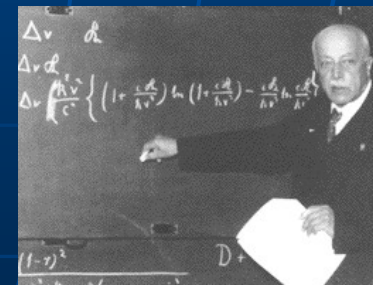


# Berlin\* – The Return of Low-Temperature Physics

\* here: Charlottenburg, Dahlem, Wannsee

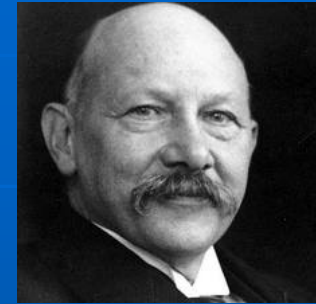
- Berlin was historically one of the early centers of low-temperature research and had the third helium liquefier worldwide. In the 1920's and 30's, students of Planck, Nernst, and Sommerfeld, among others – Walther Meissner, Peter Debye, Francis Simon, Kurt Mendelssohn, Nicholas Kurti – carried out fundamental research and made important technical advances here, mainly at the PTR (now PTB) and the Berlin University (now Humboldt University).
- In the period 1933-1945, essentially all of these researchers and infrastructure were lost. The return of low-temperature research was a slow process, but gained momentum in the years 1955-1980. A key figure at the beginning of this process was **Max von Laue**, one of the few who survived the Nazi era and the Second World War politically and scientifically intact.

William D. Brewer



## Early history: The dawn of cryogenics

➤ 1908: **H. Kammerlingh Onnes** (1853-1926; Nobel Prize 1913, Phys.) liquifies helium in Leiden



➤ **John C. McLennan** (1867-1935). 1st PhD in phys. sci. in Canada, June 13, 1900. Located He sources for Zeppelins in WW I. Traded knowledge for He with Onnes in 1919-20. Jan. 10, **1923: first liquefaction** in Toronto.

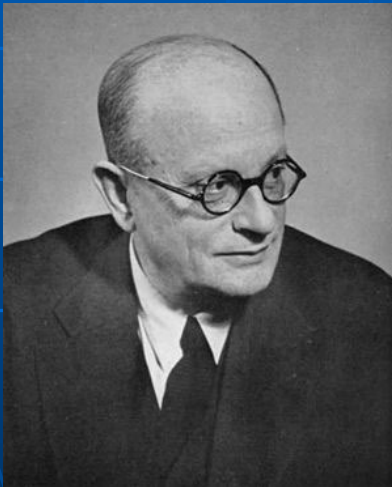


➤ **F.W. Meißner** (1882-1974): Doctorate with M. Planck, 1907. PTR from 1908, 1st liquefaction in Berlin **1925**. 1932-33: Meissner Effect; from 1934: TU München, Bavarian Academy of Sciences



## Other early cryogenic researchers in Berlin

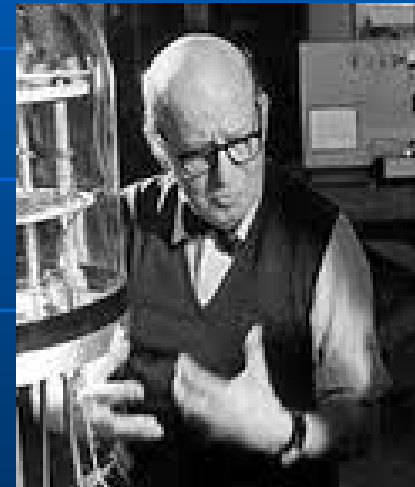
- **Franz Simon** (later *Sir Francis Simon*; 1893-1956; student of Nernst): built liquefiers at Berlin University (from 1926), Breslau (1931-33), Oxford from 1933. Work with his doctoral students **Kurt Mendelssohn** (1906-1980) and **Nicholas Kurti** (1908-1998).



