

in remembrance of
JOHN S. KING
OCTOBER 31, 1920 TO AUGUST 30, 2007

YOU TAUGHT US. WE LOVED YOU.

– *Jack Carpenter*



JOHN S. KING, Professor Emeritus of Nuclear Engineering at the University of Michigan, died at his home in Ann Arbor on August 30, following a two-year battle with lung cancer. He was 86. A distinguished nuclear physicist, his reputation for innovation in neutron spectroscopy—a powerful tool for viewing the deepest structure of matter—helped earn the university’s Department of Nuclear Engineering its world-class status.

Born in Detroit in 1920, John graduated from Princeton University in 1942 with a BA in Political Science. In May of that year he joined the US Navy, recruited into the Navy’s top-secret VT Proximity Fuze project, intensively underway in Maryland at the Applied Physics Laboratory (APL) of Johns Hopkins University. His skill and enthusiasm caught the attention of APL physicist William C. Parkinson, who enlisted him in a team of specialists doing classified research through the war years.

APL kindled a lifelong interest in science. After the war John followed his mentor Parkinson to the Physics Department at the University of Michigan, where he earned a second Bachelor’s Degree in just two years, moving swiftly on to a Master’s Degree and then a PhD by 1953. His dissertation, on a test of the nuclear shell model, presented the results of research at the cyclotron laboratory at the U of M Randall Laboratory. The work, Parkinson notes, represented a significant advance in nuclear physics, earning a mention in Nobel Laureate Maria Goeppert Mayer’s classic book with J H D Jensen, *Elementary Theory of Nuclear Shell Structure*.

In 1953 John accepted a position with the Naval Nuclear Propulsion Project at the Knolls Atomic Power Laboratory (KAPL), operated at that time by General Electric. Four years later he was named KAPL’s Manager of Reactor Physics, playing a major role in the birth of the Navy’s nuclear submarine fleet. Many are the stories he told of these years, working with Admiral Hyman Rickover, “father of the nuclear Navy,” and Henry Hurwitz, GE’s brilliant reactor physics theoretician. [continued next page]

John returned to the U of M in 1959, invited to join its nascent Department of Nuclear Engineering—"succumbing," as he later put it, "to the irresistible offer of twice the work at half the pay." Glenn Knoll, an early student who later joined the faculty, recalls the excitement of that period: "John was a driving force in the formative years of the department. Along with fellow faculty Paul Zweifel, Dieter Vincent, Richard Osborn, George Summerfield, Ziya Akcasu, Jack Carpenter, Sam Werner, and a host of very talented doctoral students, he led the effort to establish a world-class neutron scattering program using the new Ford Nuclear Reactor [at the Phoenix Memorial Laboratory on the university's North Campus]. Excellent research was carried out on the structure of polymers and other materials, demonstrating the power of the neutron scattering technique." Sam Werner, now Emeritus Professor of Physics at the University of Missouri, remembers: "John King encouraged us all to build apparatus and do 'hands-on' research... he initiated our famous weekly neutron scattering seminars in which we taught each other. He invited [the now well-known Indian physicist] G. Venkataraman. He taught us all group theory. Later Lee Feldkamp (one of our best students) and Venkataraman wrote a book on lattice dynamics based upon those early seminars." Close friend and colleague Jack Carpenter, now at the US Department of Energy's Argonne National Laboratory, adds: "Dozens of graduate students learned their science in this program... many have gone on to influential positions." Werner notes that while John took little direct credit himself for the department's collaborative accomplishments, many milestones would never have been reached without him.

John's understanding of the potential of neutron spectroscopy led him to mount experiments at facilities elsewhere in the US and abroad, most recently at the Commissariat Energie Atomique in Saclay, France, where more intense beams offered the opportunity for more challenging measurements. In 1976-77, on a sabbatical year invitation from the University of Missouri, he designed and built an innovative small-angle neutron scattering spectrometer for MURR, the University of Missouri Research Reactor.

His publications include chapters on polymer spectroscopy in *Neutron, X-Ray, and Laser Spectroscopy in Chemistry and Biology* (S. Chen and S. Yip eds., 1974), *Methods of Experimental Physics—Polymer Physics* (R. Fava ed., 1980), and (with W. Boyer, G. D. Wignoll, and R. Ullman) *Physical Optics of Dynamic Phenomena and Processes in Macromolecular Systems* (B. Sedlacek ed., 1985), and over 50 journal and conference papers. A Fellow of the American Physical Society and the American Nuclear Society, he was awarded the U of M Engineering College's Excellence in Research Award in 1983. Asked recently what he felt was his best work across his career, he responded, "Three things: nuclear reactor shutdown science [at KAPL], accelerated particle work with the cyclotron, and the physics of polymer bonds [at U of M]."

John was a demanding teacher and role model, known for his rigor and his insistence on perfection. He spoke of once walking into an empty classroom and finding on the blackboard an anonymously chalked graph labeled “Professor King” on the X axis and “irascibility factor” on the Y axis, with a formidable upward curve. Yet former students and peers alike remember him as a gentleman scholar and a man of sterling integrity. He served as chairman of the Department of Nuclear Engineering from 1974 to 1979, overseeing the complex integration of its scattered facilities into the present Cooley Building. He retired as Professor Emeritus in 1989.

In 1943 John married his sweetheart, Elizabeth (Betsy) Chickering, and they spent the early war years living in a log cabin on the Potomac River while John worked for the Navy. Three children were born over the next nine years. In 1953, in the months before the introduction of the Salk vaccine, Betsy contracted polio, which was to leave her wheelchair-bound until her death in 1985. Their remarkable partnership, reconstructing their lives and raising their children even as John achieved distinction at KAPL, remains a legacy among family and friends. John’s mature work as a scientist was accomplished always in tandem with an impeccable effort to assure Betsy’s well-being and happiness.

In 2004, John moved to Ann Arbor’s University Commons, where he found an expanded world of friendship and intellectual stimulation. A warm friendship with Joan Matthews of Greenbrae, California, and her family, enlivened the last seven years of his life.

John King will be remembered by friends and students, and lovingly by his family, for his humility, his humor, (his irascibility), and his honor. He is survived by his three children, John Jr., Frances, and Elizabeth, and by four grandchildren.

A memorial service was held on Friday, September 21 at 3 pm, at St. Andrew’s Episcopal Church, 306 N. Division Street, Ann Arbor, followed by a reception at University Commons, 827 Asa Gray Drive, Ann Arbor. The family has established the John S. King Memorial Fund at the University of Michigan, dedicated to the support of research at the Department of Nuclear Engineering and Radiological Sciences. Contributions (checks payable to “University of Michigan John S. King Memorial Fund”) may be sent to the College of Engineering, Robert H. Lurie Engineering Center, 1221 Beal Avenue, Ann Arbor, MI 48109-2102 (phone 734-647-7040).

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MILESTONES AND TRIBUTES



Betsy Chickering, John King, Mount Holyoke College, early 1940s



IN THE YEAR BEFORE HE DIED, our father slowly cleared out his office at the University of Michigan. He did not allow us to be a part of this process, although we asked often to help him. We tremble to think of what he threw away as he went through the papers and books and records of a lifetime of study. To take only one example, we vividly remember as children overhearing many spirited conversations about the reactor lab, back in the renowned days of the university's Ford Nuclear Reactor at the Phoenix Lab, dedicated to the peacetime uses of atomic energy. Dad's voluminous notebooks from teaching this lab, his personal library of the PhD thesis working drafts of his many students, and of course the massive archive of his own experimental data, distilled into the celebrated work he published... only a few people are alive now

who can comprehend the loss of such a library. It was so like him to assume that these documents would not be of value after he was gone.

