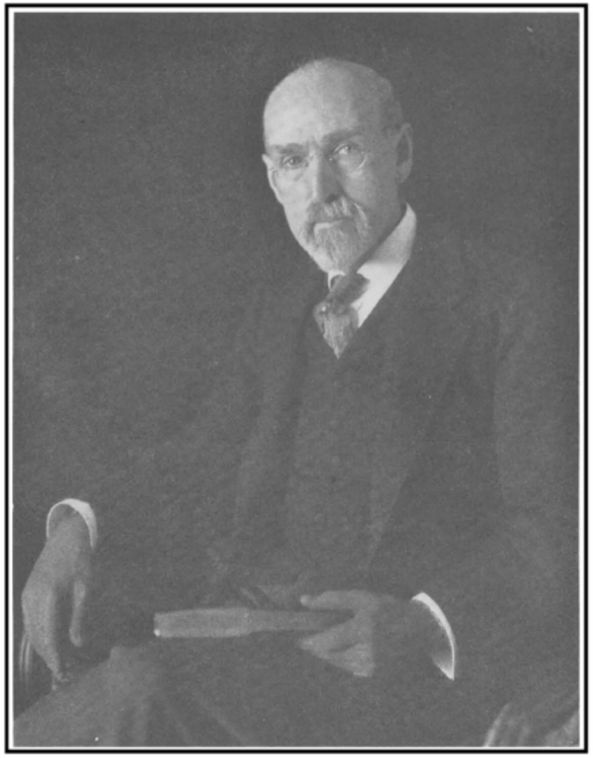
Remembering Van: Three Madison families and other tales

"Van had many enthusiasms and loyalties, but none exceeded those he felt for the University of Wisconsin and its home, Madison."

Charles Van Hise

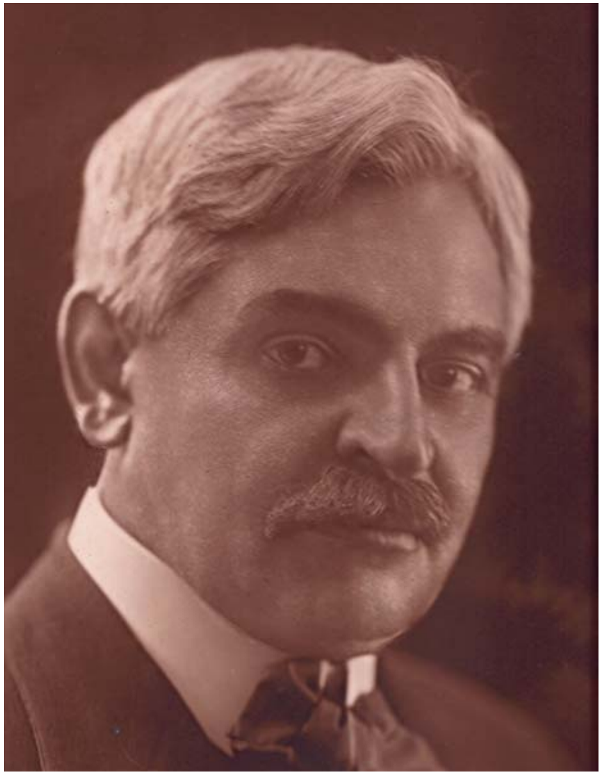


Born in 1857, Charles Van Hise was a distinguished geologist who had been elected to the National Academy of Sciences in 1902. In 1903, he was named President of the University of Wisconsin

In 1904, Van Hise recruited Charles Russell Bardeen, a member of the first class to graduate of the Johns Hopkins Medical School, to found a medical school at the University of Wisconsin

John Bardeen is at the right hand end. His grandfather, Charles W Bardeen, is second from the left.

