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

Received August 1st, 2005. In final form August 24th, 2005

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.

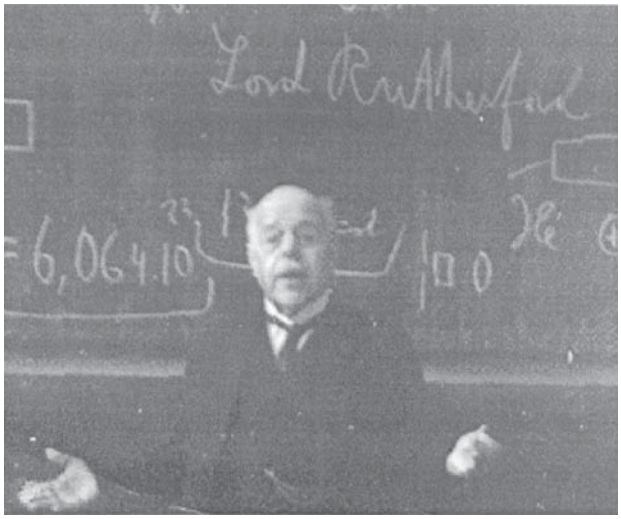

***Figure 2**. A portrait of Prof. Walther H. Nernst lecturing at the University of Berlin*

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. Schr**ö**dinger, 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. SCHRÖEDINGER - 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. Semenoff, 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.*

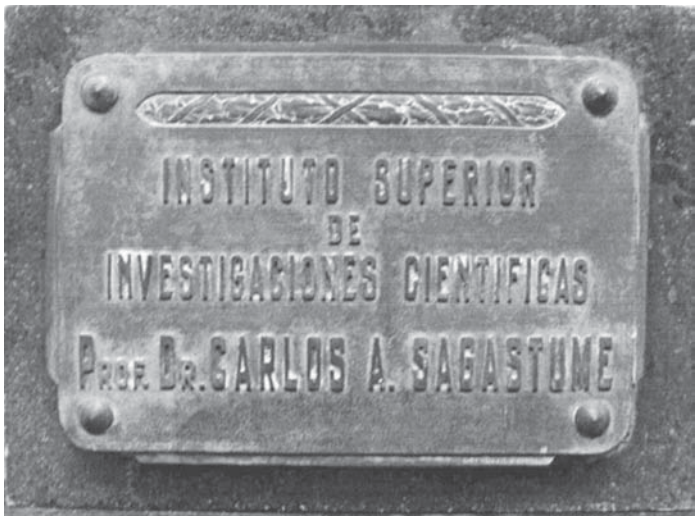

Figure 6*. Plaque at the entrance of the Advanced Scientific Research Institute "Prof. Dr. Carlos A. Sagastume", Faculty of Chemistry and Pharmacy, National University of La Plata.*

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 birefraction, 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 Ozonzersetzung.
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.

Der Mechanismus der Bildung von Chlorhexoxyd.
Bodenstein, M.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1929**, *5*, 233.

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

1930
Die thermiche Reaktion zwischen Brom und Ozon.
Lewis, B.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1930**, *6*, 423.

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.

Die photochemische Reaktion zwischen Äthylenjodid und Jod in Lösung von Tetrachlorkohlenstoff.
Schumacher, H. J.; Wiig, W. O., *Zeitschrift für Physikalische Chemie B*, **1930**, *11*, 45.

The Mechanism of the Photochemical Decomposition of Ozone.
Schumacher, H. J., *Journal of the American Chemical Society,* **1930**, *52*, 2377.

The Photochemical Decomposition of Nitrogen Dioxide.
Schumacher, H. J., *Journal of the American Chemical Society,* **1930**, *52*, 2584.

The Influence of Nitrogen Dioxide upon the Ignition Temperature of Hydrogen-Oxygen Mixtures.
Schumacher, H. J., *Nature,* **1930**, 122.

A Contribution to the Study of Chain Reactions. Remarks on a Paper by Lenher and Rollefson on the Kinematics of Phosgene. (C) The Mechanism of the Formation and Decomposition of Ethylene Iodide.
Schumacher, H. J., *Journal of the American Chemical Society,* **1930**, *52*, 3132.

1931

Der Thermischen Zerfall des Nitrylchlorids. Eine homogeneGasreaktion erster Ordnung.
Schumacher, H. J.; Sprenger, G., *Zeitschrift für Physikalische Chemie B*, **1931**, *12*, 115.

Der Einfluss der Wellenlänge auf die photochemische Reaktion zwischen Äthylenjodid und Jod.
Schumacher, H. J.; Stieger, G., *Zeitschrift für Physikalische Chemie B*, **1931**, *12*, 348.

Die photochemische Bildung von Phogen, VI. Der Einfluss des Druckes und der Gefässdimensionen auf die photometrische Phosgenbildung.
Schumacher, H. J.; Stieger, G., *Zeitschrift für Physikalische Chemie B*, **1931**, *13*, 157.

Die photochemische Bildung von Phosgen. VII. Die durch belichtetes Chlor sensibilisierte Kohlensäurenbildung.
Schumacher, H. J.; Stieger, G., *Zeitschrift für Physikalische Chemie B*, **1931**, *13*, 169.

Das Spektrum und das Photochemische Verhalten des Chlordioxyds.
Finkelnburg, W.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie,* **1931**, *15*, 127.

1932

Die thermische Reaktion zwischen Chlor und Ozon.
Hamann, A.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1932**, *17*, 293.

Die Photokinetik des Ozons. I. Der Zerfall in rotem Licht.
Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1932**, *17*, 405.

Die Photokinetik des Ozons. II. Der Zerfall des Ozons im ultravioletten Licht.
Beretta, U.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1932**, *17*, 417.

Der thermichen Zerfall des Äthylamins.
Schumacher, H. J.; Wiig, E. O., *Zeitschrift für Physikalische Chemie A*, **1932**, *162*, 419.

1933

Die Zersetzungsreaktionen der Chloroxyde.
Schumacher, H. J., *Zeitschrift für Elektrochemie,* **1933**, *35*, 7.

Der photochemische Zerfall des Chlormonoxyds zwischen 2350 und 2750 Å und die Deutung seines Absorptionsspektrums in diesem Gebiet.
Schumacher, H. J.; Townend, R. V., *Zeitschrift für Physikalische Chemie B*, **1933**, *20*, 375.

Der thermischen Ozonzerfall.
Glissmann, A.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1933**, *21*, 323.

Die Eigenschwingungen des Ozons im Gebiet von 9-20 μ.
Hettner, G.; Pohlman, R.; Schumacher, H. J., *Die Naturwissenschaften,* **1933**, *21*, 467.

Über die Ultrarot-Absorption des Ozons.
Hettner, G.; Pohlman, R.; Schumacher, H. J., *Die Naturwissenschaften,* **1933**, *21*, 884.

1934
Das Spektrum des Fluoroxyds F_2O.
Glissmann, A.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1934**, *24*, 328.