At home, he kept only a few documents from his career, many of which had been saved by our mother. These slender files Elizabeth found after he died. They offer a glimpse of the extraordinary moment in American history when a new world was being born, the dawning of the nuclear age. Among the letters he kept, perhaps the most moving is from his father-in-law, William E. Chickering, then a retired U.S. Army General. It is addressed to a young man at a crossroads in his life after World War II: a letter of advice.

We reproduce this letter here, together with a very small number of treasures selected from his personal papers, to share with all those who loved him. They are in no way a complete record of his career, but only a glimpse of some sterling fragments.

Among the books in his library at home, we found a set of seven thick leather-bound notebooks filled with the long-hand calculations and course notes he kept from his own student years at the University of Michigan. After the war, he completed accelerated bachelor's and master's degrees in physics, in preparation for his doctoral work. So elegant are these student notebooks that we chose a few pages from them to reproduce throughout this book. They show us a young scientist in love with his work, the opening chapters of a life's labors.

Many beloved friends responded to our call for tributes to Dad. These comprise the backbone of this memory book. We have arranged them in a rough chronology to tell the story of his life in the words of those whose lives he changed.

Elizabeth King
Richmond, Virginia

Francie King
Marblehead, Massachusetts

John King Jr.
Wiltshire, England

September 2008

3235 38th Street, N.W.,
Washington 16, D. C.
October 3, 1948.

Dear Johnny:

From things Betsy has written, I know you are feeling a bit unsettled in your mind regarding the advisability of going on with your graduate work beyond the M.S. level. She said she wished you and I could have a talk on the subject. I feel that such a talk would not do you much good as I have no knowledge whatever of your field of activity. However, here goes for a little talk on paper.

First off, if fears that you are being a burden on us have anything to do with it, please put that out of your mind completely. We are much better off than we were on active duty Army pay. The money we send you does not push us at all. We can well raise the ante if it is needed - just keep us posted.

Second, if it is the fact that you do not have a car and other comforts that you would have if you were out earning a fair salary, I can only say that I sympathize with you, but am sure you will be glad someday that you put up with this scrimping period. It will pay big dividends later.

Third, if you see your contemporaries out earning fair salaries and getting increases from time to time, and if, as a result, you fear that you are being left behind and getting nowhere, I think I can cite the case of one of my old playmates to show you the fallacy of your thinking. This chap, a man named Huer, was a year or so behind me at Pennsylvania, majoring in chemistry. After I graduated, I lined him up a part time job in the laboratory of the brass company I was with. He kept on in school, taking Bachelors and Masters degrees, then teaching and going on for his PhD. With the PhD. behind him, he continued teaching at Pennsylvania and did consulting work on the side. Finally, General Refractories found his part time services were not enough and made him such a fat offer he could not say no. When I saw him in 1940 he was Vice President of General Refractories, in charge of the technical end of the business. I do not know his exact salary, but bet he was well above the \$50,000 level.

Your case looks to me like the makings of a parallel one to Huer's -- in a different field, of course. His long suit is alloys of metals. Yours should offer even bigger possibilities. When atomic energy is harnessed for peaceful purposes, as surely it will be, not one man in a million will be an expert on the subject. It doesn't take much imagination to visualize how much in demand the experts will be, and how they will be able to go to town on their knowledge.

I haven't the slightest doubt that you could quit now and get a job at a fair starting figure, and that in not too many years you would be earning \$8,000 or \$10,000 -- or you can go on for your Masters degree and do somewhat better. However, I am equally convinced that the boys at the top in your field will be the ones with the top qualifications -- that a PhD. will become a must, with the leaders going on from there to make their mark.

(over)

(back)

Translating this into money, I don't think you should be disturbed in the least by seeing your contemporaries of Bachelor and Masters degree level earning \$6,000 or \$8,000 a year, and getting advances beyond that. Those boys are doing well enough, but you are pointing toward getting out from under the ceiling that is very definitely over a man of only average qualifications. You are aiming for ten times the figures those boys are making, and you will pass them in a hurry when your day comes, not too many years hence.

Them's my sentiments! You have shown that you have the capacity to take on the knowledge. Stick it out, take it on, and you will have a bang-up carrier ahead of you.

Enough preaching. The decision must be yours. We will be rooting for you whatever you decide.

Bestest to all of you.

Yours -

Poppa Chick

CHAPTER I

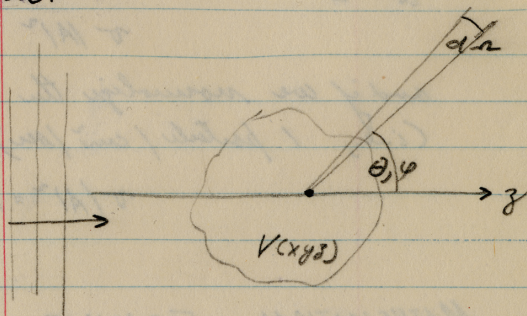
COLLISION THEORY

APPROXIMATION METHODS (CONT'D)

I. APPROXIMATE SOLNS. FOR CONTINUOUS SPECTRA:
BORN APPROXIMATION

A. SCATTERING PHENOMENA: (ELASTIC SCATTERING)

- (1) Assume we have a scattering center, represented by a pt. in space within a certain field distribution. a plane DEBROGLIE WAVE is incident upon this scattering center:



PROBLEM: What is the degree of scattering per unit solid angle, $d\sigma$, at θ ?

(2) DEFINITIONS:

(a) DIFFERENTIAL CROSS-SECTION

$$d\sigma = I(\theta) d\Omega = \frac{\# \text{ PARTICLES SCATT. / SEC IN } d\Omega}{\# \text{ PARTICLES INCIDENT / SEC / CM}^2}$$

$$\dots d\Omega = (\sin \theta d\theta d\varphi)$$

William Parkinson

I first met John in the fall of 1942 in a large open field in Stump Neck, MD.

He was an able seaman in the Navy and a member of a field crew, fresh out of Princeton with a degree in Political Science (with high honors). His job was to dig up 3-pound shells, containing proximity fuses that had been fired vertically from a Coast Guard gun so they would descend bottom first. The point was to see if the fuses were intact, having withstood the 20,000g forces. John had a scientific curiosity and a real interest in what was going on. As a result, we arranged for him to be transferred to my lab in the Applied Physics Laboratory of Johns Hopkins University in Silver Spring, MD. He developed an interest in electronics, and we spent many evenings in tutorial sessions.

Following the war, John entered the University of Michigan as an undergraduate student in the Engineering Physics program and received the BSE degree in Physics in 1948. He then entered graduate school, earned a M.A. degree in Physics in 1949. When he elected to continue in Physics, I served as his advisor and as the chairman of his PhD committee. He received his PhD in Physics in 1953. His thesis was a test of the nuclear shell model. His dissertation and published paper represented a significant advance in Nuclear Physics and is described in Nobel Laureate Maria G. Mayer's book on Nuclear Physics.

John accepted a position with the General Electric Company, eventually serving as Manager of Reactor Physics at the Knolls Atomic Power Laboratory in Schenectady, NY. In 1959 he was invited to join, as an Associate Professor, the newly-formed Department of Nuclear Engineering at the University of Michigan. He was promoted to full Professor in 1962, and became chairman of the Department in 1974. He retired as Professor Emeritus in 1989.