Simon



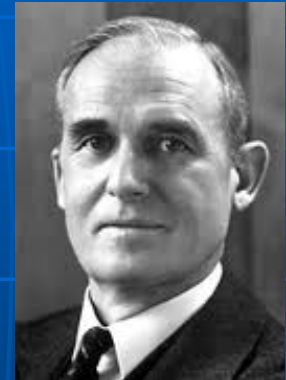
Mendelssohn



Kurti

## Other early cryogenic researchers

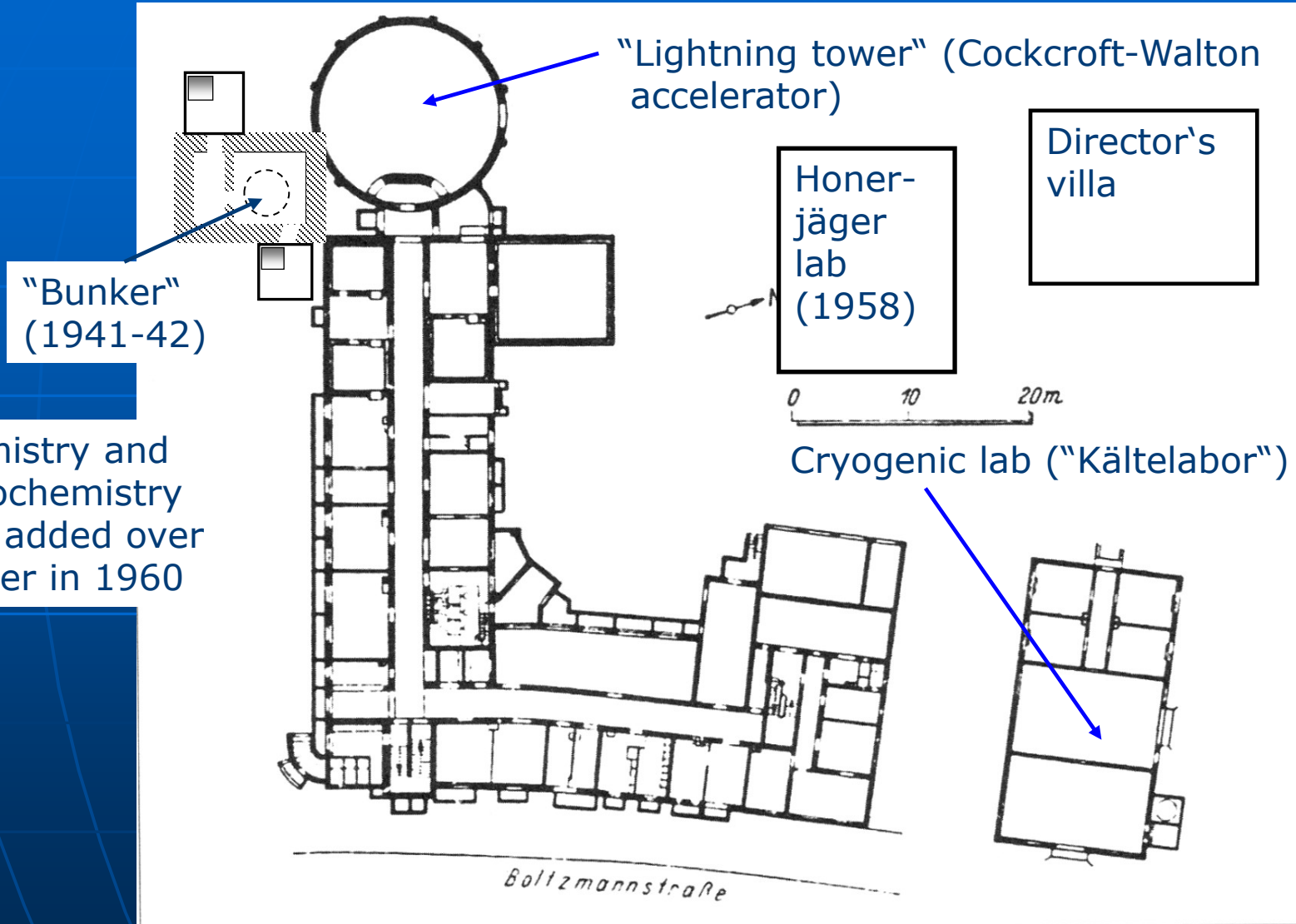
- **Peter J.W. Debye** (1884-1966; Nobel Prize 1936, Chem.). Adiabatic Demagnetization (1926). Berlin 1934-39 - **KWI-Physik** (finished 1937, dedicated 1938 !!), DPG (1938-39).
- **William F. Giauque** (1895-1982; Nobel Prize 1949, Chem.). Adiabatic Demagnetization (1926), first experiments 1933, Berkeley; first liquefaction ca. 1930. (Experiments in Leiden also March/April 1933: **deHaas, Wiersma, Kramers**)
- First helium liquefaction 1928 at Univ. Kharkov, Ukraine; first Linde **He liquefaction plant** there in 1932.
- Jan. 5, 1933: 1st liquefaction in GB (Oxford, **K. Mendelssohn** with apparatus from **Simon** in Breslau; in **F. Lindemann's** Clarendon Laboratory). Mond Laboratory, Cambridge founded by **P. Kapitza** in 1930; new liquefier type 1934.



# The Kaiser-Wilhelm-Gesellschaft (KWG)

- Founded 1908 in Berlin as an independent, semi-public research organization. First institutes: **KWI-Chemistry** (later **Otto Hahn**, **Lise Meitner**); **KWI-Physical and Electrochemistry** (**Fritz Haber**).
- **KWI-Physics** founded 1917 as a 'virtual institute'. Director: **Albert Einstein**; Vice-director: **Max von Laue**. First 20 years without a physical institute site. Einstein's departure 1933 left it orphaned; interim director **von Laue**. Planck planned **J. Franck** as successor, but he also emigrated in 1933. **Debye** was chosen since he was known as a powerful fundraiser and – as a Dutch citizen – was more immune to political pressures. He agreed in 1934, with two conditions:
  - i. He could keep his Dutch citizenship;
  - ii. The promised institute buildings (Rockefeller Foundation) would be built according to his plans.