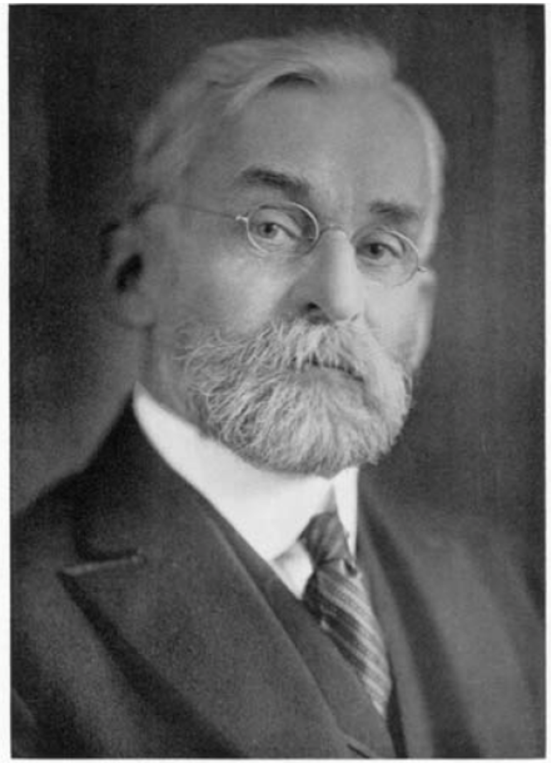
Charles Sumner Slichter
1864-1946



In 1906, Van Hise appointed Charles S. Slichter head of the math department. An applied mathematician with interests in flow of liquids through porous media, Slichter realized the department needed to strengthen the faculty in pure mathematics.

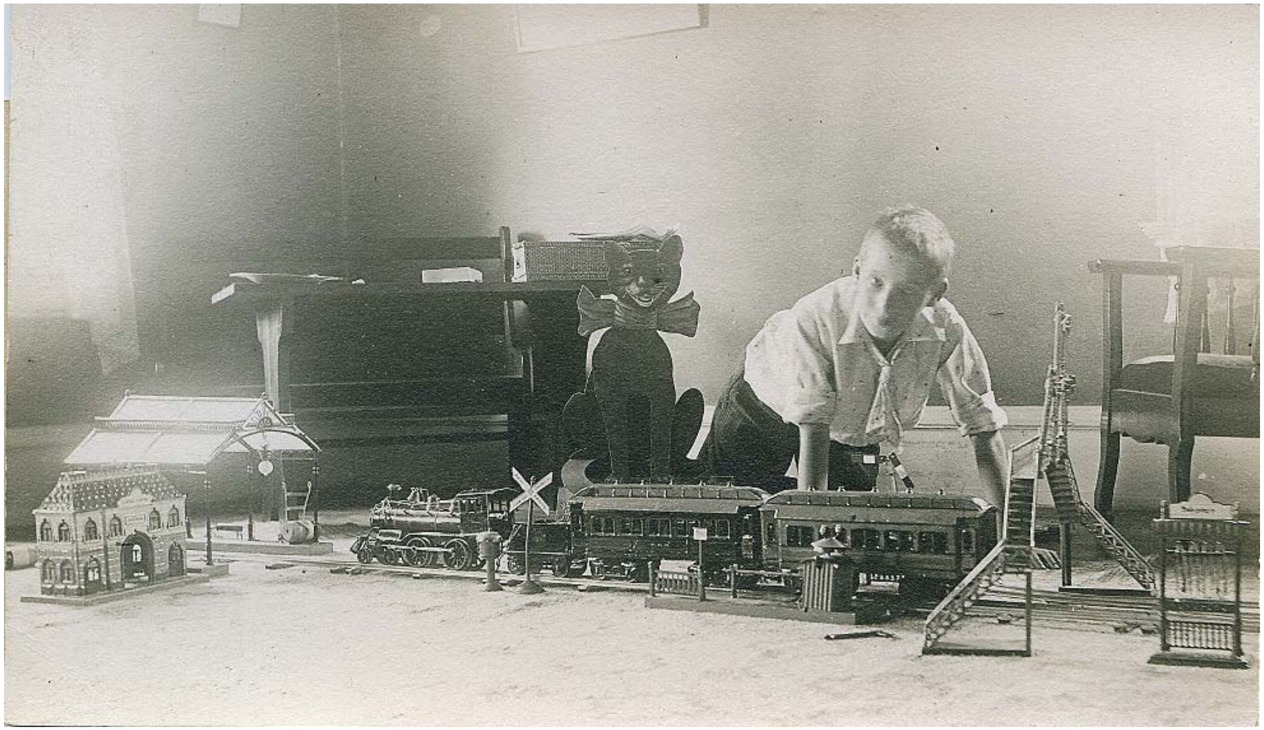
Edward B. Van Vleck

1863-1943



Edward B Van Vleck, had earned a PhD in mathematics at Gottingen in1893,
and was a member of the National Academy of Sciences.
Slichter's first action as department head was to recruit Van Vleck
to bring strength in pure mathematics.