W.C. Parkinson
Emeritus Prof. of Physics
Dept of Physics
University of Michigan
Ann Arbor

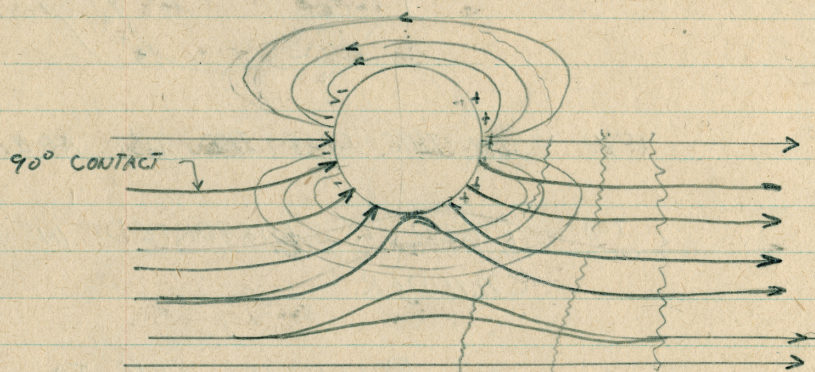
$$(E_\theta)_{(r=a)} = 0 = -E_0 \sin \theta + \frac{A_0}{a^2} \sin \theta$$

$$A_0 = E_0 a^2$$

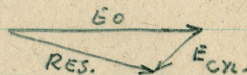
so that

$$V_0 = -E_0 r \cos \theta + E_0 \left(\frac{a^2}{r}\right) \cos \theta \quad (5)$$

(d) INTERPRETATION



① POLARIZ. OF CYLINDER PRODUCES AN OPPOSING FIELD THE VECTOR ADDITION OF WHICH PRODUCES CURVATURE OF FIELD LINES.



② WHEN $r=a$, $V_0=0$, meaning that at surface we have only the constant potential V_i .

$$\begin{aligned} \textcircled{3} (E_r)_{r=a} &= -\frac{\partial V}{\partial r(a)} = [E_0 \cos \theta + \frac{E_0}{a^2} \cos \theta] \\ &= \underline{2E_0 \cos \theta} \end{aligned}$$

$$\textcircled{4} (E_r)_{r=a, \theta=180^\circ} = \underline{\underline{-2E_0}}$$

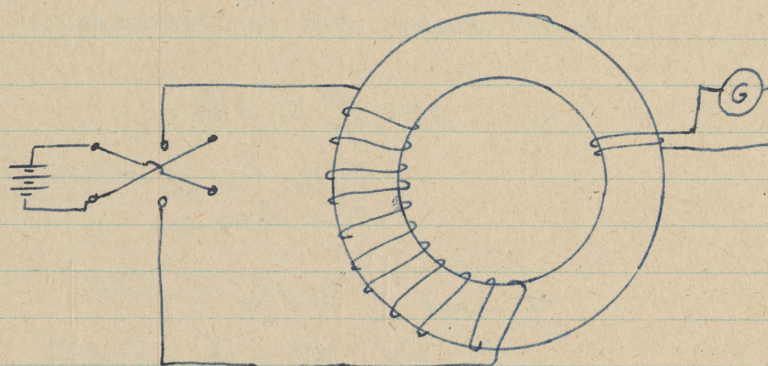
$$\mathcal{S}T = \frac{1}{4\pi} \int_{\text{ALL SP.}} (\vec{H} \cdot \delta \vec{B}) d\tilde{\omega}$$

$$T = \frac{1}{4\pi} \int_{\text{ALL SP.}} d\tilde{\omega} \int_{\vec{B}_0}^{\vec{B}_1} \vec{H} \cdot \delta \vec{B}$$

④ EVALUATING INNER INTEGRAL ONLY

$$\frac{1}{4\pi} \int_{\vec{B}_0}^{\vec{B}_1} \vec{H} \cdot \delta \vec{B} = \frac{1}{4\pi} \int_1^2 \mathcal{S}(\vec{H} \cdot \vec{B}) - \frac{1}{4\pi} \int_{H_0}^{H_1} \vec{B} \cdot d\vec{H} \quad (20)$$

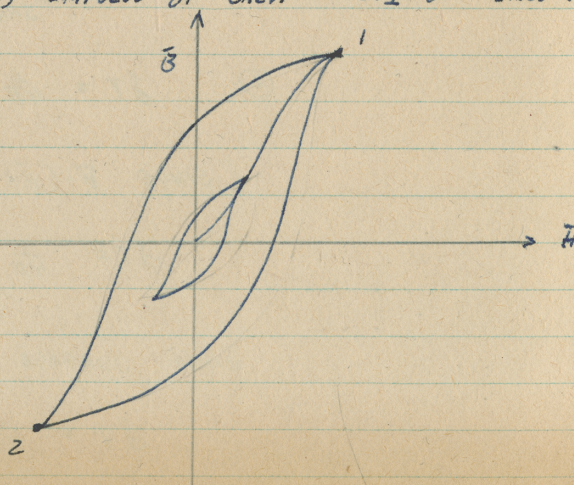
NOW TAKE AN ACTUAL EXPERIMENTAL SET-UP:



(a) APPROX. ALL FLUX IS IN TORUS

$$(b) \quad H \cdot 2\pi R = NI$$

(c) IMPULSE OF GALV. $\propto \Delta \vec{\Phi}$ and ERGO TO \vec{B}



ANGULAR DISTRIBUTIONS FROM THE REACTIONS

$\text{Cl}^{35}(\text{d,p})\text{Cl}^{36}$, $\text{Sc}^{45}(\text{d,p})\text{Sc}^{46}$, AND $\text{V}^{51}(\text{d,p})\text{V}^{52}$

AS A TEST OF THE SHELL MODEL

by
John S. King

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in the
University of Michigan
1953

Committee in charge:

Assistant Professor W. C. Parkinson, Chairman
Associate Professor R. C. F. Bartels
Professor H. R. Crane
Professor D. M. Dennison
Assistant Professor P. V. C. Hough
Assistant Professor R. W. Pidd

THE UNIVERSITY OF CHICAGO
CHICAGO 37 • ILLINOIS
INSTITUTE FOR NUCLEAR STUDIES

July 16, 1953

Dr. J. S. King
Department of Physics
University of Michigan
Ann Arbor, Michigan

Dear Dr. King:

Prof. Jensen and I are writing a book about nuclear shell structure.

Will you give us permission to use Figure 1 in your article,
Phys. Rev. 88, 142 (1952) in this publication?

Sincerely yours,

Maria Goeppert Mayer
Maria Goeppert Mayer

MGM:vr

9/13/55

RECORD OF SIGNIFICANT ACHIEVEMENT

1953 - (Research Associate, Experimental Physics, Knolls Atomic Power Laboratory).

1954 - As experimental physicist

1. Devised and used method for extending experimental measurement of SIR reactor spectrum into low energy region.
2. Devised techniques, carried out extended experimental and analytical program for the measurement of self-shielding characteristics for resonance absorbers in SIR spectrum. Presented paper on results at Oak Ridge Symposium of Reactor Technology.
3. First proposed use of samarium as an experimental stand-in for xenon in critical assemblies. Successfully predicted SIR xenon poisoning by use of this tool.
4. Devised and carried out first experimental measurement of long lived fission product poisoning in SIR reactor. Proposed extension of this program by use of enriched isotope measurement program.
5. Planned, directed, and completed on very short time schedule initial exploration of SAR design possibilities in SAR-PPA critical assembly.

1955 - As supervisor SAR Critical Assemblies

1. Sponsored revision of ATR reactor core slug design to extend versatility of ATR critical assembly experimentation.
2. Developed basic design ideas, initially started by H. B. Stewart, for a Flexible Plastic Critical Assembly to support the SAR water reactor program. Successfully promoted KAPL management and AEC approval for the construction of this facility.
3. First proposed the use of internal pulsed neutron source as a new measurement tool for critical assemblies at KAPL.

John S. King
John S. King



DEPARTMENT OF THE NAVY
BUREAU OF SHIPS
WASHINGTON 25, D. C.

IN REPLY REFER TO
22 June 1959

• Dr. J. S. King
Knolls Atomic Power Laboratory
Schenectady, New York

Dear Dr. King:

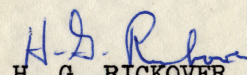
I have just been informed by Mr. B. H. Caldwell of your decision to leave the Knolls Atomic Power Laboratory in order to assume a teaching and research position at the University of Michigan.