# The Kaiser-Wilhelm-Institut for Physics (KWI-Phys)



Chemistry and Radiochemistry Labs added over Bunker in 1960

# The Kaiser-Wilhelm-Institut for Physics (KWI-Phys)

Chemistry-radiochemistry  
Labs (1960)

"Bunker" with  
street entrance

# The Kaiser-Wilhelm-Institut for Physical and Electrochemistry (now Fritz-Haber-Institut)





## After 1939...

- In early 1939, the *discovery of nuclear fission* was announced by Otto Hahn, Fritz Strassmann, Lise Meitner and Otto Frisch.
- In September 1939, *World War II began*. The KWG institutes were mobilized for the war effort. P. Debye was ordered to take up German citizenship and carry out war research; instead, he took leave from the KWI-Physics and went to the USA, initially to give a lecture series at Cornell University. Interim directors were Kurt Diebner and Werner Heisenberg, who worked on the "Uranium Project", attempting to build a nuclear reactor at the KWI-Physics. A new laboratory, the "Bunker", was added behind the main building to house the reactor.
- By 1945, most of the buildings of the Berlin universities, the PTR and the KWG were partially or totally destroyed. The remaining research apparatus was dismantled and removed. Few scientists remained in Berlin. As of July, 1945, the city had "four-power" status.

W. Heisenberg, M. von Laue,  
and O. Hahn in early 1946 in  
Göttingen, shortly after their  
return from internment at  
Farm Hall (GB).



## Timeline, after 1946...

**1948:** Founding of the Max-Planck-Gesellschaft (MPG) as successor to the KWG, with headquarters in Göttingen (later moved to Munich) and Otto Hahn as first president.

In Berlin, the Freie Universität (FUB) was founded in the western sectors as an alternative to the former Berlin University (HUB).

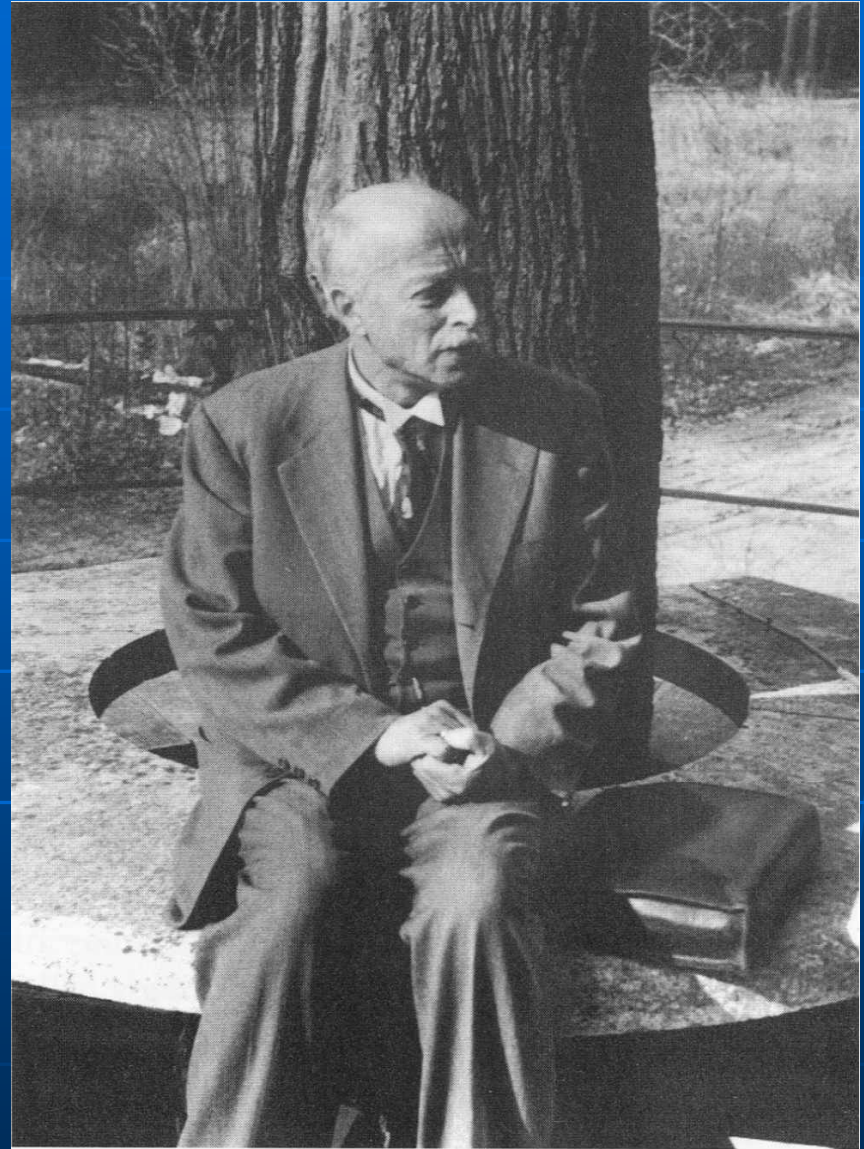
Berlin blockade.