John Hasbrouck Van Vleck was born in 1899.
His interest in trains began at a early age.

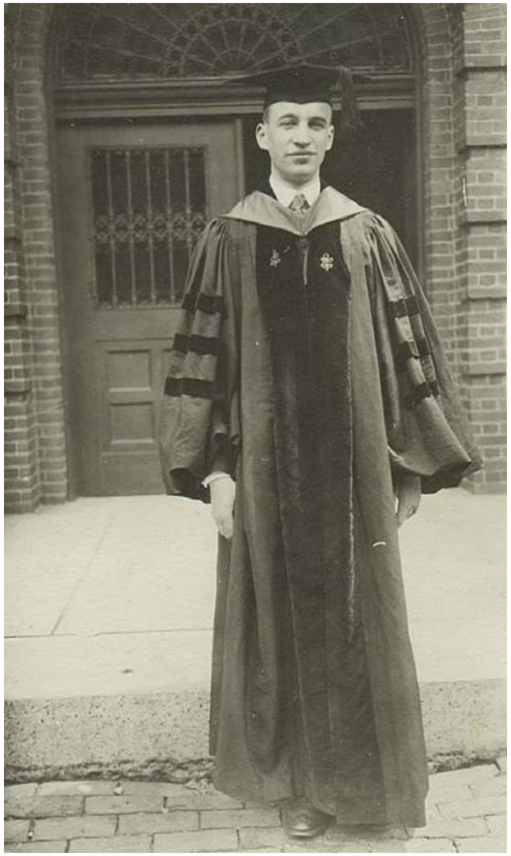


Van attended his first Wisconsin football game at age 10.(Wisconsin vs Minnesota)
It was the first game at which the band played the famous song “On Wisconsin”.
As an undergraduate at Wisconsin, Van played flute In the band.

On graduation in 1920, Van went to Harvard for graduate study.
Edwin C. Kemble, Harvard's first theoretical physicist,
was his PhD thesis advisor

Harvard's great experimental physicist, Percy Bridgman, believed that Harvard should have some faculty who were devoted to theoretical physics, a practice that was longstanding in Europe. Kemble received his PhD in 1917, and joined the Harvard faculty in1919. Van was his first student.

1922: Van gets his PhD in two years at Harvard



After a year as an instructor at Harvard, Van joined the faculty of The University of Minnesota. He became a full professor at age 29.

One of Van's most important accomplishments at Minnesota was to woo Abigail Pearson successfully. They were married On June 10, 1927

Van's early awareness and understanding of matrix mechanics (1926)

NOTE ON THE POSTULATES OF THE MATRIX QUANTUM DYNAMICS

By J. H. Van Vleck

Department of Physics, University of Minnesota

Communicated April 22, 1926

Through the researches of Born, Heisenberg and Jordan,[1,2,3] and of Dirac,[4,5] the dynamics of the quantum theory have been formulated in terms of matrices. The fundamental postulates made by Born, Heisenberg and Jordan are the Ritz combination principle

$$\nu(nm) + \nu(mk) = \nu(nk) \tag{1}$$

the Hamiltonian canonical equations[6]

$$\dot{\mathbf{q}}_k = \frac{\partial \mathbf{H}}{\partial \mathbf{p}_k}, \qquad \dot{\mathbf{p}}_k = -\frac{\partial \mathbf{H}}{\partial \mathbf{q}_k}, \tag{2}$$

the quantum conditions,

$$\mathbf{p}_k\mathbf{q}_k - \mathbf{q}_k\mathbf{p}_k = \frac{h}{2\pi i}\mathbf{1} \tag{3}$$

and the commutability relations

$$\begin{matrix} \mathbf{p}_l\mathbf{q}_k - \mathbf{q}_k\mathbf{p}_l = 0, \quad (l \neq k), \\ \mathbf{q}_l\mathbf{q}_k - \mathbf{q}_k\mathbf{q}_l = 0, \quad \mathbf{p}_l\mathbf{p}_k - \mathbf{p}_k\mathbf{p}_l = 0. \end{matrix} \tag{4}$$