Die Bildung von Tetrachlorkohlenstoff aus Chloroform und Chlor im Licht.
Schumacher, H. J.; Wolff, K., *Zeitschrift für Physikalische Chemie B*, **1934**, *25*, 161.

Die Struktur des Ozon-Moleküls und seine Banden im Ultrarot.
Hetter, G.; Pohlman, R.; Schumacher, H. J., *Zeitschrift für Physik,* **1934**, *91*, 372.

Der thermische Zerfall des F_2O. Ein monomolekularer
Zerfall, dargestellt durch eine Reaktion 2. Ordnung.
Koblitz, W.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1934**, *25*, 283.

Über den nicht explosiv verlaufenden thermischen Zerfall der Stickstoffwasserstoffsäure.
Meyer, R.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie A*, **1934**, *170*, 33.

Die durch belichtetes Chlor sensibilisierte Phosgenbildung aus Chloroform und Sauerstoff.
Schumacher, H. J.; Wolff, K., *Zeitschrift für Physikalische Chemie B*, **1934**, *26*, 453.

1935
Das Ultrarotspektrum und die Struktur des F_2O.
Hettner, G.; Pohlman, R.; Schumacher, H. J., *Zeitschrift für Physik,* **1935**, *96*, 203.

Das Ultrarotspektrum des Fluor (I) Oxyds F_2O.
Hettner, G.; Pohlman, R.; Schumacher, H. J., *Die Naturwissenschaften,* **1935**, *23*, 114.

The Thermal Decomposition of Ozone: Some Remarks on the Paper by M. Richtie on the Same Subject.
Schumacher, H. J., *Proceedings of the Royal Society (London),* **1935**, *150*, 220.

Die Dipolmomente von Chlormonoxyd und Chlordioxyd.
Sundhoff, D.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1935**, *28*, 17.

Die photochemische Bildung von Phosgen. VIII. Gleichzeitige Bildung von Phosgen und Chlorwasserstoff. Kritik an einem Einwand von G. K. Rollefson.
Bodesntein, M.; Brenschede, W.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1935**, *28*, 81.

Die thermische Zerfall des Fluoroxyds. Ein Beitrag zur Theorie monomolekularer Reaktionen.
Schumacher, H. J., *Trabajos del IX Congreso Internacional de Química Pura y Aplicada. Tomo II, Química Física.* **1935**.

Über das Bromoxyd Br_2O.
Brenschede, W.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1935**, *29*, 356.

Über die Darstellung und einige Eingenschaften eines Bromoxyds von der Formel Br_2O.
Brenschede, W.;. Schumacher, H. J., *Zeitschrift für anorganische und allgemeine Chemie*, **1935**, *226*, 370.

1936
Über einige unter dem Einfluss des Lichtes verlaufende Oxydationsreaktionen.
Schumacher, H. J., *Zeitschrift für Elektrochemie,* **1936**, *42*, 522.

Über Lichtreaktionen der Halogene mit organischen Verbindungen der aliphatischen Reihe.
Schumacher, H. J., *Angewandte Chemie,* **1936**, *49*, 613.

Die Bromierung von Acetylen im Light.
Franke, W.; Schumacher, H. J., Zeitschrift für Physikalische Chemie *B*, **1936**, *34*, 181.

Die durch Chlor sensibilisierte photochemische Phosgenbildung aus Chloroform, Chlor und Saurstoff und ihre Hemmung durch Alkohole und Ammoniak
Schumacher, H. J.; Sundhoff, D., *Zeitschrift für Physikalische Chemie B*, **1936**, *34*, 300.

Die photochemische durch Chlor sensibilisierte Oxydation von Methan, Methylchlorid und Methylenchlorid.
Brenschede, W.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie A*, **1936**, *177*, 245.

Über die Struktur des Cl_2O-Moleküls.
Pohlman, R.; Schumacher, H. J., *Zeitschrift für Physik,* **1936**, *102*, 678.

Versuche zur Darstellung von FO. Identifizierung der Gase die beim thermischen Zerfall des F_2O_3 entstehen.
Frisch, P.; Schumacher, H. J., *Zeitschrift für anorganische und allgemeine Chemie,* **1936**, *229*, 423.

1937
Die Oxydation von Rubren im Licht.
Koblitz, W.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1937**, *35*, 11.

Die photochemische Bildung von Tetrachloräthan aus trans-Dichloräthylen und Chlor.
Mueller, K. L.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1937**, *35*, 285.

Die photochemische Bildung von Phosgen. IX. Das Anlaufen und Abklingen der Kettenreaktion nach Eisetzen bzw. Aufhören der Belichtung.
Bodesntein, M.; Brenschede, W.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1937**, *35*, 382.

Über das Stickstoff-VI-Oxyd (NO_3).
Schumacher, H. J., *Zeitschrift für anorganische und allgemeine Chemie,* **1937**, *233*, 47.

Halogens as Catalysts.
Schumacher, H. J., *Transactions of The Electrochemical Society,* **1937**, *71*, 409.

Der durch Brom katalysierte Zerfall des Acetaldehyds.
Brenschede, W.; Schumacher, H. J., *Berichte der Deutschen Chemischen Gesellschaft,* **1937**, *70*, 452.

Die photochemischen Chlorierungen von cis-Dichloräthylen zu Tetrachloräthan und von Trichloräthylen zu Pentachloräthan.
Mueller, K. L.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1937**, *35*, 455.

Die durch Brom sensibilisierte photochemische Oxydation von Tetrabrom-methan zu Bromphosgen und Brom in Lösung von Tetrachlorkohlenstoff.
Koblitz, W.; Meissner, H.; Schumacher, H. J., *Berichte der Deutschen Chemischen Gesellschaft,* **1937**, *70*, 1080.

Die Kinetik des F_2O_2-Zerfalls.
Schumacher, H. J.; Frisch, P., *Zeitschrift für Physikalische Chemie B*, **1937**, *37*, 1.

Der Einfluss der Zusatsgase O_2, F_2, N_2, Ar, He, CO_2 auf die Zerfallsgeschwindigkeit des F_2O_2.
Frisch, P.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1937**, *37*, 18.

Das Absorptionsspektrum des F_2O_2.
Brodersen, P. H.; Frisch, P.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1937**, *37*, 25.

Homogene Katalyse durch Halogene.
Schumacher, H. J., *Angewandte Chemie,* **1937**, *50*, 483.

Die photochemische durch Chlor sensibilisierte Oxydation von Trichloräthylen zu Dichloracetylchlorid.
Mueller, K. L.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1937**, *37*, 365.

Die Oxydation von Rubren im Licht. Bemerkung zu der vorstehenden Arbeit von H. Graffon.
Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1937**, *37*, 462.

Das thermische verhalten des F_2O_2. Die Kinetik des Zerfalls und seine Beeinflussung durch Fremdgase.
Frisch, P.; Schumacher, H. J., *Zeitschrift für Elektrochemie,* **1937**, *43*, 807.

