

# Pilgrimage through the History of German Natural Science, University City Göttingen

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## Introduction

We left Bonn early morning to Göttingen. On the way, we changed trains at Frankfurt am Main, and arrived at Göttingen via Fulda at 11 o'clock. Most of the Houses in Göttingen are red roofed and are surrounded by the green trees. First, I make a hotel reservation at the tourist information in front of Göttingen station. The hotel is on Goethe Allee in the center of the old town, but it was quiet and convenient. A charming old lady at the reception greeted us in English, but soon we found out her English was only for every day salutation (Fig.1-2).



Fig.1. Göttingen is one of the famous University City in Germany. We arrived at Göttingen by DB (Deutsches Bahn).



Fig. 2. On the wall of a storage house adjacent to the Göttingen station, a profile of the city of Göttingen is drawn..

## History of Göttingen and the University

In the old days, Göttingen was a small trading town, which grew into a learning and studying city by the establishment of the University of Göttingen by Elector Georg August of Hannover in 1737. Therefore, the University has been called officially "Georg August Universität zu Göttingen", and numerous intellectuals emerged from both scientific and

nonscientific areas.

Göttingen belongs to Niedersachsen, an area with unusual history. When Queen Ann of England died, all of her legal successor in England died except for Georg of Hannover (1660-1727), grandson of the James of England.

The famous English Astronomer William Herschel (1738-1822) was born in Hannover. He went to England as a musician because the two countries were reigned by the same King. Herschel studied astronomy and telescope making, and he became a Great astronomer in England by the help of his sister Caroline Herschel (1750-1848). After William died (1822), Caroline returned to Hannover to study astronomy, becoming first female astronomer in the modern days. There is a small museum of William and Caroline Herschel in Bath, England. Caroline's grave is in a small church cemetery of Gartenkirche, Marien Strasse, Hannover.

George King of England was the son of George , and he established the University of Göttingen in 1737. Thus the university is not particularly old, but grew by the help of George , attracted many students from all over Germany, due to the high level of education and famous professors. And in the latter days, the University of Göttingen has been a center of learning especially in the field of Natural Science.

The name of Göttingen has been known in Japan from the old days, and 「Göttingen」 was written as 「月沈原」 which means literally "moon sinking field", stimulating our romantic imagination which was certainly influenced by the 19<sup>th</sup> century German Romanticism.

## Göttinger Sieben

Hannover enjoyed a relatively liberal Constitution since 1833, however, in 1837, new King of Hannover "Ernst August" abolished the constitution and attempted to issue new law. Seven professors in Göttingen listed below were against the new law and supported the 1833 Constitution. Many of them were expelled from Hannover, but the liberalistic

movement was well supported by the general public, and all of the professors were finally able to obtain their positions in various universities. This is the famous liberalistic movement at the University of Göttingen. The seven professors were called the “Göttinger Sieben”. Wilhelm Weber (1804-1891, physicist) costudied with Carl Friedrich Gauss (1777-1855, mathematician, physicist) came back again to Göttingen. Historian Dahrman was also expelled from Hannover, and obtained professorship at the University of Bonn. Wilhelm and Jacob Grimm were invited to Berlin University.

### Göttingen Declaration

I remember another declaration issued from Göttingen in Apr. 12, 1957 by famous physicists in Germany. They declared that Germany should not have atomic weapons and should never be involved with the preparation and testing of atomic weapon. The Göttingen declaration was certainly based on the humanities.

### From DB Station to Markt Platz

As we approached Goethe Allee and Prinzen Strasse from DB station, we can see State and University Library in right side. There is a beautiful marble bust of Carl Friedrich Gauss (Mathematician, 1777-1855) in the Library. When we proceed further we can see a strange bronze statue at the crossing point to Weender Strasse(Fig. 3). It looks as though a couple is in quarrel, but the woman has a mask in her left hand, therefore, the figure may have some relation with play or drama(Fig. 4).



Fig. 3. If we proceed Goethe Allee from DB station, we can see State and University Library in right side.



Fig. 4 A strange statue is at the crossing point of the main street in a busy old town. The woman has holding a mask in her left hand, therefore, this statue may be related to drama.

We turn to right at the crossing and we reach the Markt Platz, where the old City Hall is there(Fig. 5- 6). The bronze statue of a girl Gänseliesel is a symbol of Göttingen(Fig. 7). Two bronze statues commemorating Georg Christoph Lichtenberg (Physicist, Critic, 1742-1799) were recently erected in the Markt Platz and also in a Hof of the Library (1997 ?). Both statues are unique reflecting the character of Lichtenberg(Fig. 8- 9).

Old university building are distributed throughout the old town. Some of the new buildings were constructed in the north side of the old town. The new chemistry buildings are about 3km north of the old town. We pass through Humboldtallee, then Robert Koch Strasse, and we reach the new chemistry building. On the way to the chemistry building, there are many university buildings. Among these I saw a building signed “Geistwissenschaft”. The word “wissenschaft” mean “systematized knowledge”.