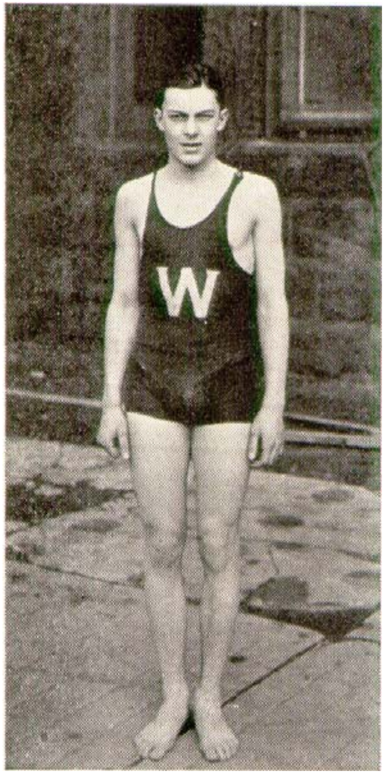
Here **H** is the energy (Hamiltonian function) and the **q**'s and **p**'s are coördinates and momenta. We shall suppose that there are s degrees of freedom, so that the subscripts k and l range from 1 to s. All expressions

In the fall of 1928, Van moved from the University of Minnesota to Madison, giving the Physics Department a theorist who was at the frontier of the latest ideas on the quantum nature of matter.

John Bardeen graduated from high school at age 13, then took two more years at Madison Central High School, studying additional math, science, and literature. In 1923, at age 15, John entered the University of Wisconsin

John Bardeen at age 17

John Bardeen lettered as a member of the University of Wisconsin swimming team



Van in a lecture hall at Madison

On arrival at Madison in 1928, Van gave an up-to-date one year course in quantum theory. Bardeen took this course.

Van helps John Bardeen

1926:Bardeen graduates.

1927-1929: gets a masters degree in engineering.

1929:With Van’s support, applies to Trinity College,
Cambridge University for a fellowship.

1930:He goes to work at Gulf Oil Research Lab in Pittsburgh.

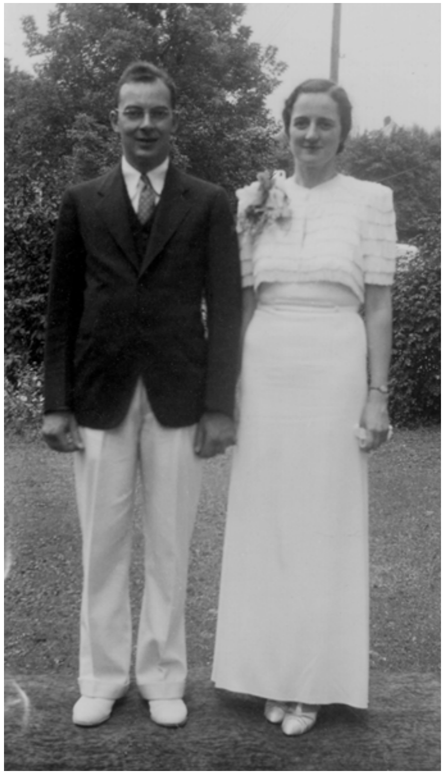
1933:John decides to go to graduate school: mathematics at Princeton.

1933-1935:Bardeen does a Physics PhD with Eugene Wigner.

1935: Van proposes John to be a Junior Fellow at Harvard’s Society of Fellows.
John has a grueling interview with the Senior Fellows!

1935-1938:Three years at Harvard.

John and Jane Maxwell were married just after John finished his term as a Junior Fellow at Harvard. With Van's help, John got a job at the University of Minnesota.



In the late 1930's, Van developed a close collaboration with the great Dutch experimental physicist, C.J. Gorter, who had developed ingenious methods that made possible measurements of relaxation times in paramagnetic substances. In 1940, Van developed the the first microscopic theory of the relaxation times .