Die photochemische Chlorierung von Äthylenverbindungen und der Einfluss des Sauerstoffs hierauf.
Mueller, K. L.; Schumacher, H. J., *Zeitschrift für Elektrochemie,* **1937**, *43*, 807.

1938

Die Bromierung von Acetylen im Licht der Wellenlängen 546 und 436 mμ.
Mueller, K. L.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1938**, *39*, 352.

Die photochemische Phosgenbildung. X. Die durch Chlor sensibilisierte Kohlensäurebildung bei Drucken von 100 bis 10 mm Hg.
Franke, W.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1938**, *40*, 115.

Die photochemische Phosgenbildung. XI. Berechnung der Konstanten der Teilreaktionen unter Einbeziehung der thermischen Phosgenbildung und zersetzung.
Bodenstein, M.; Brenschede, W.;. Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1938**, *40*, 121.

Chemische Gasreaktionen.
Schumacher, H. J., *Verlag von Theodor Steinkopff*, Dresden und Leipzig, **1938**

1939

Die photochemische durch Brom und durch Chlor sensibilisierte Oxydation von Trichlorbrommethan.
Franke, W.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1939**, *42*, 297.

Über die Lichtreaktion zwischen Chlor und Trichlorbrommethan.
Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1939**, *42*, 324.

Die photochemische Bromierung von Transdichloräthylen und der photochemische durch Brom sensibilisierte Zerfall von Dichlordibrommäthan.
Mueller, K. L.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1939**, *42*, 327.

Die Bildung von Mono- und Divinylacetylen aus Acetylen in homogener Katalyse.
Schmitz, H.; Schumacher, H. J., *Zeitschrift für Elektrochemie,* **1939**, *45*, 503.

Die photochemische Reaktion zwischen Chlor und Chloral.
Alexander, W.A.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1939**, *44*, 57.

Die photochemische durch Chlor sensibilisierte Oxydation von Chloral.
Alexander, W.A.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1939**, *44*, 313.

Die Lichtreaktionen der Halogene mit aliphatischen Verbindungen und der Eifluss des Sauerstoffs auf diese Reaktionen.
Schumacher, H. J., *Atti del X Congresso Internazionale di Chimica*, Roma,
15-21 Maggio **1938**, XVI. Vol. IV

Die photochemische Bildung von Trichlorbrommethan aus Chlroform und Brom.
Braunwarth, V.; Schumacher, H. J., *Kolloid-Zeitschrift,* **1939**, *89*, 184.

1940

Die photochemische Reaktion zwischen Brom und Chloral.
Klug, H.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1940**, *47*, 67.

Die Reaktion einiger Alkylhalogenide mit Halogenwasserstoff.
Meissner, H. P.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie A*, **1940**, *185*, 435.

Der durch Chlor induzierte Zerfall des Diäthyläthers.
Meissner, H. P.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie A*, **1940**, *185*, 447.

Bemerkungen zur Reindarstellung und analytischen Bestimmung von gasförmigem Fluor.
Schmitz, H.; Schumacher, H. J., *Zeitschrift für anorganische und allgemeine Chemie,* **1940**, *245*, 221.

Die Reaktionen zwischen Monovinylacetylen und Chlor und Monovinylacetylen und Brom.
Rengert, K.; Schumacher, H. J., *Berichte der Deutschen Chemischen Gesellschaft,* **1940**, *73*, 1025.

Die photochemischen Reaktionen der Halogene mit aliphatichen Kohlenstoffverbindungen.
Schumacher, H. J., *Angewandte Chemie,* **1940**, *53*, 501.

1941

Die photochemische durch Brom sensibilisierte Oxydation von Chloral.
Stauff, J.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1941**, *48*, 154.

Die photochemische Chlorierung und die durch Chlor sensibilisierte photochemische Oxydation von Tetrachloräthylen.
Schott, C.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1941**, *49*, 107.

Betrachtungen zur "Katalyse"
Schröer, E.; Schumacher, H. J., *Die Naturwissenschaften,* **1941**, *29*, 411.

Max Bodenstein und die Chemische Kinetik.
Schumacher, H. J., *Zeitschrift für Elektrochemie,* **1941**, *47*, 469.

Die Kinetik chemischer Gasreaktionen.
Schumacher, H. J., *Zeitschrift für Elektrochemie,* **1941**, *47*, 673.

Die Entwicklung der Reaktionskinetik unter besonderer Berücksichtigung der homogenen Gasreaktionen.
Schumacher, H. J., *Angewandte Chemie,* **1941**, *54*, 329.

Die photochemische Chlorierung und die durch Chlor sensibilisierte Oxydation von Pentacloräthan.
Schumacher, H. J.; Thürauf, W., *Zeitschrift für Physikalische Chemie A*, **1941**, *189*, 183.

1942

Über eine neue Reaktion des Chloroxyds. Die Bildung einer Verbindung der Formel ClO_2F.
Schmitz, H.; Schumacher, H. J., *Zeitschrift für anorganische und allgemeine Chemie,* **1942**, *249*, 238.

Die photochemische Bildung von Dichlor- und Dibromäthan aus Äthylen und Chlor bzw. Äthylen und Brom.
Schmitz, H.; Schumacher, H. J.; Jäger, A., *Zeitschrift für Physikalische Chemie B*, **1942**, *51*, 281.

Apparatur zur Untersuchung von Lichtreaktionen der Halogene mit Organischen Substanzen in flüssiger Phase.
Stauff, J.; Schumacher, H. J., *Zeitschrift für Elektrochemie,* **1942**, *48*, 271.

Die zur Bildung von 1,1,2-Trichloräthaen bzw. 1,2-Dibromchloräthan führenden photochemischen Reaktionen zwischen Vinylchlorid und Chlor bzw. Brom.
Schmitz, R.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie B*, **1942**, *52*, 72.

Beiträge zur Kenntnis der Reaktionen von Kohlenwasserstoffen mit Sulfurylchlorid und Schwfeldioxyd-Chlor-Gemischen.
Schumacher, H. J.; Stauff, J., *Angewandte Chemie, Neue Folge*, **1942**, *55*, 341.

Die Beeinflussung der Explosionsgrenzen von Wasserstoff-Luft-Gemischen durch Geeignete Zusätze.
Schumacher, H. J., *Deutsche Luftfahrforschung, Forschungsberichte,* **1942**, 1228.

1944

Die photochemische Bildung von Sulfurylchlorid in der Gasphase aus Schwfeldioxyd und Chlor und sein durch Chlor sensibilisierter Zerfall.
Schumacher, H. J.; Schott, C., *Zeitschrift für Physikalische Chemie,* **1944**, *198*, 343.

Löslichkeit von Gasen in Betriebsstoffen.
Schumacher, H. J., *Deutsche Luftfahrforschung, Forschungsberichte,* **1944**, *11*, 6.