**1949:** Founding of the Federal Republic of Germany and the German Democratic Republic. The FU occupies many of the former KWG institutes in Berlin-Dahlem.

**1951:** Max von Laue becomes director of the former KWI for Physical and Electrochemistry, and renames it **Fritz-Haber-Institut** (FHI).

**1953:** The former PTR is reorganized in Braunschweig, with the **Institut Berlin** as external division. Max von Laue is instrumental in achieving the reorganization of the **Physikalisch-Technische Bundesanstalt** (PTB).

**Max von Laue** sitting under the "Von-Laue Oak" at the PTB site in Braunschweig, 1956.



## Low-temperature research begins anew...

**1957: Max von Laue** starts a Cryogenics Group at the FHI and chooses **Gustav Klipping** (1922-2010) to head it. Klipping had carried out his doctoral research at the Technical University in Berlin (TUB) and then joined the FHI. Beginning with a home-built liquefier, he soon installed a large helium liquefaction plant and cryogenic technology research setup in the "machine room" of the institute.

**1959:** Founding of the **Hahn-Meitner-Institut** (now HZB) for nuclear research in Wannsee. Construction of a research reactor (BER I) is begun.

**1964:** A liquefier (with LH<sub>2</sub> precooling) is set up at the Technische Universität Berlin (TUB) in the institute of **H. Gobrecht** (1909-2002). Later, a modern Philips plant is installed. The TUB has its own LHe supply until 1984/85, when it joins the 'Helium-Verbund' (Klipping). Very-low-temperature experiments begin in the 1980's with a DR (**Tausend, Meissner**). This cryostat is still operating in the group of **A. Hoffmann**.



The Ernst Reuter House, where the central liquefaction service (ZGA) of the TU Berlin was located for over 20 years from 1964-1985.

**1969:** After von Laue's death, new groups are established at the FHI. Cryogenics is no longer a main priority, but liquid helium is still needed for technical applications. A contract is signed with the FUB for cooperation in providing cryogenics.

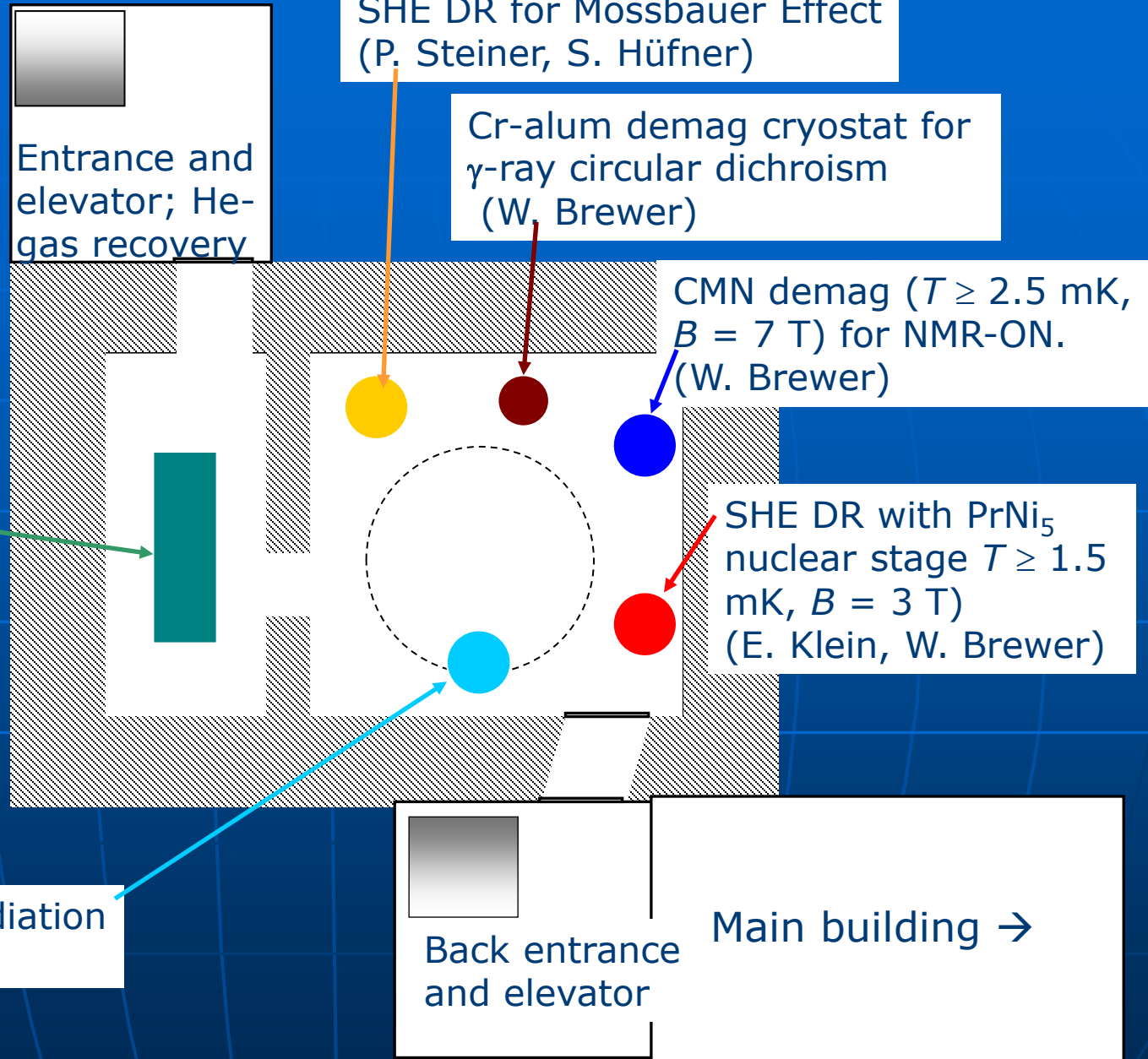
Two new institutes are founded at the FUB (Physics) by **E. Matthias** and **S. Hufner**, including low-temperature (mK) activities (**E. Klein, W. Brewer, P. Steiner, K. Lüders, K. Baberschke**). Some of these groups are located in the "Bunker", an ideal low-temperature lab.