As much as I regret your leaving the Naval Reactors program, I fully understand and appreciate your motivations. As you know, I have been quite concerned recently with educational problems and I feel that it is highly beneficial to our universities and technical schools to have on their staff men of your calibre who have had experience in directing developmental programs at industrial laboratories, such as KAPL.

At this time, I wish to thank you for your many years of distinguished and conscientious service to the Naval Reactors program. I understand that it was to a great extent through your devoted efforts that we were able to cope with the extremely difficult and complex physics problems which we faced in the design of the Submarine Advanced Reactor Core.

I would like to extend to you best wishes for a successful academic career.

Sincerely yours,


H. G. RICKOVER
Vice-Admiral, USN

Jack Carpenter

I met John King when we arrived at the Department of Nuclear Engineering, University of Michigan, at about the same time, he as an experimentalist and I as a grad student, about 1958.

John was one of the spark plugs that ignited the program in neutron scattering studies in the department. He was a driving force in the weekly Neutron Scattering Seminar series that ran for many years, in which both faculty and students lectured and listened and learned the field—starting with little prior knowledge. That program led to the construction of several neutron scattering instruments at the Ford Nuclear Reactor—John headed the triple-axis crystal spectrometer project and oversaw the heavy-water reflector installation. Dozens of graduate students learned their science in this program. I built one of those, a multi-rotor time-of-flight spectrometer.

John was a continuous inspiration then and in the years after I joined the NE faculty, serving by his side. John formed a close collaboration with George Summerfield, in which they and their students carried out important research in small-angle neutron scattering using instruments at the large neutron sources in the United States and overseas, especially in France, where he loved to work. Many of his students have gone on to influential positions. John supported me when I faced a painful decision whether to leave the NE Department to pursue spallation neutron source development at Argonne National Laboratory. Our friendship, which formed in those early years, lasted until the end. I shall greatly miss my thoughtful, insightful friend.

Jack Carpenter
Argonne Distinguished Fellow, Emeritus
Argonne National Laboratory
Argonne, IL

(as presented at the memorial service for John, St. Andrew's Episcopal Church, September 21, 2007)

Sidney Yip

Remembering John King.

Two people are most responsible for my believing that I will always be a part of Nuclear Engineering at Michigan. One was Dick Osborn, my thesis advisor, and the other was John. John was much more than a member of my thesis committee and a supportive faculty. After I left Ann Arbor, we became colleagues and also friends with whom to share aspirations and personal thoughts. It seems that my feelings for John (and Dick) go back to my graduate student days when he and Dick and I would play tennis on Sundays. It was clear to me that Dick and John simply liked each other a lot, and this apparently rubbed off on me. After Dick passed away I felt that John and I became even closer, as if we were left to care for each other. I have learned many things from knowing John, most of all I admired his easy grace and disarming modesty. And words cannot describe how much I appreciate his friendship over the years, and how special he was to me. I wished I had hopped on a plane last year to say something like this to him. Then I look back on the times we visited with each other and catch myself thinking that somehow maybe he already knew...

Sidney Yip
PhD 1962, University of Michigan
Department of Nuclear Science and Engineering,
MIT, since 1965
Department of Materials Science and Engineering,
MIT, since 2000
Cambridge, MA

Glenn Knoll

First, a few personal notes. I actually preceded John's arrival in the newly formed Department of Nuclear Engineering, University of Michigan, arriving as a new graduate student in the Fall of 1958. My initial advisor was Paul Zweifel, whose research in theoretical topics did not interest me—I wanted to do something in the laboratory. Paul let me know that a new addition to the faculty—John King—would be arriving soon and was a very talented experimentalist. When he arrived, I switched advisors and found a lifelong mentor, colleague, and friend.

John introduced me to Bill Parkinson who was supervisor of the cyclotron laboratory in the Physics Department, and the two then served as co-chairmen of my doctoral committee. My experiments involved use of an aging cyclotron accelerator that frequently broke down for extended periods. John helped me through some difficult times when I was tired of all the troubles and ready to get a real job somewhere. His positive attitude and helpful suggestions made a key difference and kept me at it until finally finishing the research. Although I do not know the details, I believe that John must have been influential in a decision by the Department of Nuclear Engineering to offer me a position as Assistant Professor when I completed my doctorate. So I owe him repeated thanks for helping me finish my degree and for participating in providing the opportunity to pursue an academic career. These are truly life-changing events.

John was a key faculty member in the formative years of the department. Along with fellow faculty members Paul Zweifel, Dieter Vincent, Richard Osborn, George Summerfield, Ziya Akcasu, Jack Carpenter, and a host of very talented doctoral students, he led the effort to establish a world-class neutron scattering program utilizing the neutron beams from the Ford Nuclear Reactor. Some excellent research was carried out on the study of the structure of polymers and other materials that demonstrated the power of the neutron scattering technique. He continued these interests throughout his career, eventually shifting some of the experimental work to newer facilities in the U.S. or abroad that provided more intense beams to allow more challenging measurements. His love for doing important work continued on well beyond his official retirement, and it was commonplace to see John show up in his lab on a daily basis long after he could have chosen to lead a more leisurely life.

John also contributed to the administrative leadership of the Department, most significantly as Department Chairman from 1974 to 1979. During this time, he planned and supervised the moving of the departmental offices, classrooms, and some labs from scattered locations on North Campus to a much-improved centralized space in the Cooley Building. These facilities remain our headquarters today and have served us well for 30 years.

John King's name and the excellence of our academic program will always be linked in the minds of those who knew him. He was in large part responsible for establishing the high standards of teaching, research, and personal integrity that those who continue on will strive to emulate.

*Prof. Glenn Knoll
College of Engineering
Department of Nuclear Engineering and Radiological Science
University of Michigan
Ann Arbor*

Sam Werner

Prof. John King: Scientist, Teacher, Gentleman, Friend.
A Personal Story.

In the Fall of 1961 I arrived in Ann Arbor as a graduate student in the Nuclear Engineering Department at the University of Michigan.

I had spent the previous two summers as a research student at the Scientific Laboratory of the Ford Motor Company in Dearborn, Michigan. I visited Ann Arbor many times during those summers and even had a tour of the new Ford Nuclear Reactor (FNR) within in the Phoenix Memorial Laboratory on the North Campus. In the Spring of 1961 I had planned to go to Harvard as a graduate student in the Applied Physics Department after leaving Dartmouth College. One weekend I went down to Cambridge to look for a place to live. I was to marry Laura (my wife) that Fall in El Paso, TX, after she graduated from Smith College. Upon seeing the apartments available in Cambridge, I decided that there was no way that we could live there. Fortunately, I had also been accepted at Michigan which offered me a very nice Fellowship. Tony Arrott and Al Overhauser at the Ford Scientific Lab were already planning to do neutron scattering experiments in Ann Arbor.

I met John King immediately upon arriving at the University. He was extremely kind and encouraged me to begin doing research at the reactor right away. The department was new, the reactor was new, the faculty was new, and the excitement was everywhere. Over the next 3 years, I continued my connections with Ford, took many courses in mathematics, physics, and nuclear engineering, and learned how to do neutron scattering research.

There was a continuing entourage of talented fellow graduate students in the department: Jack Carpenter, Mike Natelson, Jordan Lewis, Ed Straker, Hugh Kendrick, John Ulrich, Lee Feldkamp, and many others. John King encouraged us all to build apparatus and do “hands-on” research, and he was always extremely helpful in facilitating and initiating new projects. When George Summerfield came to the department, first as a post-doc and then later as a professor, John initiated weekly neutron scattering seminars in which we taught each other. John invited G. Venkataraman from India. He taught us all group theory. Later Feldkamp and Venkataram wrote a book on lattice dynamics based upon those early seminars.