1947

Das Bandenspektrum und die Dissoziationswärme des BrF.
Brodersen, P. H.; Schumacher, H. J., *Zeitschrift für Naturforschung 2a*, **1947**, *358*.

Das Bandenspektrum und die Dissoziationsenergie des ClF.
Schmitz, H.; Schumacher, H. J., *Zeitschrift für Naturforschung 2a*, **1947**, 359.

Die Wärmetönung der Reaktion ½ F_2 + ½ Cl_2 = ClF.
Schmitz, H.; Schumacher, H. J., *Zeitschrift für Naturforschung 2a*, **1947**, *362*.

Das Gleichgewicht ClF + F_2 = ClF_3.
Schmitz, H.; Schumacher, H. J., *Zeitschrift für Naturforschung 2a*, **1947**, *362*.

Das Gleichgewicht ClF_3 + ClF_3 = $(ClF_3)_2$.
Schmitz, H.; Schumacher, H. J., *Zeitschrift für Naturforschung 2a*, **1947**, 363.

Das Absorptionsspektrum des ClF_3.
Schmitz, H.; Schumacher, H. J., *Zeitschrift für Naturforschung 2a*, **1947**, 363.

Kinetik photochemicher Gasreaktionen.
Schumacher, H. J., *Naturforschung und Medizin in Deutschland 1939-1946. Physikalische Chemie*, **1947**, *30*, 65.

1950

El Espectro de Bandas y el Calor de Disociación del Monofluoruro de Bromo.
Brodersen, P. H.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1950**, *38*, 52.

El Espectro de Absorción del Trifluoruro de Cloro.
Schmitz, H.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1950**, *38*, 61.

El Espectro de Bandas y el Calor de Disociación del Monofluoruro de Cloro.
Schumacher, H. J.; Schmitz, H.; Brodersen, P. H., *Anales de la Asociación Química Argentina,* **1950**, *38*, 98.

La Energía de la Disociación del Flúor.
Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1950**, *38*, 113.

La Oxidación Fotoquímica del Monofluoro-diclorometano sensibilizada por Cloro.
Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1950**, *38*, 159.

Progresos en el Campo de las Combinaciones entre el Flúor y el Oxígeno y las Combinaciones Interhalogenadas.
Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1950**, *38*, 209.

1951

Die Beeinflussung der Explosionsgrenzen von Wasserstoff-Luft-Gemischen durch Zusaetze.
Schumacher, H. J., *Angewandte CEIME,* **1951**, *63*, 560.

Editor's note: *Anales de la Asociación Química Argentina refers to An. Asoc. Quím. Argent. (This Journal).*

La Influencia de ciertas Substancias en los Límites de Explosión de la Mezcla Hidrógeno-Aire.
Schumacher, H. J.; Baum, E., *Ciencia e Investigación,* **1951**, *7*, 128.

1952
Mecanismo de la Reacción de Wohl-Ziegler.
Schumacher, H. J.; Orazi, O. O.; Corral, R. A., *Anales de la Asociación Química Argentina,* **1952**, *40*, 19.

1953
El Sistema Ozono-Oxígeno y su Comportamiento a distintas Presiones y Temperaturas. I. La Preparación de Ozono puro.
Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1953**, 41, 197.

El Sistema Ozono-Oxígeno y su Comportamiento a distintas Presiones y Temperaturas. II. La Acción de la Mezcla Líquida de Ozono y Oxígeno sobre algunos Metales.
Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1953**, *41*, 203.

El Sistema Ozono-Oxígeno y su Comportamiento a distintas Presiones y Temperaturas. III. El Diagrama de Solubilidad del Sistema Ozono-Oxígeno.
Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1953**, *41*, 208.

El Sistema Ozono-Oxígeno y su Comportamiento a distintas Presiones y Temperaturas. IV. El Diagrama de Ebullición de la Mezcla Ozono y Oxígeno a Presión Atmosférica.
Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1953**, *41*, 216.

El Sistema Ozono-Oxígeno y su Comportamiento a distintas Presiones y Temperaturas. V. La Determinación de los Límites de Explosión para las Mezclas Gaseosas de Ozono y Oxígeno.
Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1953**, *41*, 230.

El Sistema Ozono-Oxígeno y su Comportamiento a distintas Presiones y Temperaturas. VI. La Descomposición Explosiva de la Mezcla Gaseosa de Ozono y Oxígeno sin Estímulo Externo y a Presiones de hasta 150 Atmósferas.
Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1953**, *41*, 249.

El Sistema Ozono-Oxígeno y su Comportamiento a distintas Presiones y Temperaturas. VII. Las Condiciones para la Propagación de Explosiones de la Fase Gaseosa a la Líquida.
Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1953**, *41*, 259.

The Solubility Diagram and the Temperature-Composition Diagram at Atmospheric Pressure of the Liquid System Ozone-Oxygen.
Schumacher, H. J., *The Journal of Chemical Physics,* **1953**, *21*, 1610.

1954
The Reaction between Fluorine and Chlorine Dioxide, a Homogeneous, Bimolecular Reaction.

Aymonino, P. J.; Sicre, J. E.; Schumacher, H. J., *The Journal of Chemical Physics,* **1954**, *22*, 756.

1955

Estudio Cinético de la Reacción $F_2 + 2\ ClO_2 = 2\ FClO_2$.
Aymonino, P. J.; Sicre, J. E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1955**, *43*, 207.

Die thermische Stabilität des Chlorylfluorids ($FClO_2$).
Schumacher, H. J.; Basualdo, W. H., *Angewandte Chemie,* **1955**, *67*, 231.

Die thermiche Reaktion zwischen Fluor und Chlorhexoxyd (Cl_2O_6).
Arvia, A. J. ; Basualdo, W. H.; Schumacher, H. J., *Angewandte Chemie,* **1955**, *67*, 616.

1956

Der thermiche Zerfall des Chlorhexoxyds in Gegenwart von Fluor.
Arvia, H. J.; Basualdo, W. H.; Schumacher, H. J., *Zeitschrift für anorganische und allgemeine Chemie,* **1956**, *286*, 58.

Über die Herstellung und einige Eigenschaften des Chlorylfluorids (ClO_2F).
Sicre, H. J.; Schumacher, H. J., *Zeitschrift für anorganische und allgemeine Chemie*, **1956**, *286*, 232.

Sobre la Preparación y algunas Propiedades del Fluoruro de Clorilo.
Sicre, J. E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1956**, *44*, 123.

La Descomposición Térmica del Hexóxido de Cloro en Presencia de Flúor.
Arvia, A. J.; Basualdo, W. H.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1956**, *44*, 132.

Der thermische Zerfall von gasförmigem Chlorheptoxyd.
Coloccia, E.; Figini, R. V.; Schumacher, H. J., *Angewandte Chemie,* **1956**, *68*, 492.

1957

Berstellung von reinem Perchloylfluorid.
Sicre, H. J.; Schumacher, H. J., *Angewandte Chemie,* **1957**, *69*, 266.