# The Klipping Low-temperature Lab (TTL)

The low-temperature lab (TTL) in the "machine room" at the Fritz-Haber-Institut (ca. 1975)



# The "Bunker" around 1975





## Timeline, continued...

**1974:** *Michael Steiner* joins the HMI and is active in the Risø neutron-scattering experiment to detect nuclear ordering. *Michael Meissner* finishes his doctorate at the TUB and continues high-field and low-temperature work there.

**1977:** A Low Temperature Department is founded at the PTB. A liquefier and DR are set up in the Institut Berlin.

**1978:** *G. Klipping* transfers from the FHI to the Physics Dept. of the FUB. A new cryogenic facility (TTL) is planned for the new building at Arnimallee 14.

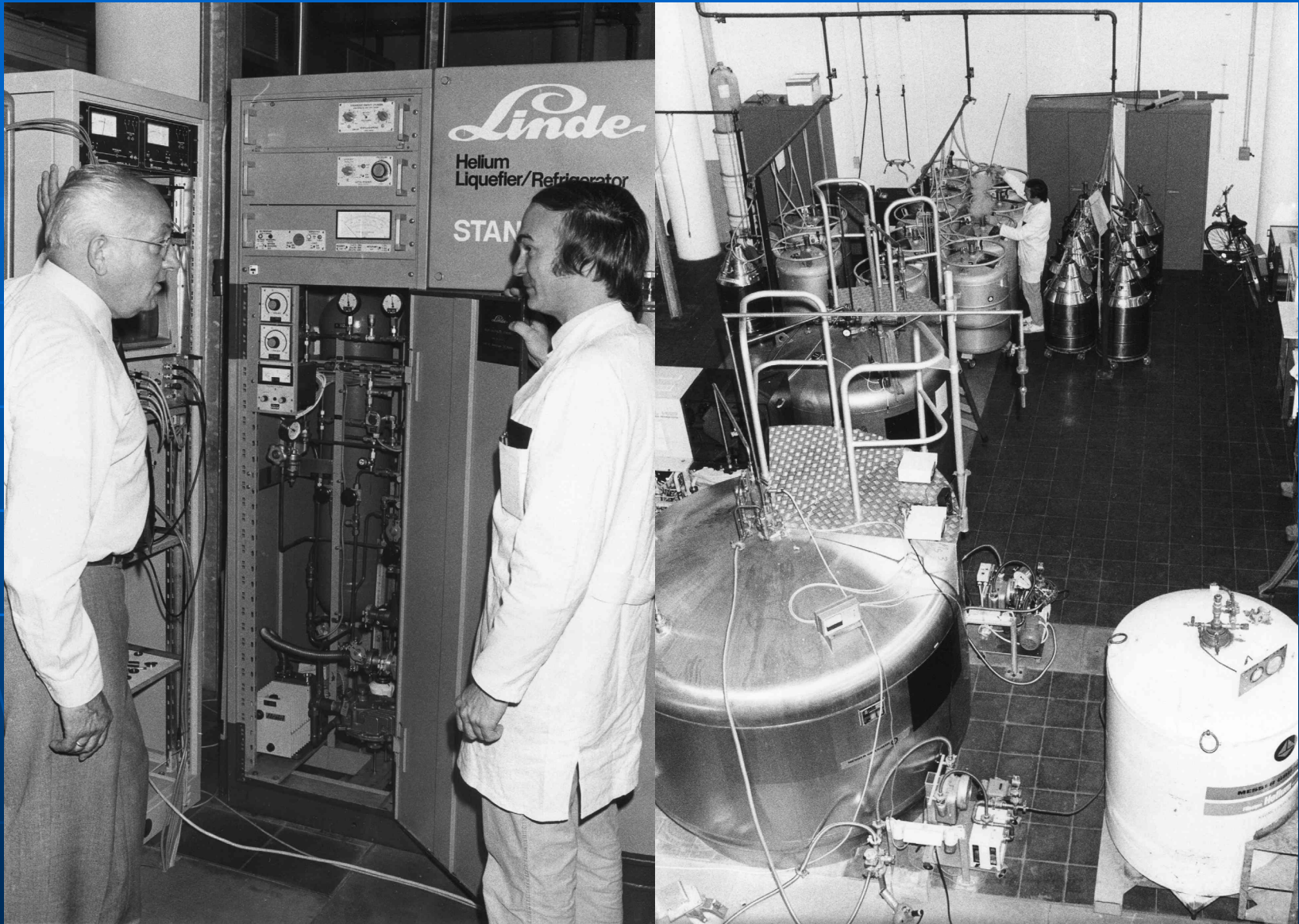
**1979:** *Wolfgang Buck* joins the PTB and begins setting up the ultra-low temperature facility.