After I got my degree under John’s and Tony Arrott’s direction in 1964, I took a job at Ford, and continued doing neutron scattering research at the reactor in Ann Arbor until 1975, when I left to join the physics department at the University of Missouri. John arranged an Adjunct Faculty appointment in the NE department for me during those years. In 1968 he showed me an article on dynamical diffraction by Batterman and Cole in *Reviews of Modern Physics* that he thought I would be interested in reading. I studied it for several months. It formed the basis for my understanding of this subject and later led to our successful implementation of neutron interferometry, first achieved at the FNR in 1975. For some of the things that I have mentioned here, John received little or no direct credit. However, they certainly would not have occurred without his help and encouragement.

During the academic year 1976–77, John took a sabbatical leave from Michigan to come to the University of Missouri. During that year he designed and built a small angle scattering spectrometer. He was the principal investigator on the NSF grant. All this in one year. The year that he and his wife Betsy spent in Columbia, MO was a very happy time for all of us. Over the years, John became very well known in the polymer and small angle scattering communities. He was instrumental in the important theoretical accomplishments in this field by George Summerfield, Ziya Akcasu, and Boualem Hammouda.

John King was a wonderful teacher, scientist, and mentor to more than 20 graduate students. His honesty, high standards and integrity serve as a model for us all. To have been his friend for 46 years is a wonderful gift and high honor for me personally.

A gentleman par excellence. I will miss him very much.

Sam Werner
Curators’ Professor Emeritus
The University of Missouri/Columbia
Columbia

David Mildner

(in a letter, September 2007)

I realize that I have known John now for forty years. It was in 1966 that I met him when I started graduate school. To the beginning student he was a gruff man, but I know he took great pains to make sure that all students had some form of stipend for their studies. And as I got to know him better he became more approachable, though I found him a little gruff at times. But it was when he was with your mother [Betsy King] he was most charming. And indeed they were a most delightful pair. Theirs was a marriage of true love, a great testimony. He looked after your mother so meticulously. It was great to see him interacting with her. Of course, ultimately we came to love his gruffness! Let me give a few reminiscences.

In my first year I worked for him. On the beam port floor we had small huts around each instrument, each with an air conditioner. This was because the Phoenix Lab [at the University of Michigan] and the reactor were built in times when air conditioning was not standard. One day the air conditioner broke down for the umpteenth time, and your father told me to buy another from Montgomery Ward. I had to get a purchase order number from the Office of Research Administration. I had great difficulty persuading them that we needed an air conditioner for an instrument. After getting nowhere, I had to go back to your father. He got on the phone and really chewed out the bureaucrat in no uncertain terms. It was his research money and it was he who decided what was appropriate! And ORA was there to serve the researchers. That really impressed me—your father was someone who got things done, and fast. He did not seem afraid to say what he thought.

A year later, I remember I effectively ruined a detector that had cost about a thousand dollars. I felt so bad. To me that was a huge amount. I thought he would really chew me out. But he seemed to understand my remorse.

I remember being impressed by your father at seminars. Often he would ask what he called a “dumb question,” though usually they were most fundamental. Students were often quietly grateful because the answer was helpful to us. We were either frightened to show up our ignorance by asking a silly question, or were too dumb to think of a suitable question. But your father often saved us.

Though I did not do my thesis under your father, he was on my committee. In those days Michigan was strong in neutron scattering, and he formed a trio, with Jack Carpenter and the

late George Summerfield, regular members of the department, together with Sam Werner from Ford Scientific. I am fortunate to have been at Michigan in those days.

I remember that a few months before I left Michigan, I drove him down in my VW bug to Oak Ridge in Tennessee where he was to perform some measurements. I was not involved in them but I wanted to take the opportunity to see the reactor there, before I returned to England. It allowed me to get to know him better. We stayed at a war-time-era hotel that no longer exists. He was kind enough to look after me and show me the ropes. I have good memories of that trip.

I also recall a little earlier being in Cambridge for some neutron meeting. When your father was in my VW the whites of his knuckles were visible as he held on for dear life, since I immediately realized that I was in my element adapting to the crazy driving in Boston. I do not recall his comments on my driving but I am sure they were not flattering! You may recall that it was on that occasion that I first met you [Francie King]. You were as charming as your mother.

I think it was in the early 70s when he took your mother to a neutron scattering meeting in France, at Rennes in Brittany. How both of them managed this I do not know, but their memories of this trip were great, despite the obvious difficulties. I believe that the outcome of this visit was the push that he, together with George Summerfield, initiated for the development of small-angle neutron scattering in the U.S. It took a long time, and I know he visited the reactor at Saclay, outside Paris, at least once to perform SANS measurements. For some reason he had a layover at Heathrow Airport in London. I was working in England at the time, and we arranged to meet and we drove into London for the evening. He was most gracious and treated me as a great friend, even though I had been a student only months previously.

Your father did pioneering neutron scattering work on polystyrene at Michigan. Later his interests turned to small-angle scattering from polymers. As you know your parents spent a year 1976–77 at Missouri. They both enjoyed their stay greatly, and it was reciprocated. During this time he designed and constructed the first small-angle scattering instrument in the U.S. I overlapped their visit by a couple of weeks, and I took over the construction of the instrument from your father. Later we produced a scientific paper describing the spectrometer using polymer data collected by one of his students to illustrate its capabilities.

(David Mildner cont.)

It was during this overlap time that we received the first linear position-sensitive detectors that your father had originally specified. I set up a quick and rather crude method of testing them since we did not have the appropriate electronics at the time. It was far from ideal but at least it enabled us to see whether the detectors worked as expected. I will not go into detail, but it required a judgment of the average height of pulses on an oscilloscope from each end of the detector. I needed someone to make that judgment independent of my moving the detector across a narrow beam. When I explained to your father what I wanted him to do, he said that this was not the way to do an experiment. I had to admit he was right, it was really an impossible task, but I said “Never mind John, please attempt to do it.” (He was correct, we did not have the electronics available at the time, but I wanted to make this test before he left Missouri.) After a couple of measurements, he wanted to stop because “this was just terrible,” but I cajoled him. A little later, “Didn’t we teach you anything at Michigan about doing experiments, David?” “I know it is impossible, John, but give it your best try.” Finally after many interruptions of this nature, we finished. “David, this is the worst experiment I have ever done.” “Yes, John, but have a look at this.” What he did not know was that I was plotting on graph paper his readings against the movement I was making of the detector. We ended up with a straight line which was exactly what we wished to find. I needed his independent readings so as not to bias the results. Later we published the first paper on the calibration of these detectors, though admittedly not with this set of “terrible” data. Incidentally these linear PSDs are now used throughout the world. I remember some years later telling your mother about this interaction. She enjoyed it and roared with laughter. “That’s my Johnny.”

I am not sure when I last saw your father—we would see each other at various neutron centers, Ann Arbor, Argonne, Gaithersburg, Saclay. I know we met in the 90s again at Saclay outside Paris, when he visited to perform some measurements and while I was also there for measurements. Each night we would go out with other colleagues to taste the cuisine of different restaurants.

It has been a great pleasure to have been a colleague of John King, your father.

David Mildner
National Institute of Standards and Technology
Gaithersburg, MD

Ganesh Venkataraman

(from a letter, September 2007)

Yesterday [Wednesday, 19th September, 2007], around 11.30 in the morning, I was walking from my office to my room when the postman beckoned me to hand me a letter. I looked at the envelope, and noted that the letter was addressed to the room I occupied more than ten years ago. I then looked at the top left hand corner to see who it was that had sent the letter. I noticed it was from Richmond, but could not recall knowing anyone living there. Then I saw the name King, and began to wonder whether the writer was in any way related to John King. I was not too sure, since I had lost touch with John many years ago. It was only when I reached my room and opened the envelope that I learnt the sad news and from where the letter came. As is to be expected, memories came rushing back in a non-stop flood, all so lovely because they related to such a wonderful person. Before I say anything else, please accept my heart-felt condolences, and pass them on to the other members of the King family also. I am glad that your father lived to a ripe old age, although it was distressing to learn that he suffered from lung cancer towards the end. I hope the end was peaceful.