Die Kinetik der thermischen Zerfalls von Perchlorylfluorid.
Gatti, R.; Sicre, J. E.; Schumacher, H. J., *Angewandte Chemie,* **1957**, *69*, 638.

Der Mechanismus der thermischen Reaktion zwischen Chlor und Ozon.
Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1957**, *13*, 353.

1958

Die Kinetik des thermischen Zerfalls von gasförmigen Chlorheptoxyd.
Figini, R. V.; Coloccia, E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1958**, *14*, 32.

El Mecanismo de la Reacción Térmica entre Cloro y Ozono.
Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1958**, *46*, 20.

La Cinética de la Reacción Térmica entre el Flúor y el Ozono.
Sicre, J. E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1958**, *46*, 38.

La Cinética de la Descomposión Térmica del Heptóxido de Cloro Gaseoso.
Figini, R. V.; Coloccia, E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1958**, *46*, 66.

Método para la Preparación del Fluoruro de Perclorilo puro ($FClO_3$).
Sicre, J. E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1958**, *46*, 90.

1959

Die Bildung fester Bromoxyde bei der thermischen Reaktion zwischen Brom und Ozon.
Arvia, A. J.; Aymonino, P. J.; Schumacher, H. J., *Zeitschrift für anorganische und allgemeine Chemie,* **1959**, *298*, 1.

Die Kinetik des thermischen Zerfalls von gasförmigem Chlorylfluorid ($FClO_2$).
Heras, M. J.; Aymonino, P. J.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1959**, *22*, 161.

La Cinética de la Descomposición Térmica del Fluoruro de Clorilo ($FClO_2$) gaseoso.
Heras, M. J.; Aymonino, P. J.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1959**, *47*, 157.

La Cinética de la Descomposición Térmica del Fluoruro de Perclorilo ($FClO_3$).
Gatti, R.; Sicre, J. E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1959**, *47*, 180.

La Influencia de Gases Inertes sobre la Velocidad de la Descomposición Térmica del Fluoruro de Perclorilo.
Gatti, R.; Sicre, J. E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1959**, *47*, 197.

1960

Die Kinetik des thermischen Zerfalls von Perchlorylfluorid ($FClO_3$) und der Einfluss von Fremdgasen auf die Reaktion.

Gatti, R.; Sicre, J. E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1960**, *23*, 164.

Bis-monofluorcarbonyl-peroxyd.
Arvia. A. J.; Aymonino, P. J.; Waldow, C. H.; Schumacher, H. J., *Angewandte Chemie,* **1960**, *72*, 169.

Mechanism of Ozone Decomposition. Comments and Errata.
Schumacher, H. J., *The Journal of Chemical Physics,* **1960**, *33*, 938.

1961

Die Kinetik der photochemischen Reaktionen zwischen Chlor und Tetrafluoräthylen und Chlor und Trifluormonochloräthylen.
Castellano, E.; Bergamin, N. R.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1961**, *27*, 112.

Die Kinetik der thermischen Reaktion zwischen Fluor, Kohlenmonooxyd und Sauerstoff.
Heras, J. M.; Arvia, A. J.; Aymonino, P. J.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1961**, *28*, 250.

Die Kinetik der durch Bis(monofluorcarbonyl)peroxyd [$(COF)_2O_2$] Induzierten Polimerisation von gasförmigem Tetrafluoräthylen
Arvia, A. J.; Aymonino, P. J.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1961**, *28*, 393.

Die Kinetik des thermischen Zerfalls von Nitroxychlorid (NO_3Cl).
Cafferata, L. F. R.; Sicre, J. E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1961**, *29*, 188.

Estudio Cinético de la Polimerización del Tetrafluoretileno en Fase Gaseosa indicida por el Peróxido de Bis(monofluorcarbonilo).
Arvia, A. J.; Aymonino, P. J.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1961**, *49*, 81.

Estudio Cinético de la Descomposición Térmica del Cloróxido de Nitrilo (NO_3Cl).
Cafferata, L. F. R.; Sicre, J. E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1961**, *49*, 92.

Estudio Cinético de la Reacción Fotoquímica entre Cloro y Tetrafluoretileno.
Castellano, E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1961**, *49*, 109.

Estudio Cinético de la Reacción Fotoquímica entre Cloro y Tetrafluormonocloroetileno.
Bergamin, N. R.; Castellano, E; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1961**, *49*, 123.

1962

Estudio Cinético de la Reacción Térmica entre Flúor, Monóxido de Carbono y Oxígeno.
Heras, J. M.; Arvia, A. J.; Aymonino, P. J.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1962**, *50*, 1.

Über die Darstellung und einige Eigenschaften des Bis(monofluorcarbonyl)peroxyds ($(COF)_2O_2$).
Arvia, A. J.; Aymonino, P. J.; Schumacher, H. J., *Zeitschrift für anorganische und allgemeine Chemie,* **1962**, *316*, 327.

Die photochemische Reaktion zwischen Fluor und Ozon.
Staricco, E. H.; Sicre, J. E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1962**, *31*, 385.

Die Kinetik der thermischen Reaktion zwischen Stickstoffdioxyd (NO_2) und Nitroxyfluorid (NO_3F).
Viscido, L.; Sicre, J. E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1962**, *32*, 182.

Die Kinetik der thermischen Reaktion zwischen Fluor und Nitroxyfluorid und der Einfluss des Fluors auf diesen thermischen Zerfall.
Sicre, J. E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1962**, *32*, 355.

Die Kinetik des thermischen Zerfalles von Nitroxyfluorid (NO_3F) und der Einfluss inerter Gase auf diese Reaktion.
Viscido, L.; Sicre, J. E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1962**, *33*, 1.

Photochemical Decomposition of Ozone in Yellow-Red Light and the Mechanism of its Thermal Decomposition.
Castellano, E.; Schumacher, H. J., *The Journal of Chemical Physics,* **1962**, *36*, 2238.

Die Kinetik des photochemischen Zerfalles von Ozon in rot-gelbem Licht.
Castellano, E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1962**, *34*, 198.

Preparación y Propiedades del Peróxido de Bis(monofluorcarbonilo).
Arvia, A. J.; Aymonino, P. J.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1962**, *50*, 135.

La Reacción Fotoquímica entre Flúor y Ozono.
Staricco, E. H. Sicre, J. E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1962**, *50*, 144.

Die Kinetik der photochemischen Reaktion zwischen Schwefeltrioxyd und Fluor.
Staricco, E. H. Sicre, J. E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1962**, *35*, 122.

Der photochemische Zerfall des F_2O.
Gatti, R. Staricco, E. Sicre, J. E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1962**, *35*, 343.

1963
Das Infrarotspektrum und die Struktur von NO_3Cl und NO_3F.
Arvia, A. J.; Cafferata, L. F. R.; Schumacher, H. J., *Chemische Berichte,* **1963**, *96*, 1187.