MARCH 1, 1940 PHYSICAL REVIEW VOLUME 57

Paramagnetic Relaxation Times for Titanium and Chrome Alum

J. H. VAN VLECK
Harvard University, Cambridge, Massachusetts

(Received December 26, 1939)

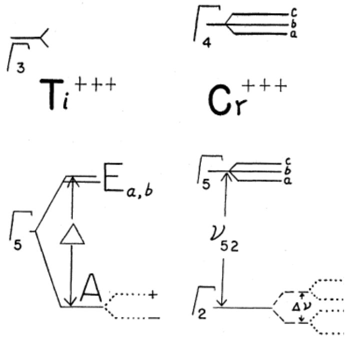
The opening lines of that paper discuss the physics behind Gorter's experiments, including spin-spin and spin-lattice relaxation times and the use of spin temperature, and illustrate Van's felicitous and gracious writing style.

I. Introduction

A NOTEWORTHY series of experiments on magnetic absorption and dispersion in paramagnetic media at radio and lower frequencies have been performed within the last few years by Gorter and other Dutch physicists.[1] In solid bodies the spin and orbit are largely decoupled, and the magnetism results almost entirely from spin. At first sight, it may seem that, owing to this decoupling, the spin moment is a constant of the motion, and so does not undergo any of the oscillations prerequisite to absorption or dispersion. The constancy is, however, spoiled by "spin-spin coupling," i.e., interaction between the spins of different paramagnetic atoms, and also by a slight potential energy of alignment of spin relative to the crystal lattice which arises because the spin is never perfectly decoupled from the orbit, and so indirectly feels the influence of the crystalline Stark effect acting on the orbit. The measurements on absorption and dispersion are particularly instructive because of the light which they shed on (*a*) the relaxation time τ_s involved in spin-spin interaction and (*b*) that τ characteristic of the coupling between spin and lattice. The present paper is devoted to τ rather than τ_s. Ordinarily τ_s is small compared to τ and is unimportant at the frequencies employed experimentally. The most elegant way of determining τ is furnished by the thermodynamic treatment of Casimir and du Pré,[2]

[1] See *Physica*, from 1936 on, or the dissertations of Brons and of Teunissen (Groningen, 1939).

[2] H. B. G. Casimir and F. K. du Pré, Physica **5**, 507; also especially Casimir, Physica **6**, 156 (1939).



Let us imagine the matrix elements of the spin in (49) computed not in the system of representation (46), but rather in one which diagonalizes the combined energy, apart from fluctuations caused by lattice oscillations, of the spin in the magnetic field H, and in the electric field due to surrounding ions, which indirectly affects the spin via the spin-orbit coupling. Let the eigenstates of the energy, shown by dotted lines in Fig. 1, be denoted by $W_{\eta'}$, $W_{\eta''}$, $\cdots$. Then by obvious generalization of (25), (26) to systems with more than two spin components, the rate of transfer from spin to lattice, is

$$dQ/dt=\sum_{\eta',\eta''}N_{\eta'}A_{\eta'\to\eta''}(W_{\eta'}-W_{\eta''}). \tag{51}$$

The transition probabilities $A_{\eta'\to\eta''}$ are connected with the matrix elements in the η system of representation by relations analogous to (18), and the matrix elements of the Q's are, of course, still given by (9), (12), (14). One now has, however, $\hbar\omega=W_{\eta''}-W_{\eta'}$ instead of $\hbar\omega=2\beta H$, and $N_\eta=\frac{1}{4}Ne^{-W_\eta/kT_S}$ in place of (29). Since $A_{\eta'\to\eta''}=e^{\hbar\omega/kT}A_{\eta''\to\eta'}$, and since we still have $\hbar\omega/kT\ll1$, $T_S-T\ll T$ we can write

$$N_{\eta'}A_{\eta'\to\eta''}(W_{\eta'}-W_{\eta''})+N_{\eta''}A_{\eta''\to\eta'}(W_{\eta''}-W_{\eta'})=\tfrac{1}{8}N[A_{\eta'\to\eta''}+A_{\eta''\to\eta'}](W_{\eta'}-W_{\eta''})^2(T_S-T)/kT^2. \tag{52}$$