Fig. 5. Old city hall is in the Markt Platz. A Tourist Information is in the first floor of the building.



Fig. 6. There are four churches in Göttingen. A copper plate indicating the directions to the churches is buried on the paved ground in the corner of the Markt Platz.



Fig. 7. The bronze girl is called "Ganseliesel", which is a nickname (or abbreviation) of "Elithabeth accompanying goose". The statue was made in 1901, and is now a symbol of Göttingen.



Fig. 8. Two bronze statues commemorating Georg Christoph Lichtenberg, were erected in the Markt Platz and also in the Hof of the Library in about 1997. Both statues are unique reflecting the character of Lichtenberg.



Fig. 9. Bronze statues commemorating Georg Christoph Lichtenberg, who is a physicist and also a critic were erected in the Markt Platz and also in the Hof of the Library in about 1997. Both statues are unique reflecting the character of Lichtenberg.

### Hotel room number

I recalled the room number problem I experienced years ago, when I visited Göttingen and stayed at another hotel. My room number was No. 123. At that time the number 123 had special meaning for Japanese. One day before I left Japan, a domestic JAL flight 123 took off from Narita Airport and crashed in the mountainous area, killing most of the passengers. In our flight, many passengers were waiting nervously and watching TV news of yesterday accident (Fig. 10). I checked my escape route in this hotel in case of accident.



Fig. 10. One day before I left Japan by JAL. Flight No. 123 crashed in the mountainous area of Japan. The key number I received in my Hotel is No. 123. I checked escape way in case of emergency.

### To the Department of Chemistry

When we turn Koch Strasse to right, we can see chemistry building on the left, and the Geoscienc building in the right side. The road leading us to the chemistry building is Tammann strasse (Gustav Tammann, 1861-1938), and the road to geoscience building is V. M. Goldschmidt Strasse (Victor Moritz Goldschmidt, 1888-1947)(Fig. 11-13). Tammann was a professor at Göttingen. He is famous as an expert of alloy metallography, and he was a editor of "Zeitschrift für anorganische und allgemeine Chemie".



Fig. 11. The road to the Chemistry Building is Tammann Strasse, and the way to the Geoscience building is Goldschmidt Strasse.





Fig. 12.



Fig. 13.

Fig. 12, 13. Chemistry building is composed of three large buildings, these are from left to right Organic Chemistry, Inorganic Chemistry and Physical Chemistry.

Goldschmidt was a professor of Geochemistry at Göttingen. He has interested in the geochemical circulation of matter and proposed a new image of the planet Earth. He escaped to Norway in 1938 and he engaged in cosmochemical studies.

The chemistry building in Göttingen is composed of three large buildings of similar size, and each building is occupied by Organic Chemistry, Inorganic Chemistry, and Physical Chemistry, respectively. At the present time (2002 AD), new constructions of additional research buildings are going on (Fig. 14).



Fig. 14. There is a Chemistry Museum called "Museum der Göttinger Chemie" in the building of Inorganic Chemistry.

#### Old Chemistry Department, University of Göttingen

The history of the Department of Chemistry in the University was briefly summarized by Dr. Günther Beer who is in charge of the Chemistry Museum in the University of

Göttingen(Fig. 15- 17).



Fig. 15. Dr. Günther Beer is in charge of the Museum for past long years.



Fig. 16.



Fig. 17

Fig. 16, 17. The Chemistry Museum collect and displayed many kinds of chemistry related materials such as old books, documents, letters, photographs, medals, certificates, glass wares and old apparatus etc. Many things are displayed systematically showing the history of the Department of Chemistry, University of Göttingen.

In the early days(Fig. 18-19), medical professors taught chemistry, but the first "real" chemistry professor in Göttingen



Fig. 18



Fig. 19.

Fig. 18, 19. The chemistry professors in the old days (1735-1775) before J. F. Gmelin, were Erxleben and Vogel.

was Johann Friedrich Gmelin (1748-1804). He taught chemistry for more than twenty years. He came from the famous scholar family in Tübingen. He is the father of Leopold Gmelin (1788-1853, Chemist). Leopold was born in Göttingen. J. F. Gmelin taught Chemistry, Pharmacology, Botany, Mineralogy and History of Chemistry and he wrote several Textbooks (Fig. 20- 21). The next professor of chemistry is Friedrich Stromeyer (1776-1835). He studied mineralogy at Göttingen and Paris and found the element Cadmium. Leopold Gmelin is a pupil of F. Stromeyer. The famous chemist Robert Bunsen studied for short time (1835-1836) in Göttingen. Later Friedrich Wöhler became a professor of chemistry and studied for forty-four years in Göttingen, making the department of chemistry famous. Wöhler was a student of J. J. Berzelius (1709-1848) and Leopold Gmelin (1788-1853).



Fig. 20

Fig. 21.