Die photochemische Reaktion zwischen Fluormonoxyd und Schwefeltrioxyd.
Gatti, R.; Staricco, E. H.; Sicre, J. E., Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1963**, *36*, 211.

Sulfuryl-fluorid-fluorperoxyd.
Gatti, R.; Staricco, E. H.; Sicre, J. E.; Schumacher, H. J., *Angewandte Chemie,* **1963**, *75*, 137.

Die Kinetik der photochemischen Chlorierung von 2-Perfluorbuten (C_4F_8).
Roselli, M. E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1963**, *38*, 326.

Die Kinetik der thermischen Reaktion zwischen Fluormonoxid und Stickstoffdioxid.
de Staricco, E. R.; Sicre, J. E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1963**, *39*, 337.

1964
Die photochemischen Reaktionen von Fluor und Fluormonoxid mit Thionylfluorid.
Castellano, E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1964**, *40*, 51.

Die photochemischen Reaktionen des Fluors und des Fluormonoxids mit Bis-fluorsulfuryl-peroxyd ($F_2S_2O_6$).
Gatti, R.; Sicre, J. E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1964**, *40*, 127.

Die Kinetik der photochemischen Chlorierung von 1-1-Difluorätylen.
Bergamin, N. R.; Castellano, E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1964**, *40*, 246.

Die Kinetik der thermischen Reaktion zwischen Stickstoffmonoxid (NO) und Nitroxifluorid (NO_3F).
Bolzan, J. E., Sicre, J. E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF*, **1964**, *41*, 101.

Das Gleichgewicht $F_2S_2O_6 = 2\ FSO_3$, das Absorptionsspektrum des Radikals FSO_3 und die Kinetik der thermischen Reaktion zwischen Bis-Sulfurylfluoridperoxid und Schwefeltetrafluorid.
Castellano, E.; Gatti, R.; Sicre, J. E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1964**, *42*, 174.

Die Kinetik der thermischen Reaktion zwischen Fluor und Thionylfluorid.
Vallana, C.; Castellano, E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1964**, *42*, 240.

La Descomposición Fotoquímica del Monóxido de Flúor.
Gatti, R.; Staricco, E. H.; Sicre, J. E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1964**, *52*, 161.

La Reacción Fotoquímica entre Monóxido de Flúor y Trióxido de Azufre.
Staricco, E. H.; Sicre, J. E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1964**, *52*, 167.

La Cinética de la Reacción Fotoquímica entre Flúor y Trióxido de Azufre.
Staricco, E. H.; Sicre, J. E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1964**, *52*, 177.

1965

Die Bestimmung der Absolutgeschwindigkeit der Reaktionen zwischen F-Atomen und SO_3-Molekülen bzw. FSO_3-Radikalen.
Bolzan, J. E.; Sicre, J. E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF*, **1965**, *46*, 78.

Die Kinetik der photochemischen Reaktion zwischen Chlor und 1,1-Dichlor-2,2-Difluoräthylen.
Vallana C.; Castellano, E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF*, **1965**, *46*, 294.

Die photochemische Reaktionen von Fluorfluorsulfunat, F_2SO_3, mit Schwefeltrioxid und Schwefeldioxid im Licht der Wellenlänge 2537 Å.
Basualdo, W. H.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1965**, *47*, 57.

The Homogeneous Reaction between N_2F_4 and O_2.
Sicre, J. E.; Schumacher, H. J., *Journal of Inorganic and Nuclear Chemistry,* **1965**, *27*, 2277.

Sobre la Cinética y el Mecanismo de algunas Reacciones Químicas.
Schumacher, H. J., *Anales de la Academia Nacional de Ciencias Exactas, Físicas y Naturales,* **1965**, *17*, 1.

1966

A New Method of Preparation and some Properties of Chlorine Pentafluoride.
Gatti, R.; Krieger, R. L.; Sicre, J. E.; Schumacher, H. J., *Journal of Inorganic and Nuclear Chemistry,* **1966**, *28*, 655.

Die Kinetik der thermischen Reaktion zwischen Kohlenmonoxid und Fluormonoxid.
Arvia, A. J.; Aymonino, P. J.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1966**, *51*, 170.

Die Kinetik der photochemischen Bildung von Chlorpentafluorid, ClF_5, aus Chlortrifluorid und Fluor.
Krieger, R. L.; Gatti, R.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1966**, *51*, 240.

1967

Die Kinetik der thermischen Reaktion zwischen Fluorfluorsulfonat, F_2SO_3, und Schwefeldioxyd.
Castellano, E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie, NF* **1967**, *54*, 77.

Das Gleichgewicht $N_2F_4 = 2\ NF_2$.
von Ellenrieder, G.; Castellano, E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1967**, *55*, 144.

Die Kinetik der durch Bis-Fluorsulfurylperoxyd sensibilisierten Kohlendioxidbildung aus Kohlenmonoxid und Sauerstoff.
Gatti, R.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1967**, *55*, 149.

Die Kinetik der thermischen Reaktion zwischen Chlortrifluorid un Tetrafluorhydrazin.
von Ellenrieder, G.; Castellano, E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1967**, *56*, 20.

La Cinética de las Reacciones Térmicas del Peróxido de Bis-fluoro-sulfurilo con SO_2 y con SF_4. La Energía de Disociación $D(FSO_3\text{-}SO_2)$ y $D(FSO_3\text{-}SF_4)$ y de los Intermediarios $FSO_3\text{-}SO_2$ y $FSO_3\text{-}SF_4$.
Castellano, E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1967**, *55*, 147.

1968

Die Kinetik der thermischen Reaktionen zwischen Tetrafluorhydrazin und Bis-fluorsufurylperoxid ($F_2S_2O_6$) bzw. Fluorfluorsulfonat (F_2SO_3).
von Ellenrieder, G.; Castellano, E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1968**, *57*, 19.

Der Mechanismus der thermischen Reaktion zwischen Bis-Fluorsulfurylperoxid und Stickstoffmonoxid.
von Ellenrieder, G.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1968**, *59*, 151.

Die Kinetik der thermischen Reaktion zwischen Bis-Fluorsulfurylperoxid und Sauerstoff.
von Ellenrieder, G.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1968**, *59*, 157.

Die Kinetik der thermischen Zerfalles von Fluorfluorsulfonat in Gegenwart von Chlor.
von Ellenrieder, G.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF* **1968**, *60*, 49.

La Reacción Fotoquímica entre el Flúor y el Difluoruro de Trisulfurilo.
Bolzán, J. E. Sicre, J. E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1968**, *56*, 55.

The Kinetics and Mechanisms of some Photochemical Reactions of Fluorine Atoms and Fluorine-containing Radicals.
Schumacher, H. J., *Photochemistry and Photobiology,* **1968**, *7*, 755.

The Energy of the O-F Bond in Trifluoromethyl Hypofluorite.
Czarnowski, J.; Castellano, E.; Schumacher, H. J., *Chemical Communications,* **1968**, 1255.