My first contact with your father was in 1967, I think, when I landed in the US in May I believe. I had flown in direct from Bombay, and stopped over in NYC to spend a few days with my classmate who lived in Manhattan. I was in America as the result of a post-doctoral fellowship awarded to me by the U of M, and my correspondence was entirely with your father. A day or so after I reached NYC my friend suggested that I call Prof King and let him know that I was in America and would soon be in Ann Arbor. So I called him and his secretary connected me to John. I had barely spoken a sentence or two to say I had landed in America when he interrupted me to drop a bombshell. He said, “Listen, who asked you to come? I had not approved your coming here and what do you mean by showing up like this?” You can imagine my shock. I mean it is not easy to get a visa to America, and I had entered the country because I had very legitimate papers, all from the U of M with Prof. John King being my sponsor and all that, and here he was asking why the hell did I come!

You can imagine my mental state! I had just about \$30 (that was for me and my wife), and I was depending on my friend to help me with a loan to get settled on reaching my destination. And here was the terrible prospect of having to go back all the way to India, with my pockets empty! Somehow, I managed to convey why I was there, and luckily, I was able to communicate. Prof. King told me that he had mistaken me for a person who had applied to the graduate school—I think he was the Chairman of the Nuclear Engineering Department then—and that was why he had responded the way he had; it was a case of mistaken identity, and boy was I relieved!

A few days later when my wife and I landed in Detroit, John was there to receive us, and we had a big laugh about the mistake! That was the beginning of a wonderful friendship and for me a very rich one too. I can go on and on recalling so many incidents and events, but what comes through from every one of them is the beautiful nature of John. At first, I was very hesitant to call him by his first name, and kept on referring to him as Prof. King, something we have to do in India, and it took me a long time to adapt to the more friendly and informal style that is unique to America. Prof. King became John only when I saw even graduate students calling him that!

I went back to India in 1968, and came back for a brief tour of the US in 1981, when I stopped over in Ann Arbor for about two or three days. But in 1985, I came back for a three-month stay, from fall to mid December. This time it was John again who received me, put me in the Union for a day or so, got me set up in the North Campus, and helped me to get settled. In particular, he would let me ride with him every weekend for the shopping trip. He was with me all the way, helping me in ever so many ways, and in fact dropped me at Detroit Airport when it was time to return. We spent a wonderful one hour in the coffee shop until my flight to New York was called for boarding. That was the last time I saw him.

I should not forget to mention your mother, who endeared herself to me and my late wife, with her affection, and I was amazed how she bore her difficulty with such stoicism. I also recall John redoing the kitchen so that your mother could handle the kitchen easily from her chair.

It is surprising that though I moved closely with John at the personal as well as the professional level, I knew so little about him. For example, I was stunned to learn that his first degree was in Political Science. To change over from Political Science to Physics and Nuclear Engineering is amazing and shows how brilliant he was though always so self-effacing.

It is remarked in the obituary that he took little credit for many things done under his supervision, letting others take the limelight. That was typical of him and so untypical of many scientists. I still remember Jack Rush (a neutron physicist who spent many years in NIST, Washington) telling me once about Don Hughes of Brookhaven (Don Hughes was the big man in Brookhaven, almost a don!). Jack Rush said, “That guy had a rubber stamp and put his name on all papers published from Brookhaven, even though he had little to do with the research being reported.” That remark is enough to show how different your father was compared to the run-of-the-mill supervisors, ever ready to ride piggy-back, contributing little.

Your father can be praised in many ways, but for me he was above all, a good man, a real and noble human being. At the end of the day, when the final call comes and one goes to meet the Heavenly Father, I am sure the Lord would have a special welcome for those who are remembered as good people back on earth. I personally believe that, all things considered; ultimately, that is what really counts. To me, John King represented always the best of America, epitomising the qualities that endear Americans to people everywhere—warm, friendly, ready to share and care, hard working, fair, always ready to laugh, honest, compassionate and considerate. You should be proud that your father was such a good man.

I am truly grateful to you for tracking my [old] address and taking the trouble to write to me. I thought of John very often but unfortunately lost his address for communication. However, some years ago when two of my students here went to Ann Arbor as graduate students, I asked them to call on John and convey my respects and regards. That was the last time I tried to communicate in the usual manner but in my heart I thought of John often. No surprise in that considering that good people are becoming increasingly rare. May his soul rest in peace!

Sharing your sorrow, and once again with my deepest condolences,

G.Venkataraman, or Raman as I used to be known over there.

G. Venkataraman
R4 A2 Prasantinilayam
India

Knolls Atomic Power Laboratory



HEADLINE

Vol. 11, No. 41—December 18, 1968

Published by KAPL Communications

Dr. King Returns to KAPL



Among the many former KAPL associates greeting Dr. John S. King, who returned to the Laboratory last week as speaker in KAPL's series of scientific and engineering colloquia, were: Dr. R. G. Luce, Manager-

Advance Physics, NPE; Dr. Frank Feiner, Manager - ADA Advanced Reactor Physics; Dr. King; and Floyd C. Merriman, Manager-AIG Nuclear Engineering.

THE LATEST in a continuing series of scientific and engineering colloquia was presented last week with Dr. John S. King, a former KAPL manager and now professor of nuclear science and engineering at the University of Michigan, as guest speaker. Dr. King spoke on "Application of Thermal Neutron Inelastic Scattering to Materials and Liquid State Problems."

A KAPL employee from 1953 to 1959, Dr. King was Manager-SAR Physics from 1956 until he left the

Laboratory in 1959 to join the Department of Nuclear Engineering at the University of Michigan. He had earned his PhD in nuclear physics from that University in 1942 and received his undergraduate degree in physics from Princeton University.

Arrangements for the lecture were made by **Dr. Frank Feiner**, Manager - ADA Advanced Reactor Physics, and **G. L. Smallwood**, Consulting Specialist - Manpower Resource Development.



Nuclear Fellow

Prof. John S. King of the U-M nuclear engineering department was one of 10 persons named Tuesday as a fellow of the American Nuclear Society. The society, at its 15th annual meeting in Seattle, announced that the new fellows will be added to the existing roster of 208. Prof. King, who joined the U-M faculty in 1959, holds an undergraduate degree from Princeton University and advanced degrees from U-M.



John and Betsy, St. Andrews Episcopal Church, Ann Arbor, Michigan, June 1972

THE UNIVERSITY OF MICHIGAN • COLLEGE OF ENGINEERING

ANN ARBOR

DEPARTMENT OF NUCLEAR ENGINEERING
Phone: (313) 764-4260

MEMO

TO: Dean Ragone

FROM:

RE: Chairmanship of the Nuclear Engineering Department

DATE: 22 January 1974

We strongly urge you and the College Executive Committee to appoint Professor John S. King as the next Chairman of the Department of Nuclear Engineering. You will note that we constitute a majority of the faculty of the Department.

Professor King's scholarly qualifications are outstanding. He has authored over forty papers in various journals and conferences. Among these, his studies of the vibrational spectra of polymers using neutron inelastic scattering can truly be said to have pioneered an entirely new approach in polymer physics which is now used throughout the world. He has directed more than ten doctoral theses. These represent about one doctoral student per year since 1963. This rate appears particularly high when one examines the enormous complexity of these experimental topics and the care insisted upon by Professor King in the performance of the experiments.

Professor King's scholarly standing has been recognized in his appointment to Fellowship in the American Nuclear Society as well as appointment to a divisional executive committee and two divisional honors committees of this society. He has also served on Fellowship and Physics survey committees of the National Academy of Sciences. He serves as a reviewer for four technical journals and reviews proposals for the National Science Foundation and the Atomic Energy Commission.