Fig. 20, 21. A portrait of chemistry professor Johann Friedrich Gmelin (1749-1804) and his book "Handbuch der allgemeinen Chemie" (1789) are displayed

### Leopold Gmelin

Leopold Gmelin (1788-1853) is a son of J. F. Gmelin and he was born in the house at Hospital Strasse 10 Göttingen, which is now called "Wöhler Hause". He was a great organizer of the developing chemistry in the early 19<sup>th</sup> century. F. Wöhler (1800-1882) was a pupil of L. Gmelin, and Leopold was a student of F. Stromeyer (1776-1835) (Fig. 22- 23). He was interested in physiological chemistry and he is famous of his "Handbuch der theoretischen Chemie" (Fig. 24- 25). He stayed in Heidelberg rest of his life after he got the position of chemistry professor.



Fig. 22.

Fig. 23.

Fig. 22, 23. A portrait of the second chemistry professor Friedrich Stromeyer (1776-1835) and his book "Grundris der theoretischen Chemie" (1808) are displayed.



Fig. 24

Fig. 25.

Fig. 24, 25. Leopold Gmelin (1788 –1853) and his book "Handbuch der theoretischen Chemie".

### Wöhler and the Laboratory of General Chemistry

Wöhler (Fig. 26- 29) was famous for his abiotic Urea synthesis and isolation of metallic aluminum and coresearch with Justus Liebig. William S. Clark (1826-1886), who is famous in Japan for his saying "Boys be ambitious", was originally a chemist and he was the first American student under F. Wöhler. He obtained a Ph D degree from the University of Göttingen by his study on the elemental analysis of various iron meteorites. Wöhler's laboratory was organized as the "Laboratory of General Chemistry" (Allgemeines chemisches Laboratorium) and the following chemists took the director's position.

Laboratory of General Chemistry	
Director of the Laboratory	in Position
Johann Friedrich Gmelin,	1783 -1803
Friedrich Stromeyer,	1776 -1800
Friedrich Wöhler,	1836 -1880
Hans Hübner,	1874 -1884
Viktor Meyer,	1885 -1889
Otto Wallach,	1889 -1915
Adolf Windaus,	1915 -1945



Fig. 26. Friedrich Wöhler (1800-1882) was a chemistry professor in Göttingen. There are many Wöhler related materials in this Museum.



Fig. 27. A portrait of young Wöhler is in the museum, and a plaster bust is displayed in the Wöhler Auditorium in the chemistry building.



Fig. 28. Wöhler's photograph is wearing fur court and having a stick.



Fig. 29. Large medal celebrating Wöhler's 80<sup>th</sup> birthday in 1880 .

### Chemical Laboratory for the "Institute of General Chemistry" (1842-1977)

First Chemical Laboratory was constructed in 1842 (Fig 30) for Wöhler (1800-1882). The Development of the Chemical Laboratory of the "Institute of General Chemistry" is shown in the photographs (Fig. 30-33). In 1860 additional building (Fig.31) was constructed and later the Laboratory expanded further as shown in Fig. 33. Many great researches have been accomplished in the Laboratories by Friedrich Wöhler (1800-1882), Victor Meyer (1848-1897), Otto Waldach (1847-1931) and Adolf Windaus (1876-1959). However, total laboratory buildings were demolished in 1977. This is a historical building in chemistry.



Fig. 30. First chemical laboratory was constructed in 1842 for F. Wöhler.



Fig. 31. The development of Chemical Laboratory between 1842-1977 is summarized as shown in the Figure .



Fig. 32. Additional adjacent building was constructed in 1860.



Fig. 33. Further additional building was constructed and the final laboratory building is shown as in the bottom of the page. However, all of the buildings were demolished in 1977.



### Victor Meyer

Victor Meyer (1848-1897)(Fig. 34-35) studied in Heidelberg under Robert. Bunsen (1811-1899), and in Berlin under Adolf. Beayer (1835-1917), and became a professor of chemistry at Turich Hochschule. He later became a professor of Göttingen and then at Heidelberg. Meyer synthesized many organic compounds. He found Thiophen in Benzene, structure of Oxim, and he introduced the technical term “stereochemistry”. We can visit his grave at the “Berg Friedhof”, Heidelberg.



Fig. 34.



Fig. 35.

Fig. 34, 35. Victor Meyer was the successor after Hübner. Meyer's photograph and plaster bust are in the Museum.

### Otto Wallach

Otto Wallach (1847-1931)(Fig. 36- 37) studied under F. Wöhler in Göttingen and under August Kekule (1829-1896) in Bonn and became a professor at Bonn. He established terpene chemistry, which Kekule thought was too complex to develop into a research field. Otto Wallach (1847-1931) moved to Göttingen after Victor Meyer left to Heidelberg, and he completed his productive research. Otto Wallach, the founder of terpene chemistry, received Nobel Prize in 1910(Fig. 38).



Fig. 36



Fig. 37.

Fig. 36, 37. Wallach's students made a memorial medal for him with his relief on it.



Fig. 38. Otto Wallach was the successor of V. Meyer and he established the terpentine chemistry and received Nobel Prize Chemistry in 1910.