Die Kinetik der thermischen Reaktion zwischen Fluorfluorsulfonat und Stickstoffdioxid.
Gatti, R.; Schumacher, H. J.
Zeitschrift für Physikalische Chemie NF, **1968**, *62*, 159.

1969

Die Kinetik und der Mechanismus des photochemischen Ozonzerfalles im Licht der Wellenlänge 313 mμ.
Castellano, E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1969**, 65, 62.

Die Kinetik der thermischen Reaktion zwischen CF_3OF und SO_3.
Czarnowski, J.; Castellano, E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1969**, *65*, 225.

Die Kinetik der thermischen Bildung von Chlorfluorsulfonat, FSO_3Cl, aus Bis-Fluorsulfurylperoxid und Chlor.
Vasini, E. J.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1969**, *65*, 238.

Die Kinetik der photochemischen Reaktion zwischen Fluor und Kohlendioxid.
Jubert, A. H.; Sicre, J. E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF*, **1969**, *67*, 138.

Die Kinetik der thermischen Reaktion zwischen Kohlendioxid und Fluor.
Czarnowski, J.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1969**, *68*, 149.

1970

La Reacción Fotoquímica entre el Monóxido de Flúor y el Monóxido de Carbono.
Jubert, A. J.; Sicre, J. E.; Schumacher, H. J., *Anales de la Asociación Química Argentina*, **1970**, *58*, 79.

Die Kinetik der photochemischen Bildung von Chlortrifluorid im System Fluor-Chlormonofluorid.
San Román, E. A.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1970**, *71*, 153.

Die Kinetik der thermischen Reaktion zwischen Pentafluorschwefelhypofluorid und Kohlenmonoxid.
Colussi, A. J.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1970**, *71*, 208.

Die Kinetik und der Mechanismus der Bildung von Bis-Trifluormethylperoxid, $(CF_3O)_2$, aus Trifluormethylhypofluorid, CF_3OF, and Fluorphosgen, COF_2.
Czarnowski, J.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1970**, *78*, 68.

Estudios sobre algunas Nuevas Substancias Compuestas de Nitrógeno, Oxígeno y Flúor.
Bruna, P. J.; Jubert, A. H.; Sicre, J. E.; Schumacher, H. J., *Anales de la Sociedad Científica Argentina*, Serie I, **1970**, *190*, 41.

Nitrosyl Hypofluorite, ONOF.
Bruna, P. J.; Sicre, J. E.; Schumacher, H. J., *Chemical Communications,* **1970**, 1542.

1971

The Kinetics and the Mechanism of the Photochemical Decomposition of Ozone with Light of 2537 Å wavelength.
von Ellenrieder, G.; Castellano, E.; Schumacher, H. J., *Chemical Physics Letters,* **1971**, *9*, 152.

The Thermal Reaction between SF_5OF and NO_2.
Colussi, A. J.; Schumacher, H. J., *Journal of Inorganic and Nuclear Chemistry,* **1971**, *33*, 2680.

Über die Existenz einiger neuer O, N, F-Verbindungen.
Sicre, J. E.; Schumacher, H. J., *Zeitschrift für anorganische und allgemeine Chemie* **1971**, *385*, 131.

Die Kinetik und der Mechanismus des photochemischen Ozonzerfalles im Licht der Wellenlänge 2537 Å.
von Ellenrieder, G.; Castellano, E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1971**, *76*, 240.

Die Kinetik des photochemischen Ozonzerfalls im Licht der Wellenlänge 313 mμ.
Castellano, E., Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1971**, *76*, 258.

1972

The Kinetics and the Mechanism of the Photochemical Decomposition of Ozone with Light of 3340 Å wavelength.
Castellano, E.; Schumacher, H. J., *Chemical Physics Letters,* **1972**, *13*, 625.

Die Kinetik thermischen Reaktion zwischen Trifluomethylhypofluorid un Stickstoffdioxid.
Czarnowski, J.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1972**, *78*, 234.

Die Kinetik des thermischen Zerfalles von Pentafluorschwefelhypofluorid (SF_5OF) in Gegenwart von Chlor.
Colussi, A. J.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF* **1972**, *78*, 257.

The Kinetics of the Thermal Decomposition of F_2O.
Czarnowski, J.; Schumacher, H. J., *Chemical Physics Letters,* **1972**, *17*, 235.

La Cinética y el Mecanismo de la Descomposición Fotoquímica del Ozono en distintas Regiones del Espectro.
Castellano, E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1972**, *60*, 375.

Reacciones de los Atomos de Flúor y de los Radicales FO con Compuestos de N, O y F. I). Observaciones respecto del Comportamiento de los Atomos de Flúor y Radicales FO frente al ONF, FNO_2 y NO_3F. II). La Cinética y el Mecanismo de la Reacción Fotoquímica entre el Monóxido de Diflúor (F_2O) y el nitrato de Flúor (NO_3F).
Bruna, P. J.; Sicre, J. E.; Schumacher, H. J., *Anales de la Sociedad Científica Argentina,* **1972**, *194*, 69.

1973

Die Kinetik und der Mechanismus des photochemischen Ozonzerfalles im Licht der Wellenlänge 3340 Å.
Castellano, E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF* **1973**, *83*, 54.

Die Kinetik der photochemischen Reaktion zwischen Chlor und Trifluorazetaldehyd.
Antonelli, L.; Castellano, E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1973**, *84*, 188.

Die Kinetik des thermischen F_2O-Zerfalles.
Czarnowski, J.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF* **1973**, *86*, 7.

1974

Die Kinetik und der Mechanismus des photochemischen Zerfalles von F_2O bei höheren Temperaturen.
Ghibaudi, E.; Sicre, J. E.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1974**, *90*, 95.

Die Kinetik des thermischen Zerfalles von Bis-trifluormethylperoxid in Gegenwart von Peroxodisulfurylfluorid und Kohlenoxid.
Czarnowski, J.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1974**, *92*, 329.

Kinetics of the Photochemical Fluorination of Carbonyl Fluoride.
López, M. I.; Castellano, E.; Schumacher, H. J., *Journal of Photochemistry,* **1974**, *3*, 97.

1975
The Photochemical Preparation of Peroxydisulfuryl difluoride, Fluorine fluorosulfate and Peroxysulfuryl difluoride.
Gambaruto, M.; Sicre, J. E.; Schumacher, H. J., *Journal of Fluorine Chemistry,* **1975**, *5*, 175.

La Descomposción Fotoquímica del Ozono a 3200 Å.
Castellano, E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1975**, *63*, 9.

Die Kinetik der thermischen Reaktion zwischen F_2SO_3 und CO.
Vasini, E. J.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1975**, *94*, 39.

1976
Die Kinetik der photochermischen Reaktion zwischen F_2 und OSF_4.
Vasini, E. J.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1976**, *99*, 21.

