Brom und Ozon.

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Der thermische Ozonzerfall.

Schumacher, H. J.; Sprenger, G., *Zeitschrift für Physikalische Chemie B*, **1930**, *6*, 446.

Der thermische Zerfall des Chlordioxyds.

Schumacher, H. J.; Stieger, G., *Zeitschrift für Physikalische Chemie B*, **1930**, *7*, 363.

Über die Aktivierungsenergie bimolekularer Reaktionen.

Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1930**, *8*, 218.

Zum thermischen und photochemischen Ozonzerfall.

Schumacher, H. J.; Sprenger, G., *Zeitschrift für Physikalische Chemie B*, **1930**, *11*, 38.

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