**1980's:** The "*Helium-Verbund*" expands to include the HMI and TUB. Many technical LHe users are also supplied (BESSY, BAM, hospitals with MRT apparatus, VICKSI at the HMI...). Production exceeds 200,000  $\ell/a$ .

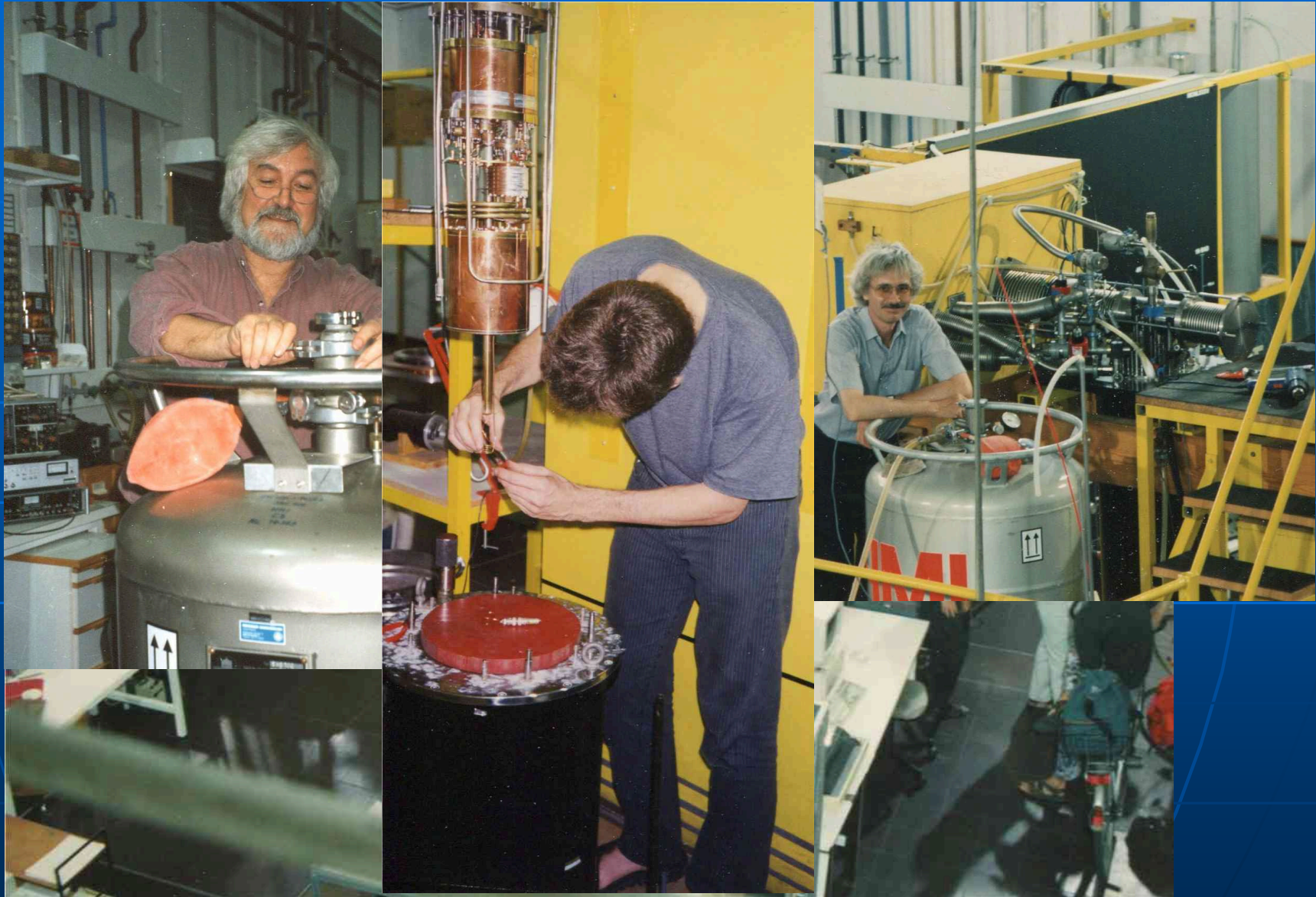


- The PTB/PTR celebrates its **100th** anniversary
- The "**Millikelvin-Runde**" (now Berlin-TTK) is founded by **W. Buck** and **M. Tinkler**. Low-temperature physics has come of age in postwar Germany.