The Kinetics of the Thermal Decomposition of Bis-(pentafluorsulfur peroxide).
Czarnowski, J.; Schumacher, H. J., *Journal of Fluorine Chemistry,* **1976**, *7*, 235.

Die Kinetik der photochemischen Reaktion zwischen CF_3OCl und CO.
Dicelio, L.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1976**, *100*, 55.

1977
The Preparation and some Properties of Bis-pentafluorinesulfurtrioxide.
Czarnowski, J.; Castellano, E.; Schumacher, H. J., *Revista Latinoamericana de Química,* **1977**, *8*, 143.

1978
Kinetics of the Thermal Decomposition of Bis-Pentafluorine Sulfur Peroxide in the Presence of Carbon Monoxide.
Czarnowski, J.; Schumacher, H. J., *International Journal of Chemical Kinetics,* **1978**, *10*, 111.

Comments on "The Chlorine Atom sensitized Oxidation of $HCCl_3$, HCF_2Cl and HCF_3"
Schumacher, H. J., *Journal of Photochemistry,* **1978**, *9*, 495.

Data on the Formation and Decomposition of Bis(Pentafluorosulfur) Trioxide, Bis(Pentafluorosulfur) Dioxide, Bis(Pentafluorosulfur) Monoxide, and of the Radicals SF_5O_2 and SF_5O. A Review of Earlier Kinetic Investigations.
Czarnowski, J.; Schumacher, H. J., *Journal of Fluorine Chemistry,* **1978**, *12*, 497.

La Descomposición Fotoquímica del Hipoclorito de Trifluormetilo (CF_3OCl) y su Descomposición iniciada por Atomos de Cloro.
Dicelio, L.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1978**, *66*, 283.

1979

Die Kinetik der thermischen Reaktion zwischen Fluorfluorsulfonat, Kohlenmonoxid und Sauerstoff.
Vasini, E. J.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1979**, *104*, 219.

The Kinetics of the Photochemical Reaction between Trifluoromethylhypochlorite (CF_3OCl) and 1,1,-Dicloro-2,2,-difluoroethylene (CF_2CCl_2).
Dicelio, L.; Schumacher, H. J., *Journal of Photochemistry,* **1979**, *11*, 1.

The Kinetics and the Mechanism of the Thermal Decomposition of Bis-Pentafluorosulfur-trioxide (SF_5OOOSF_5).
Czarnowski, J.; Schumacher, H. J., *International Journal of Chemical Kinetics,* **1979**, *11*, 613.

Kinetics of the Thermal Decomposition of Bis-Pentafluorosulfur Ttrioxide (SF_5OOOSF_5) in the Presence of Carbon Monoxide.
Czarnowski, J.; Schumacher, H. J., *International Journal of Chemical Kinetics,* **1979**, *11*, 1089.

1980

La Cinética y el Mecanismo de la Descomposición Fotoquímica del SF_5Cl y el Efecto del Oxígeno sobre esa Reacción.
Féliz, M.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1980**, *68*, 217.

Die Kinetic der durch den thermichen Zerfall von Bis-Pentafluorschwefeltrioxid sensibilisierten Kohlendioxidbildung.
Czarnowski, J. Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF,* **1980**, *123*, 91.

1981

Die Kinetik der durch SF_5O Radikale sensibilisierten CO-Oxydation.
Féliz, M.; Schumacher, H. J., *Journal of Photochemistry,* **1981**, *15*, 109.

The Kinetics and the Mechanism of the Thermal Decomposition of Bis(trifluoromethyl) Trioxide. The Influence of Carbon Monoxide on its Decomposition.
Czarnowski, J.; Schumacher, H. J., *International Journal of Chemical Kinetics,* **1981**, *13*, 639.

Die Kinetik und der Mechanismus der thermischen Reaktion zwischen Schwefeltetrafluorid und Fluor.
González, A. C.; Schumacher, H. J., *Zeitschrift für Naturforschung 36b*, **1981**, *1381*.

Die Kinetik der thermischen Reaktion zwischen Schwefeltetrafluorid und Fluor in Gegenwart von Sauerstoff.
González, A. C.; Schumacher, H. J., *Zeitschrift für Physikalische Chemie NF* **1981**, *127*, 167.

1982
La Cinética y el Mecanismo de la Reacción Fotoquímica entre el Tetrafluoruro de Azufre y el Monóxido de Flúor a 365 nm en la Presencia de Altas Presiones de Oxígeno.
González, A. C.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1982**, *70*, 179.

Die Kinetik und der Mechanismus der photochemischen Reaktion zwischen F_2O und SF_4 bei 365 nm.
González, A. C.; Schumacher, H. J., *Journal of Photochemistry,* **1982**, *20*, 85.

Cinética de la Recombinación de Radicales Fluorosulfato estudiada mediante fotólisis flash.
San Román, E.; Aramendía, P. F.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1982**, *70*, 887.

The Kinetics and Mechanism of the Formation of Chlorine Monofluoride in the Photochemical Reaction between Chlorine and Fluorine at 365 nm.
San Román, E.; Schumacher, H. J., *Journal of Photochemistry,* **1982**, *20*, 287.

1983
The Kinetics and Mechanism of Ozone Photolysis at 253.7 nm.
Cobos, C.; Castellano, E.; Schumacher, H. J., *Journal of Photochemistry,* **1983**, *21*, 291.

Kinetics and the Mechanism of the Thermal Reaction between Trifluoromethylhypofluorite and Hexafluoropropene.
Dos Santos Afonso, M.; Schumacher, H. J., *International Journal of Chemical Kinetics,* **1983**, *16*, 103.

1984
La Fotólisis del Ozono a 313 nm.
Cobos, C.; Castellano, E.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1984**, *72*, 429.

La Descomposición Térmica de Fluoroperoxitrifluorometano, CF_3OOF.
Czarnowski, J.; Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1984**, *72*, 517.

1985
The Kinetics and the Mechanism of the Thermal Reaction between Sulfurtetrafluoride (SF_4) and Trifluoromethylhypofluorite (CF_3OF).

González, A. C.; Schumacher, H. J., *International Journal of Chemical Kinetics,* **1985**, *17*, 43.

1986

The Kinetics and the Mechanism of the Thermal Gas-Phase Reaction between NO_2 and 1,1,-Dichlorodifluoroethylene, CF_2CCl_2.
Czarnowski, J.; Schumacher, H. J., *International Journal of Chemical Kinetics,* **1986**, *18*, 907.

La Cinética y el Mecanismo de la Reacción Térmica entre Perfluoropropeno y Monóxido de Flúor.
Dos Santos Afonso, M., Castellano, E., Schumacher, H. J., *Anales de la Asociación Química Argentina,* **1986**, *74*, 465.

Photochemical Decomposition of SF_5OF in the Presence of Carbon Monoxide: Kinetics and Mechanism.
Féliz, M. R.; Schumacher, H. J., *Journal of Photochemistry,* **1986**, *35*, 23.