### Adolf Windaus

Adolf Windaus (1876-1959)(Fig. 39) studied medicine first, then became interested in chemistry by the influence of Emil Fischer (1852-1919). In 1913, he was appointed professor of medicinal chemistry at the University of Innsbruck. In 1915, he became a professor of chemistry after Wallach. He studied on Steroid and Vitamin D related compounds and he received Nobel Prize chemistry in 1944(Fig. 40). He retired and became a professor of “Laboratory of General Chemistry”. Identification and the synthesis of human sexual hormone by Adolf F. J. Butenand't (1903-1995 ) is an extension of Windaus's work. Butenandt was a pupil of Wallach, and received Nobel Prize in 1939(Fig. 41-42).



Fig. 39. Adolf Windaus (1876 –1959).



Fig. 40. Adolf Windaus's celebration medal for his 75<sup>th</sup> birthday. Windaus was a steroid chemist and he received Nobel Prize of Chemistry in 1928.



Fig. 41.



Fig. 42.

Fig. 41, 42. Many samples were collected during the chemical research of terpene and steroid in the laboratories of Wallach and Windaus.

### Institute of Physical Chemistry

In the year 1890<sup>th</sup>, Walther Nemst (1864-1941) started his lectures on physical chemistry(Fig. 43). In 1891, the new "Institute for Physical Chemistry" building was constructed, and Nemst became the first professor of physical chemistry. The professors of the Institute for Physical Chemistry are as follows.

Directors of Institute of Physical Chemistry	in Position.
Walter Nemst(Fig. 44)	1895 -1904
Friedrich Dolezalek (Stellvertreter bis 1906)	
Gustav Tammann(Fig. 44)	1908 -1929
Arnold Eucken(Fig. 44)	1929 -1950
Ewald Wicke (stellvertreter bis 1953)	
Wilhelm Jost	1953 -1971
Werner Bingel	1963 -
Heinz-Georg Wagner	1965 -
Jurgen Troe	1975 –



Fig. 43. The physical chemistry building is at the Burgerstrasse 30.



Fig. 44. There are three plaques on the building. The first one is for Walther Nemst (worked 1891-1905), The second and third plaques are for Gustav Tammann (worked 1908-19309) and for Arnold Eucken (worked 1929-1950).

### Hermann Walther Nemst (1864-1941)

Nemst showed signs of his brilliant capabilities early in his career(Fig. 45-46). When he was twenty-five years old, he proposed the equation of electromotive force, by a combination of chemical theory and thermodynamics. Thus, he established the foundation of physical chemistry of cell and extended the field of physical chemistry. He became a professor of chemistry at Göttingen in 1891. In 1905, he moved to the University of Berlin and found the Third Law of Thermodynamics, studied chain reaction, and designed the

Nemst lamp. He received Nobel Prize for the establishment of chemical thermodynamics. A book entitled "Rise and Fall of German Science, by Mendelssohn" is a book describing several scientists including Nemst working in Berlin from the end of the 19<sup>th</sup> century to the beginning of the 20<sup>th</sup> century.



Fig. 45



Fig. 46.

Fig. 45, 46. Walther Nemst was the first professor of physical chemistry in Göttingen. The lecture of physical chemistry by Nemst started in 1891 Nemst's photograph, Nemst lamp and photograph of balance are on display.

### Gustav Tammann (1861-1938)

Tammann(Fig. 47-49) was an assistant of Carl Schmidt, who was a professor of Ostwald, and studied interdisciplinary areas of chemistry and physics. Later he met Arrhenius and Van't Hoff, becoming lifelong friends. He contributed to the newly born physical chemistry. Tammann was a specialist of metals, alloys and metal compound. Kotaro Honda, who studied in Tammann's laboratory, created a strong magnetic steel (KS steel) which is a Cobalt containing Tungsten steel. Tammann was an experimental scientist just as Kotaro Honda.



Fig. 47



Fig. 48



Fig. 49.

Fig. 47, 48, 49. Gustav Tammann was a second professor of physical chemistry. His portrait and his books are on display. The photograph in the bottom right is his death mask.



Arnold Eucken (1884-1950)(Fig. 50-51)

He studied physics and mathematics at Kiel and Jena, then he studied under Nernst in Berlin, and developed chemical kinetics and catalytic reactions. Eucken's father (Rudolf Eucken, 1846-1926) was a professor of philosophy at Jena and received Nobel Prize of Literature. Eucken named "Chemical Physics" on the subject he studied. On the other hand, Ostwald called "General Chemistry" and Nernst gave the name "Theoretical Chemistry".



Fig. 50. Arnold Eucken (1884-1950) was the 4<sup>th</sup> professor of physical chemistry.



Fig. 51. Gauss Weber Medal.