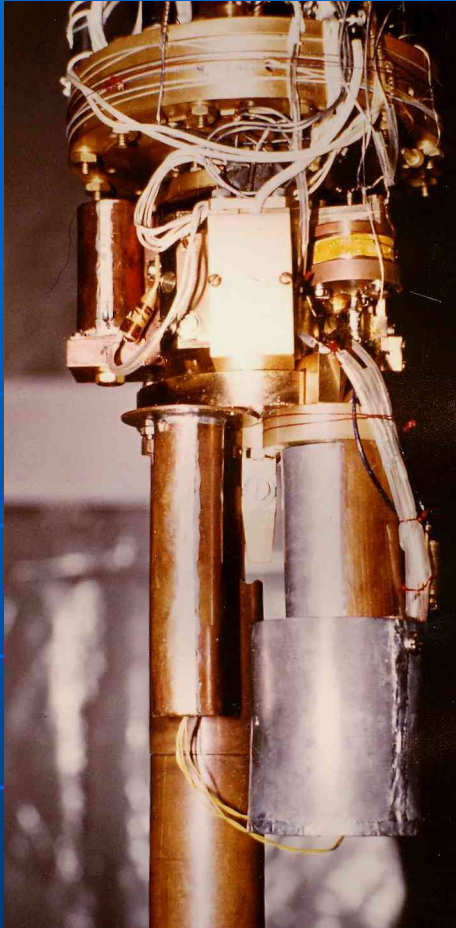
# The TTL liquefier hall at the FU Berlin



# The low-temperature nuclear orientation lab at the FU Berlin



# Low-temperature benchmarks at the PTB Berlin



Thermometers on the mixing chamber, MK1



Nuclear demag stage being mounted for first test, 1987

# The "Millikelvin-Runde", aka Berliner Low-temperature Colloquium

30. 10. 87

## Millikelvinrunde

Anwesend: Jolmann, Ploete, Hechtfisher, Wolke, &  
Stein, Reißner

### Freideggs besprechung:

Vorschlag Reißner: Millikelvin-Steuer Tisch

Vorschlag Buch: Beschäftigung der Apparaturen

Termin: Dienstags 16.15

Ort: Jolmanns - Reuecks Tisch

Periode: 1x im Monat

Themen und Verantwortliche werden immer  
1 bis 2 Termine im voraus benannt.

Schreibende Einladungen erfolgen nicht.

Dr. Stein bemüht sich um Kontakt mit der Fu.

Nächstes Termin: 10. 11.; Thema: Kernaufhebung  $\rightarrow$  KISS  
(Stein)

**Minutes** of the very  
first meeting, Oct. 30,  
1987

## The "Millikelvin-Runde", some of the early talks...

- 30.10.1987 *Gründungs-Besprechung*
- 10.11.1987 *Dr. M. Steiner, Hahn-Meitner-Institut:*  
"Das Risø-Experiment  
(Kernordnung in Cu mit Neutronen-Streuung)"
- 15.12.1987 *Dr. D. Hechtfisher, PTB Berlin:*  
"Magnetische Schirmung und Feldhomogenisierung"
- 22.03.1988 *Dr. M. Meissner, TU Berlin:*  
"The famous Orange Cryostat (TU-Berlin)"
- 26.04.1988 *Dr. W. Buck, PTB Berlin:*  
"Millikelvin 'facilities' im IB der PTB"
- 17.05.1988 *L. Lohmaier, TU Berlin:*  
"Design von Spinflip-Magneten für Neutronenstreu-  
Experimente"
- 31.05.1988 *Dr. M. Meissner, Hahn-Meitner-Institut Berlin:*  
"Meßmethoden für die spezifische Wärme bei Millikelvin-  
Temperaturen"

## The "Millikelvin-Runde", a few more recent talks...

- 19.06.2008 *S. Bandler, Brown University, Providence USA/  
NASA Goddard Space Flight Center*  
"Future X-Ray Astrophysics at NASA"
- 24.06.2008 *Prof. Jeffery Tallon, MacDiarmid Institute, Industrial  
Research Ltd and Victoria University, Wellington,  
New Zealand*  
"High- $T_c$  superconductivity – from fundamental physics  
to manufacturing"
- 15.07.2008 *Arne Scherrer, Technische Universität Berlin*  
"Helium als kostbare Reserve: research, recovery &  
recycling"
- 20.11. 2008 *Prof. Dr. Dieter Vollhardt, Universität Augsburg,  
mit Laborbesichtigung (Der Vortrag wird per Video nach  
Berlin übertragen (HvH, Hörsaal)*  
"Supraflüssiges  $^3\text{He}$ : Von den tiefen Temperaturen bis  
zum Urknall"
- 16.12.2008 *Dr. Ernst Kreysa, Max-Planck-Institut für  
Radioastronomie, Bonn*  
"Bolometer-Kameras für die Astronomie im THz-Bereich"



*Thank you for your attention!*

and...