When average values are computed by means of (20) and (22), which reduces to $\langle n_i\rangle_{Av}=kT/\hbar\omega$, it is found that $dQ/dt=\alpha(T_S-T)$ with

$$\alpha=NC\sum_{k=2\cdots6}\sum_{\eta',\eta''}|H^{(k)}(\eta';\eta'')|^2|W_{\eta'}-W_{\eta''}|^4,\quad C=R^2(4v_t^{-5}+6v_l^{-5})\pi^3V/15TM\hbar^4. \tag{53}$$

Eq. (53) can also be written as

$$\alpha=NC\sum_{k=2,\ldots,6}\mathrm{spur}\,[V_kW-WV_k]^2,\quad V_k=WH^{(k)}-H^{(k)}W, \tag{54}$$

where W is the matrix (internal to Γ_2) associated with the Hamiltonian function whose proper values are the W_η. The great advantage of writing (54) as a spur is that (54) is valid in any system of representation, and so it is not necessary to actually find the system which diagonalizes W. In chrome alum the matrix W has the structure

$$W=2\beta[H_xS_x+H_yS_y+H_zS_z]+\tfrac{1}{6}h\Delta\nu[S_x+S_y+S_z]^2. \tag{55}$$

The first member of (55) is clearly the Zeeman energy in the field H. The second is the energy of the crystalline electric field. The latter has trigonal rather than perfect cubic symmetry and so splits the quartet $^4\Gamma_2$ into two doublets, whose separation is denoted by $h\Delta\nu$, and which correspond, respectively, to $S_{z'}=\pm\frac{3}{2}$, and $S_{z'}=\pm\frac{1}{2}$, where the z' direction is parallel to the trigonal axis. The

Van as my advisor

September 1941:I enter Harvard as freshman physics major.

December 1941: Pearl Harbor attacked.

January 1942: 2-year elementary physics class compressed into 1 year.

Summer 1942: like most physics majors, I take the mid-level E and M and math.

Fall 1942: The grad students have left, so I was hired to grade lab reports of the E and M course I just took. Van was the lecturer.

Fall 1942-Spring 1943: 4 semesters of electronics and circuit theory.
Winter 1943: Van suggests I apply to E. Bright Wilson for war project.

June 1943-January 1946: Underwater Explosives Research Lab, Woods Hole Oceanographic Institution.

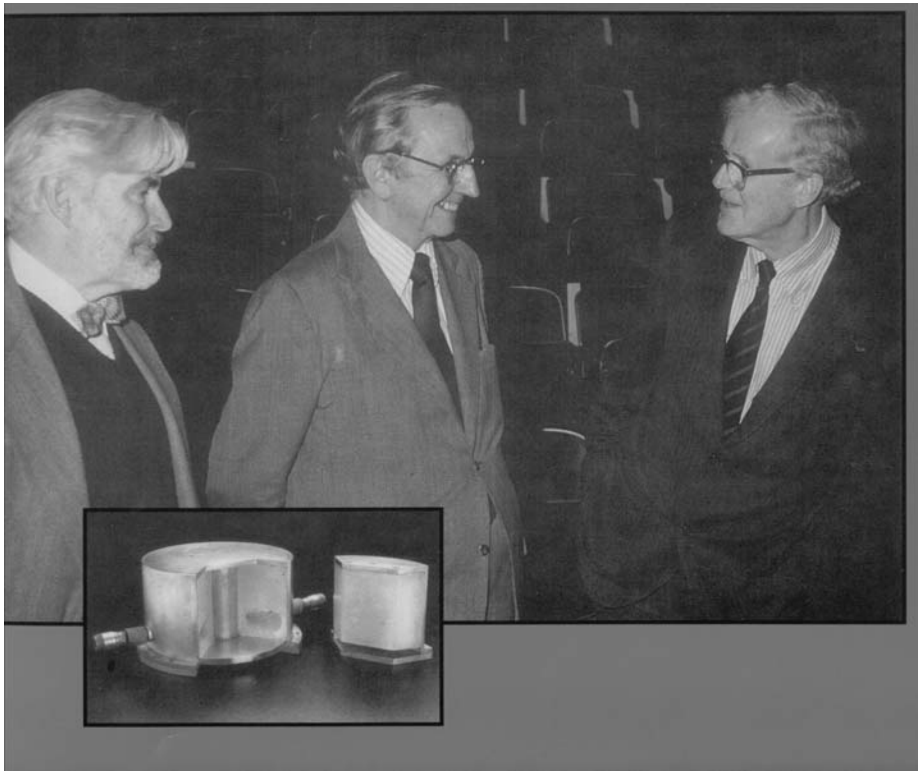
Spring 1946:2nd semester of Van's middle level course in classical mechanics.
Van encourages me to stay at Harvard for grad study since new faculty are so strong.