Institute for Inorganic Chemistry

After establishment of "the Institute of Physical Chemistry", "Institute of Inorganic Chemistry" was established. The first professor of the Institute was G. Tammann, and the second professor was R. Zsigmondy (Fig. 52- 53). Directors of the "Institute of Inorganic Chemistry" are as follows,

Director	in Position
Gustav Tammann	1903 -1907
Richard Zsigmondy	1908 -1929
Peter A. Thiessen (Stellvertreter bis 1933)	
Hans von Wartenberg	1933-1937, 1945-1948
Josef Goubeau (Stellvertreter bis 1952)	
Oskar Glemser	1952 -1980
Anton Meller	1973
George M. Sheldrick	1978-
Herbert W. Roesky	1980-



Fig. 52. The colloid chemist Richard Zsigmondy (1865-1929) invented supemicroscope.



Fig. 53. There is a Lecture Hall named "Zsigmondi-Horsaal" in the chemistry building.

Richard Zsigmondy (1865-1929)

Zsigmondy worked initially at a glass company in Jena. He invented the ultramicroscope and studied colloid chemistry, and he became a professor of inorganic chemistry at Göttingen in 1907 (Fig. 52). The ultramicroscope is an optical device to observe colloid particles which could not observe by using normal optical microscope, in a dark background employing the Tyndal phenomenon.

Institute for Organic Chemistry.

University of Göttingen had a strong tradition for the study of organic compounds. The research conducted by V. Meyer, O. Wallach and A. Windaus indicate high levels of research ability. However, research institution for organic chemistry in Göttingen were established after the 2<sup>nd</sup> World War (1945 ~).

The first professor of the "Institute for organic chemistry" was Hans Brockmann (1945-1972, Professor in office).

Director of the Institute of Organic Chemistry	in Position
Hans Brockmann	1945 -1972
Wolfgang Luttke	1960 -
Ulrich Schollkopf	1964 -
Lutz F. Tietze	1978 -

### Chemistry Museum in Göttingen University

University of Göttingen has a chemistry museum on the ground floor of the Inorganic Chemistry building(Fig. 14). The official name of the Museum is "Museum der Göttinger Chemie". This organization is composed of university staff and members of the general public of the city of Göttingen, and the management of the museum was carried out by Dr. Günther Beer of the University(Fig. 15). The history of chemistry is one of his areas of specialty. Dr. Beer is a very generous person, and every time I visited Göttingen, Dr. Beer has generously provided information on what I am interested in. He has improved the quality of display in the Museum over the years(Fig. 16- 17). The museum is not always open, and if you wish to visit the museum, you must make a reservation.

The area of the museum is about 20m x 15m, and the 200 year history of the university is displayed chronologically using, photographs, printed matter, books, certificate, memorial metal, glassware, old instruments and prepared chemicals.

In the 18<sup>th</sup> century chemical education in Göttingen was carried out by J. O. P. Erxleben and R. A. V. Vogel, both professors of medicine(Fig. 18- 19). There are two silhouettes of the above mentioned professors and a textbook written by Vogel on display.

### J.F. Gmelin(Fig. 20-21)

J. F. Gmelins, who established his laboratory in the Hospital Strasse, Copies of two books written by Fmeline are shown on the wall. These are a) Grundstaze der Lechnichen Chemis (1786), b) Grundris der allgemeine Chemie (1789). There is a portrait of J. F. Gmelin in his first book.

### F. Stromeyer(Fig. 22-23)

F. Stromeyer was a expert of chemical analysis. He became famous by analyzing strontium in aragonite. He contributed to the foundation of modern chemistry and mineralogy. Stromeyer has also been known as a finder of Cadmium. A copy of Stromeyer's book cover "Grundriss der theoretischen Chemie" was on the wall, and his portrait was in display. Leopold Gmelin (1788-1859) and Robert Wilhelm Bunsen (1811-1899) were the pupil of Stromeyer and their portraits were also in display near Stromeyer's portrait on the wall.

A photograph of J. F. Gmelin's laboratory on "Hospital Strasse (10)" was on the wall. The laboratory building was also

used for living. After him F. Wöhler and O. Wallach lived in the same house. Leopold Gmelin, a son of J. F. Gmelin, was born in this house. The old historical house is now called "Wöhler Hause", and is used by the Metal Research Institute.

### Friedrich Wöhler(Fig. 54)

Friedrich Wöhler who is well known for the abiotic synthesis of urea in 1828, stayed at Göttingen more than forty years as a director of the Institute of General Chemistry.



Fig. 54. Photograph of Friedrich Wöhler (center) surrounded by many students and assistants.

On the west side of the Wöhler house along Hospital Strasse, a small laboratory building for the "Institute of General Chemistry" was constructed in 1842 as shown Fig. 30, 31. As Wöhler's chemical research progressed, the laboratory building was expanded further to west -side in 1860 as shown in Fig. 32, and again the research building expanded further as shown in Fig. 33. A part of these research building were used by Wallach and Windaus. Thus all of the chemistry research laboratories along the Hospital Strasse were completed. But these buildings at Hospital Strasse were all destroyed except "Wöhler Haus" (hospital strasse 10), which is the oldest and most historical building.