# Photos -- PTB Seminar 2002



# PTB Seminar 2002, group



# PTB Seminar 2007



# PTB Seminar 2007, group

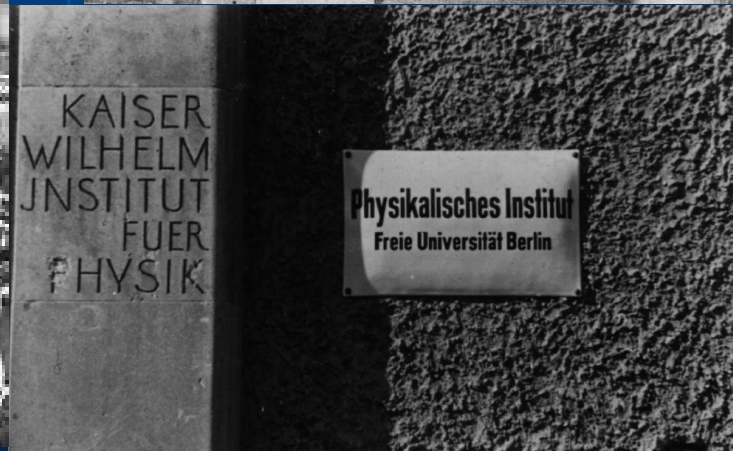
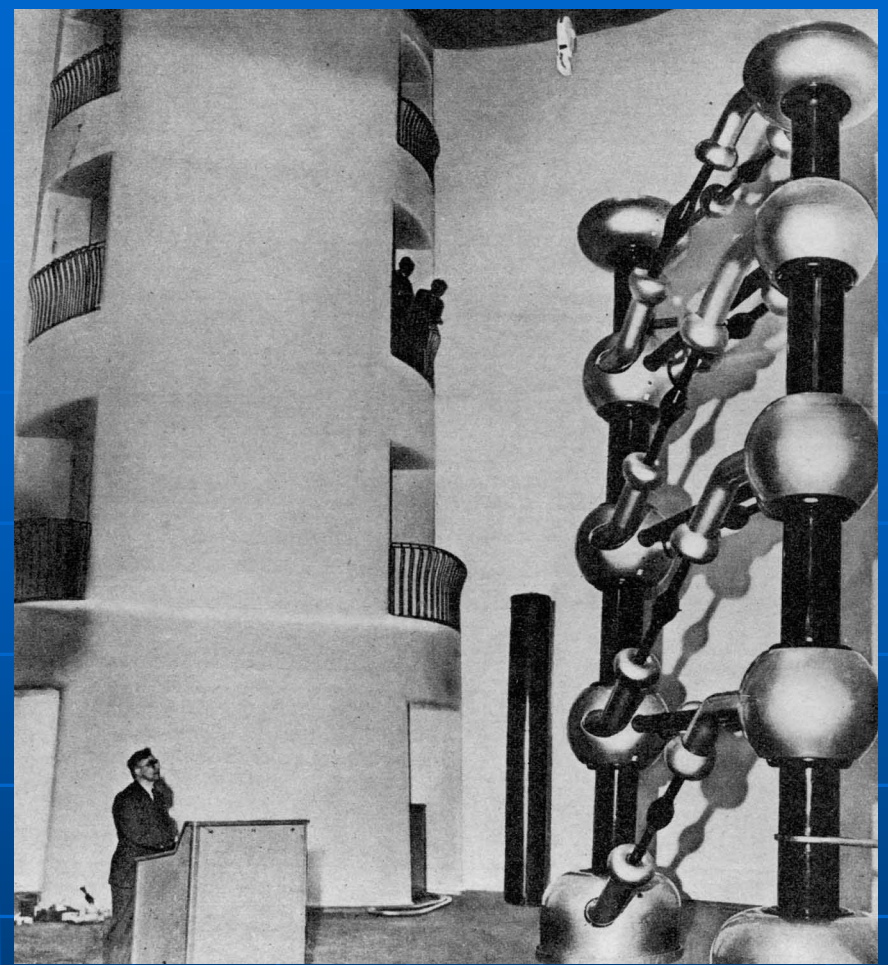


# PTB Seminar 2009



# PTB Seminar 2009, group







# Low-temperature benchmarks at the PTB Berlin



The Ultralow-temperature Laboratory is now led by **Peter Strehlow**



Visitors during the Low-Temperature Seminar, 2007

# Sample Environment facilities and MagLab at the HMI/HZB



Reactor hall of  
BER II (HMI/  
HZB)