Summer 1946: Goudsmit's classical dynamics class. I graduate at the end.

Fall 1946: I enter Harvard as physics grad student.

Winter 1947: Van stops me in the hall and suggests I do an electron spin resonance thesis with Purcell.

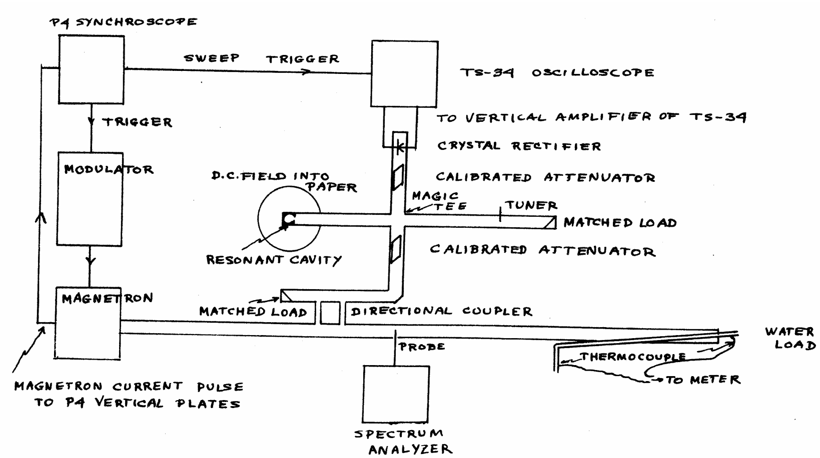
Bob Pound, Henry Torrey, and Edward Purcell



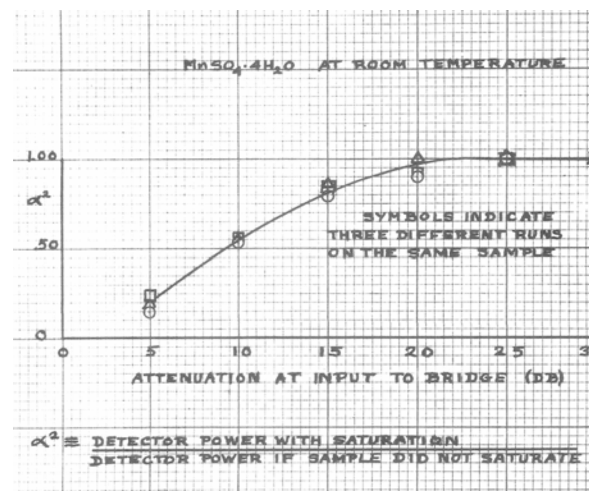
Inset: the resonant cavity with paraffin used for the first observation of NMR in December 1945

Winter of 1947
Van suggested I ask Purcell to be my advisor to study electron spin resonance of paramagnetic salts

Bloembergen was just finishing his thesis and George Pake was in his second year with Purcell



High power ESR apparatus to measures spin-lattice relaxation times by the saturation method.



Saturation of the ESR signal as the incident microwave power is varied.

Some subsequent events

In 1949 I got my PhD and went to the U of Illinois
In 1951 John Bardeen came to Illinois
In 1955, Chun Lin got his PhD with Van and went to the U of Oklahoma
In 1968, Chun Lin joined the faculty of the U of Wisconsin

FRIDAY AFTERNOON, 26 FEBRUARY 1965 — FORUM ROOM AT 2:00

(CHUN C. LIN presiding)

Symposium on Magnetism

M1. Some Reflections on the Exchange Mechanism in the Transition Metals. J. H. VAN VLECK, *Harvard University.* (30 min.)