F. Wöhler's bronze statue formerly stood in front of the "Herbart Schule", but it was moved to the west -side of the "Wöhler Hause", and the mosaic chemical structure of Urea is on the ground in front of the statue(Fig. 55- 56). Thermal conversion of ammonium cyanate to Urea ( $\text{H}_2\text{N}-\text{CO}-\text{NH}_2$ ) is a simple chemical reaction, but the reaction is an epochmaking achievement in chemical history. The formation of urea by the Wöhler's method denied the presence of a vital force for the formation of organic compounds.



Fig. 55

Fig. 56.

Fig. 55, 56. Friedrich Wöhler's standing bronze statue is now in the Hospital Starasse. Chemical structure of urea is expressed in front of the stature. The statue was formerly in front of the Herbart Schule, which is now moved to the present site.

1873 was the fiftieth anniversary since F. Wöhler received his Ph D at Heidelberg University. The fiftieth anniversary in marriage is usually celebrated as "golden wedding". The certificate (goldene Doktorurkunde) displayed on the wall. During the fifty years, the chemistry section where Wöhler belonged to reorganized to the Department of Philosophy from the Department of Medicine. Eighteen signs are on the "Goldene Doktorurkunde" to celebrate the Wöhler's anniversary. Scientists signed on the document are Robert Bunsen (1811–1899), Hermann Kopp (1817-1892) and Gustav R. Kirchhof (1824-1887)(Fig. 57).



Fig. 57. Congratulatory address for commemoration of 50<sup>th</sup> anniversary after F. Wöhler received Ph D degree. We can see signatures of Hermann Kopp and Robert Bunsen in the bottom of the certificate.

Fig. 58 is a certificate of honorary member of an organization to encourage the development of learning and arts in Frankfurt. am Main.

Fig. 59 is a member certificate of Science Academe in Petersburg. This was given to Wöhler from Nicolai I (1796-1855). On the top of the certificate, two-headed eagle, the crest

of royal family of Romanov is on the document.



Fig. 58. Certificate of honorary membership for Wöhler given by a society in Frankfurt.



Fig. 59. Member certificate of Petersburg Academy of Science for F. Wöhler

On the certificate of Swedish Academy of Science, we can see Berzelius's sign(Fig. 60). Wöhler became a member of the academy when he was a young teacher at a technical school in Kassel.



Fig. 60. Member certificate of Swedish Science Academy for F. Wöhler. We can see Berzelius's signature who was a secretary of the Academy at that time.



In the corner of the museum, a beautiful white marble portrait of Wöhler was displayed (diameter 30 cm) (Fig. 61). This marble relief was given to Wöhler to celebrate his 80<sup>th</sup> birthday (Fig. 62). Herman Kopp (1817-1892) wrote a booklet entitled "AUREA CATENA HOMERI" to celebrate the Wöhler's 80<sup>th</sup> birthday. In this article Kopp praise Wöhler's various contributions in chemistry. The text of the booklet starts with the words "Lieber Wöhler! • • •". It seems that Kopp is not only a noticeable person, but he was a talented man with tender heart.



Fig. 61. Marble relief of F. Wöhler was made to celebrate his 80<sup>th</sup> birthday.



Fig. 62. AUREA CATENA HOMERI is a booklet written by Hermann Kopp to congratulate F. Wöhler's 80<sup>th</sup> birthday in 1880.

Many people do not know that Wöhler was a pioneer of cosmochemistry (Fig. 63- 64). He was interested in analyzing, iron meteorite and also stony meteorite. In 1838, a strange stony meteorite, (carbonaceous chondrite), fell in Coldwockeweld, South Africa. Later, in 1857, a similar carbonaceous meteorite fell in Caba, Hungary. Carbonaceous chondrites contain some organic compounds and other volatile matter. Wöhler analyzed organic compound of above mentioned two carbonaceous meteorites, and obtained organic compounds, but he could not identify them, because the technical level of chemical analysis was not sufficiently high at the time. Wöhler's analysis of organic compound in carbonaceous meteorite was the first attempt to analyze organic compounds in extraterrestrial matter. One interesting question

that arose here was Whether the isolated organic compounds were of biological or inorganic origin.

Later, after the World War , fundamental methods to analyze organic compounds in meteorite was established, and Lunar sample have been analyzed in similar ways.



Fig. 63



Fig. 64.

Fig. 63, 64. Wöhler made various kind of research. Analytical studies of metallic and stony meteorites were carried out by Wöhler. The photograph shows stony meteorite fell in Costa Rica in 1850. Wöhler is a pioneer of cosmochemistry.

### In the museum

In the museum of Göttingen University, there is a meteorite specimen which was studied by Wöhler (Fig. 63, 64). This stony meteorite is Heredia meteorite that fell in San Jose, Costa Rica on April 1<sup>st</sup> 1857, according to the "Catalog of Meteorite" published by the British Museum. According to the catalog, the weight of the meteorite kept in Göttingen is 422 g. In the same display box, there is a small glass bottle containing purified Selenium. It is said that the small glass bottle was prepared by Berzerius by glass blowing (Fig. 65).