Evidently, Professor King's technical expertise and scholarly accomplishments are well known in scientific circles. We might also note that Professor King has been the sole investigator for \$133,600.00 in research grants since 1967.

Dean Ragone
22 January 1974
Page 2

In view of these striking technical accomplishments, it is quite surprising that Professor King has any time or energy left for administrative duties. Yet he has held eighteen departmental and ten college committee assignments. He has had the longest tenure on the departmental Executive Committee, appointment to which is made by a vote of the departmental faculty. His duties on the departmental Fellowship Committee require that he contact virtually every prospective graduate student applying for financial aid. His untiring efforts in seeking support for the best of these students has gone far to insure that the quality of our graduate enrollment remains high.

We feel that Professor King will present the goals and accomplishments of the department clearly and forcefully, both inside and outside of the college. We feel that he will be able to easily handle the administrative duties of the department. (We might note that, prior to accepting a position here, he was manager of Reactor Physics for the General Electric Company, Knolls Atomic Power Laboratory.) Perhaps most importantly, we expect that Professor King will be able to continue to make significant technical contributions.

Our principal task is, of course, education. In this, Professor King has been very active.

He has taught at various times, nine of the regularly offered courses in the department. These range from the reactor laboratory, which he developed, to very sophisticated solid-state theory courses. Over the years he has also run our advanced research seminar on solid-state and molecular physics. This was principally oriented toward neutron scattering studies of condensed systems. We could look to Professor King for imaginative direction in the development and evolution of the departmental curriculum.

In all aspects of guiding and administering this department, Professor King has the qualifications of an outstanding Chairman.

THE UNIVERSITY OF MICHIGAN • COLLEGE OF ENGINEERING

ANN ARBOR

DEPARTMENT OF NUCLEAR ENGINEERING

Phone: (313) 764-4260

July 18, 1974

Dr. John Lauritzen
National Bureau of Standards
Washington, D. C.

Dear Dr. Lauritzen:

I would like to nominate Professor John S. King for the APS High Polymer Physics prize. I am enclosing a biographical sketch to provide you with some general information.

The research which qualifies Professor King for this honor is, I believe, his pioneering work on the application of Neutron Inelastic Scattering to the study of dynamical properties of polymers. His was the first neutron scattering work to provide reliable, accurate numbers for the vibrational spectra of crystalline polymers. I am listing here a sequence of papers he published between 1964 and 1969, with brief descriptions of the results, in which virtually all of the inelastic neutron scattering techniques currently applied to crystalline polymers were introduced.

"Scattering of 'Warm' Neutrons from Polyethylene," (with J. L. Donovan) Bull. Amer. Phys. Soc. 9, 623 (1964). In this work, it was shown for the first time that incoherent, inelastic neutron scattering could accurately determine the V_5 and V_9 cut-off frequencies in polyethylene.

"Polyethylene Frequency Spectrum from 'Warm' - Neutron Scattering," (with W. Myers and J. L. Donovan) J. Chem. Phys. 42, 4299 (1965). Here the generalized phonon spectrum was obtained using inelastic, incoherent neutron scattering. Also, several 'minor' features of the spectrum were observed for the first time.

"Neutron Scattering in Stretch-Oriented Polyethylene." (with W. Myers and G. Summerfield) J. Chem. Phys. 44, 184 (1966). Here the strong longitudinal and transverse polarizations of the atomic motions were directly observed by orienting the neutron's momentum transfer vector, first perpendicular and then parallel to the chain axis.

"Neutron Scattering in Normal and Deuterated Polyethylene," (with J. Lynch, G. Summerfield and L. A. Feldkamp) J. Chem. Phys. 48, 912 (1968). Here the isotope shifts of V_5 and V_9 were observed by comparing the phonon spectra of deuterated and normal polymers in both stretched and unstretched form.

"Neutron Scattering in Deuterated Polyethylene," (with L. A. Feldkamp) in "Molecular Dynamics and Structure of Solids." R. Carter and J. S. Rush Editors (Nat'l. Bur. of Stand., Wash., D. C. 1969). Here refinements of his previous techniques permitted Professor King to observe several new features such as $V_5(0)$ and its polarization.

"Dispersion Relation for Skeletal Vibrations in Deuterated Polyethylene." (with L. A. Feldkamp and G. Venkataraman) Neutron Inelastic Scattering, Fourth IAEA Symposium, Copenhagen, Denmark, 1968. Here coherent inelastic neutron scattering was applied for the first time to measure the longitudinal dispersion relation in a stretched, deuterated polymer.

Professor King's work has shown that it is possible to study the complete, low-frequency vibrational spectra of polymers using neutron inelastic scattering. Further, they show that one can obtain reliable results for the atomic motions involved in the vibrations. The techniques he developed are now being applied by polymer groups all over the world. They will most certainly lead to enormous advances in our understanding of the vibrational motions of polymers.

Sincerely yours,

G. C. Summerfield

The American Physical Society

335 EAST 45TH STREET
NEW YORK, N.Y. 10017
(212) 685-2014

W. W. Havens Jr.
Executive Secretary

J. A. Burton
Treasurer

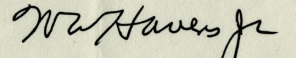
Dear Sir:

I have the honor of informing you that at a meeting of the Council of The American Physical Society held at Washington on 21 April 1974 your nomination for Fellowship in the Society received favorable action.

Upon receipt of your acceptance of Fellowship on the enclosed form, to be sent to the Treasurer not later than three months from this date, you will be enrolled as a Fellow of the Society.

This action of the Council will be void if your response is not received within three months from the date above, except that the Secretary may lengthen the period of validity to six months for compelling reason.