M2. Low-Field Relaxation and Ultraslow Motion of Atoms. C. P. SLICHTER, *University of Illinois.* (30 min.)

M3. Localized Magnetic Moments in Transition Metals. A. M. CLOGSTON, *Bell Telephone Laboratories.* (30 min.)

M4. Magnetic Aspects of Superconductivity. F. BLOCH, *Stanford University.* (30 min.)

February 6,1967 Van receives the National Medal of Science from President Johnson while Lady Bird Johnson looks on.

Note from Van (Oct 1977)

HARVARD UNIVERSITY

DEPARTMENT OF PHYSICS

To: Charlie

From: Van

Date: Time:

(1) Comment and return ☒

(2) Information and return ☐

(3) Please call ☐

(4) ....

Comments: I'm suggesting to the Holland Society of New-York (an ancestor worshipping society for which membership requires a male ancestor in N.Y. while it was still New Amsterdam) that they award their medal in 1978 to Uhlenbeck & Goudsmit.

This medal usually goes to some one prominent in public affairs (e.g. Det Bronk

P T O

Gen Westmorland, Walter Cronkhite.) I'm suggesting that they should honor the two scientists who are the greatest oversight of the Nobel Prize Committee. The medal doesnt often go to any one with Dutch connections but this should be a "plus" like sons of Harvard men getting into Harvard but not a decisive factor.

After this lengthy preamble my question is whether I am free in my letter of recommendation to mention that U & G were strongly recommended by the Stever Committee for the Medal of Science but were over-ruled by the White House. Unless I hear from you to the contrary, I assume that

HARVARD UNIVERSITY

DEPARTMENT OF PHYSICS

Time:

...ment and return ☐

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(4) ....

Comments: II this is priviledged information that you told me and should not be ~~quoted~~ mentioned in my letter.

I'm still hoping that U & G will sometime get the National Medal of Science.

JHV

His return letter received October 11, 1977

OCT 11 1977

HARVARD UNIVERSITY

DEPARTMENT OF PHYSICS

LYMAN LABORATORY OF PHYSICS
CAMBRIDGE, MASSACHUSETTS 02138

5 October 1977

Professor Charles P. Slichter
Department of Physics
University of Illinois at Urbana-Champaign
Urbana, Illinois 61801

Dear Charlie:

Thanks for your letter. In proposing Uhlenbeck and Goudsmit for the medal of the Holland Society I am going to quote verbatim the following three sentences of your letter:

> "I am always surprised at the large number of physicists who are under the distinct impression that Goudsmit and Uhlenbeck in fact did receive the Nobel prize. It's certainly hard to think of a concept which has been more all pervasive in modern day physics than the concept of spin. Besides, think of all of us who earned our living solely on that one idea."

I would like to say this is a quotation from one "C. P. Slichter, a

If my plan is satisfactory please return this letter with an O.K. on it, otherwise I will simply refer to you anonymously as a distinguished physicist.

One snag my proposal may encounter in connection with the Holland Society is that they have not awarded a joint medal before.

Yours sincerely,

Van

J. H. Van Vleck

JHV:vr

See you Dec. 4

October 11,1977

The Swedish Academy awards the Nobel Prize in Physics to
J H Van Vleck, Neville Mott, and Phil Anderson

Van greeted by a well-wisher. With characteristic humor, Van remarked
“ I thought I might be ruled out by the statute of limitations”

“Van was well known for making remarks with a special touch for just about any occasion.”

Chun C. Lin, Madison, Wisconsin, June 16,1981

Van’s comments on rivalry among scientists on the occasion of his receiving the Lorenz Medal

“There are three Dutch physicists Gorter, Kramers, and Kronig, whose research interests have often been unusually close to my own. Consequently we often duplicated each other in the results of our investigations; sometimes published independently, sometimes unpublished to avoid duplication. I cannot emphasize too strongly that it was never a case of cutthroat competition such as is described In Watson’s book *Double Helix* the race to find the structure of the DNA molecule, but rather an unavoidable overlap When we were thinking along similar lines.”

With characteristic modesty he the adds:

“In the case of Gorter, however, our results were more apt to be in series rather than parallel, as he is also an experimenter whereas I am a mere theorist”