Fig. 65. A small glass container in the right is said to be made by Berzelius.

### Chemists after Wöhler

If we move to the younger generation of scientists in Göttingen, we can see the display of , H. Hübner (Fig. 66) and Victor Meyer (1848-1897)(Fig. 34-35). There is a photograph of Victor Meyer in which he was lecturing with two assistants Traugott Sandmeyer (1854-1922) and Ludwig Gattermann (1860-1920). Both Wallach(Fig. 36-38) and Windaus(Fig. 39-40) received Nobel Prizes in chemistry by the development terpene and steroid chemistry.



Fig. 66. Hans Hübner was a student of F. Wöhler, and later a successor of the Chemical Laboratory.

Tammann (1861-1938) was a director of Institute of Inorganic Chemistry. He developed Metal Sciences based on his physical background. Richard Zsigmondy (1865-1929) is a colloid chemist and he developed the ultramicroscope to observe colloid particle.

Nemst (1859-1927)(Fig. 45- 46) studied under Ostwald, and he was the second generation of physical chemists. Jacobs Henricus van't Hoff (1852-1911), and Svanate Arrhenius (1859-1927) were among the first generation of physical chemists. Nemst is a pioneer in the field of chemical thermodynamics, and founder of third law of thermodynamics.

The Bunsen medal for physical chemistry and A. Windaus's 75 years celebration medal were displayed in the cabinet(Fig. 40, 67- 68). In the preparation room of the Museum, three Plaster busts were found on the shelf. These are August Wilhelm Hofmann (1818-1892)(Fig. 69), Victor. Meyer (1848-1897) and Heinrich Rose (1795-1864)(Fig. 70).



Fig. 67. Robert Bunsen (1811-1899) was a chemist of same generation as F. Wöhler,



Fig. 68. Bunsen medal (bottom right) is awarded for the research of physical chemistry (Bunsen Society).



Fig. 69. Plaster bust of August Wilhelm Hofmann (1818-1892).



Fig. 70. Plaster bust of Heinrich Rose (1795-1864).

In Wöhler auditorium, which is located in the development of chemistry, Wöhler's bust can be found(Fig. 27). When we pass through the building of inorganic chemistry we also found "Zsigmondy auditorium", and we can observe a large photograph of the old chemical laboratory (Wöhler's first laboratory) and other laboratories along Hospital Strasse.

On the front wall and above the entrance of the “Wöhler House” on Hospital Strasse 10(Fig. 71), there were three plaques for F. Stromeyer, J. F. Gmelin and F. Wöhler which are written with classic German letters. However, rather recently (1990 ?), an additional plaque of Leopold Gmelin was added, and at the same time, the letters of the old plaques were changed to the contemporary letters(Fig. 72- 73).

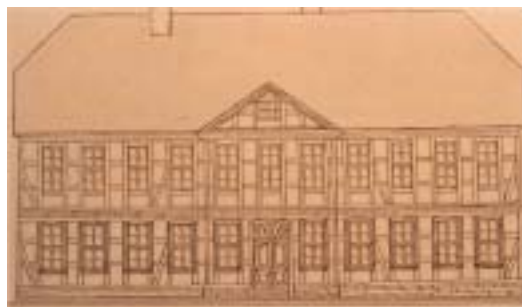


Fig. 71. The old “Wöhler House” is in the Hospital Strasse 10. The building has been used for living and also for research. Many famous chemists lived here as shown in the plaques.



Fig. 72. In the past, most of the chemistry professor of the University of Göttingen lived here. J. F. Gmelin lived 1783-1804. Friedrich Wöhler lived 1836-1882. Leopold Gmelin lived 1788-1804 and Otto Wallach lived 1889-1915. Leopold Gmelin was born in this house and later he became a professor of Chemistry in Heidelberg. At the present time, Institute for Metalphysics occupy the building.



Fig. 73. Recently old plaques were replaced with new one. The old plaques were written in old style.

#### Gauss -Weber Monument

On the south side of the building along the Hospital Strasse, there is a garden with lawns, where a monument of Gauss (1777-1855) and Weber (1804-1891) stand(Fig. 51,74 ). Gauss, who has been called one of the greatest mathematician in

history, discovered the “method of least squares” where he was a teenager. He attended University of Göttingen, when he showed an interest in a wide range of subjects such as mathematics, astronomy and physics. He became a professor of mathematics and astronomy in 1807. He published “Disquisition’s Arithmetical” in 1801, which contains various principles of new and higher mathematics. He recorded Earth magnetism. The unit of magnetism is expressed by the unit of Gauss referring his name.



Fig. 74. Gauss and Weber coworked for long time especially on the electric telegram. They are regarded as a pioneer of telegram system.

#### Old Physical Chemistry Building

Weber was once expelled from Göttingen because he was one of the Göttinger Sieben. After he came back to Göttingen, Weber continued cwork with Gauss. As we pass by the Gauss-Weber Denkmal, we can see the old Institute of Physical Chemistry across Burger Strasse(Fig.43). Here, we were able to find three plaques, mentioned before one for W. Nernst (as director, 1896-1905), another for G. Tammann (as director, 1908-1930), and finally for A. Eucken (as director, 1929-1950)(Fig. 44- 51).

#### Astronomical Observatory

After we visit the old physical chemistry building, we go to the Kepler Strasse(Fig. 75). There is an old observatory in the southern part of Kepler Strasse. The building is, making of stone and there is a small dome for the telescope in the middle of the building(Fig. 76).

On the wall of the observatory, there are two plaques. One of the plaque is to memorize Gauss and Weber, who together invented the telegram(Fig. 77). The other plaque is for Karl Schwarzschild (1873-1916), who is the founder of astrophysics(Fig. 78). He wrote an astronomical article at the



age of 16, and became a professor of astronomy at the University of Göttingen. He was in the position between 1901-1909, and during this time, developed his astronomical theory. Unfortunately he became ill in the battlefield and died at the age 43 during the 1<sup>st</sup> World War.



Fig. 75

Fig. 76

Fig. 75, 76. There is an astronomical observatory of the University of Göttingen near Kepler Strasse.



Fig. 77. Two plaques are on the wall of the observatory. The one is the plaque for Gauss and Weber.



Fig. 78. The second plaque is for astrophysicist Karl Schwarzschild who worked here between 1901-1909.

We are allowed to enter the observatory building, where we are able to see various historical objects related to Gauss and Weber (Fig. 79- 81). Many small optical instruments, Gauss's black cap he used to, Herschel's telescope and its mirror, and portraits of young Gauss and William Herschel are displayed on the wall (Fig. 82- 83). Herschel's telescope is made of wood with a metallic mirror. I heard some years later the original telescope mirror disappear. In the dome of the observatory, there is still small refractive telescope (Fig. 84). The dome and the telescope are both manually operated. The telescope is relatively small, with what looks like a 15cm objective lens.



Fig. 79. Astronomical telescope made by W. Hershell was in the display room. Diameter of the mirror is about 20 cm and whole telescope body was made of wood.



Fig. 80



Fig. 81

Fig. 80, 81. In the display room upstairs. There are two portraits of young C. F. Gauss and Friedrich Wilhelm Herschel (1738-1822).



Fig. 82



Fig. 83

Fig. 82, 83. In the glass cabinet, various small tools for astronomical observation are displayed. Among these 1) black silk cap which Gauss always put on his head and 2) the metallic mirror for Herschel's telescope are especially interesting to me.

In the small lecture Hall, oil-painted portraits of Gauss and Weber' of similar size are displayed on the wall(Fig. 85). When we came back the exhibition room, we find a large metal plate for Gauss given by Georg V (1851-1866) in 1855 celebrating Gauss's accomplishments(Fig. 86). The year 1855 was the year Gauss died.

It will continue to the following issue. All of the photographs shown in this article were taken by the author.

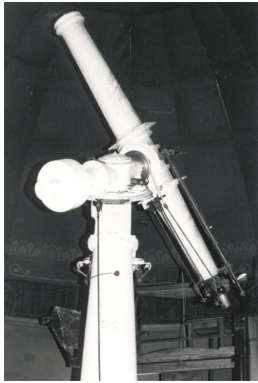


Fig. 84. In the center of the observatory building, there is a small dome for astronomical telescope. The old and small telescope in the dome is now a historical instrument for museum.



Fig. 85. In the small lecture Hall, oil-painted portraits of Gauss and Weber' of similar size are displayed on the wall.



Fig. 86. Georg V sent this plaque to Gauss appreciating the whole studies done by Gauss.

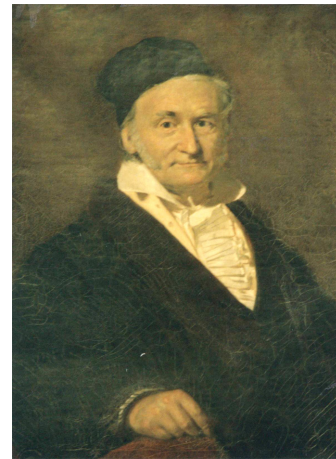


Fig. 87.

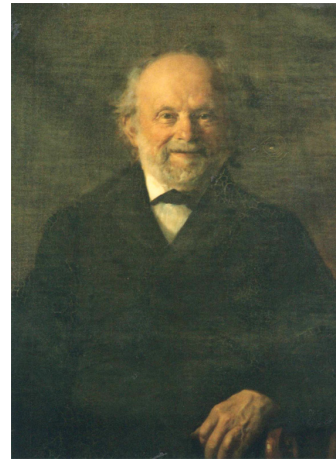


Fig. 88.

Fig. 87. 88., There are oil portraits of Gauss and Weber in an auditorium of the observatory. The lady guided us kindly open the curtain to introduce more light. The light is still not enough but I got acceptable photographs under the conditions. The portrait of Gauss comes from the 10 DM note.