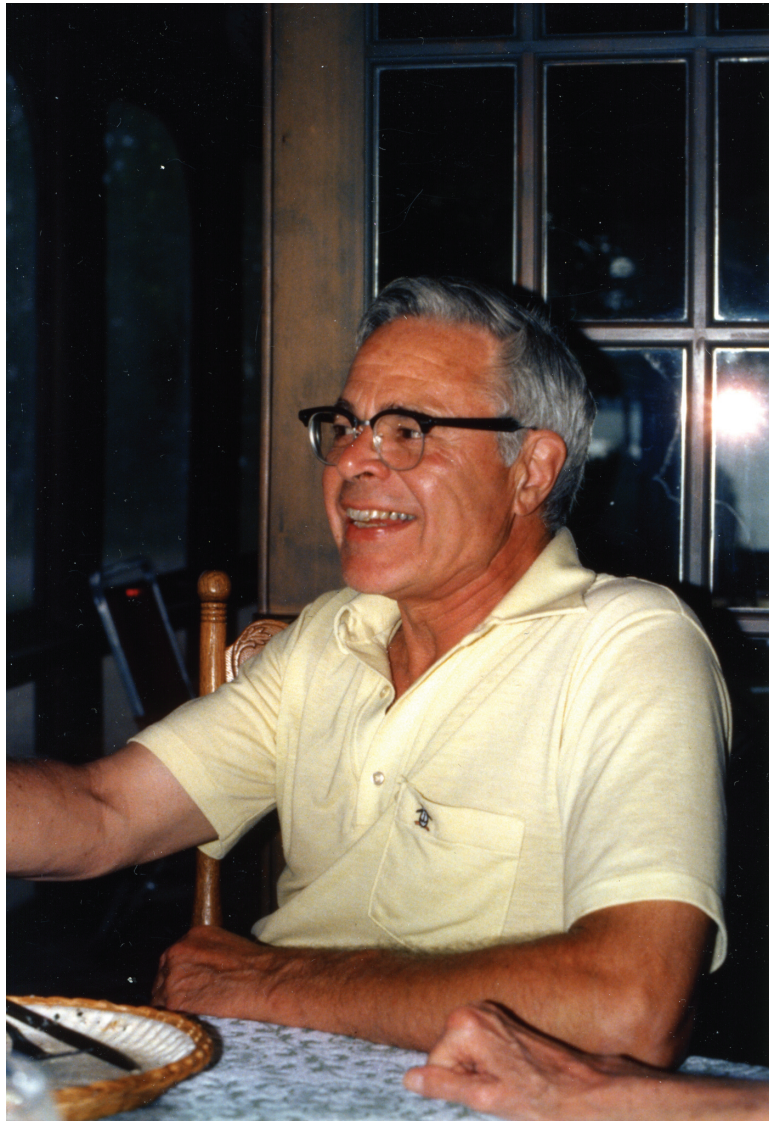
Respectfully yours,



Executive Secretary

To

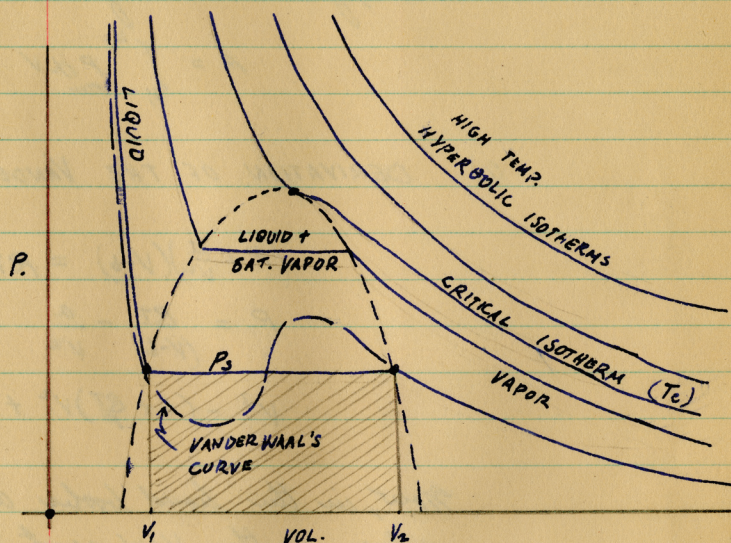
Dr. John S. King
2311 Vinewood
Ann Arbor, Michigan 48104



Crystal Lake, Beulah, Michigan, summer 1983

IV EQUATIONS OF STATE FOR REAL GASES

A. BEHAVIOR OF A REAL GAS



(1) APPROXIMATIONS TO REAL BEHAVIOR

(a) VAN DER WAALS' $(P + \frac{a}{V^2})(V - b) = RT$

CLAUSIUS $(P + \frac{a}{T(V+c)^2})(V - b) = RT$

BERTHELOT $(P + \frac{a}{TV^2})(V - b) = RT$

DIETERICI $P = \frac{RT}{V-b} e^{-\frac{a}{RVT}}$

①

B. VANDER WAAL'S EQUATION (as the best approximation with two constants over the general region. This equation is qualitatively correct at almost all points but nowhere quantitatively accurate. At high temperatures it agrees very well, but of course it diverges at the discontinuities. knowing VDW curve we can choose a straight line

?

$$(g) \quad dE = \left(\frac{\partial E}{\partial T}\right)_P dT + \left(\frac{\partial E}{\partial P}\right)_T dP = C_P dT - \frac{a}{RT} dP$$

$$E_{PT} = C_P T - \frac{aP}{RT} + E_0 \quad (8)$$

(h) ENTROPY

$$\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V = \frac{R}{V-b}$$

$$S = R \log(V-b) + F(T)$$

$$\left(\frac{\partial S}{\partial T}\right)_V = \frac{C_V}{T}; \quad S = C_V \log T + F(V)$$

Combining these two

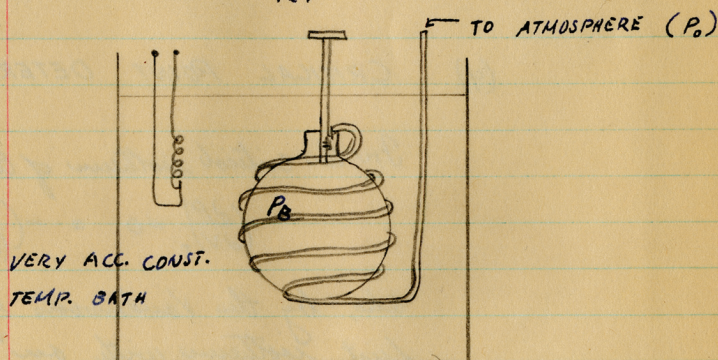
compare with ideal
gas, page 65

$$S_{(V,T)} = R \log(V-b) + C_V \log T + S_0 \quad (9)$$

(3) ROSSINI-FRANSEN EXPERIMENTAL MEASUREMENT
OF E_{PT} FOR REAL GAS (AIR)

?

$$E_{PT} = -\frac{aP}{RT} + C_V T + E_0$$



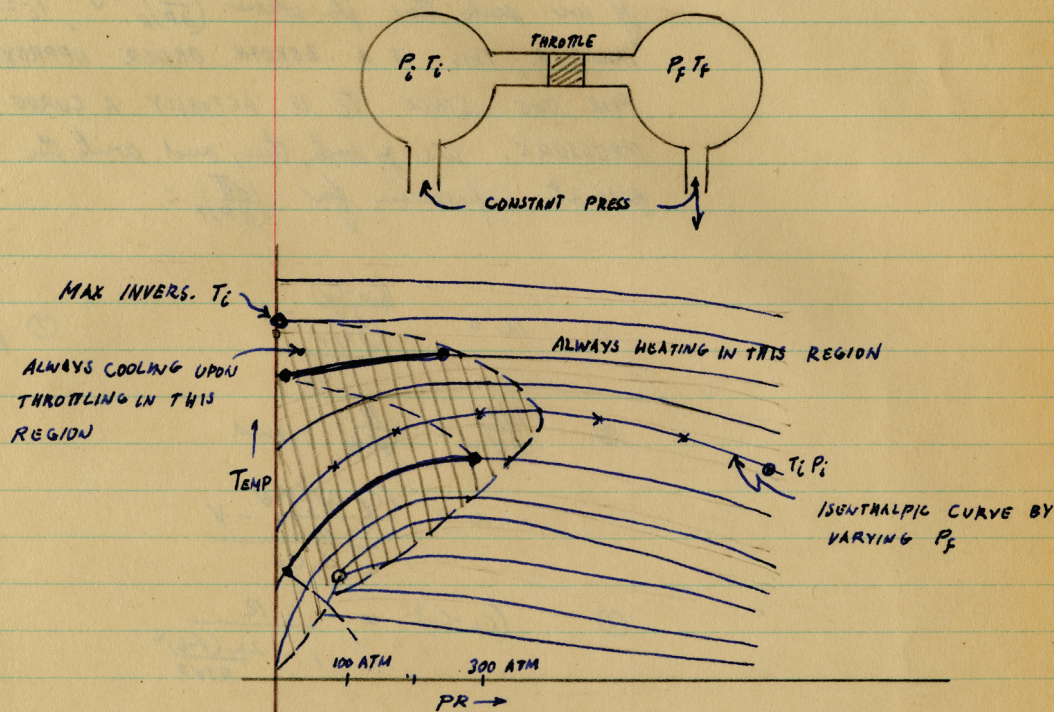
$$\Delta W = P_0(nV_0 - V_0)$$

$$\Delta Q = \text{experimentally measured}$$

$$\begin{aligned} \Delta E &= \text{change in internal energy of bomb} \\ &= E(P_0 T) - E(P_0 T) = \frac{\Delta W - \Delta Q}{n} \end{aligned}$$

(2) INVERSION TEMPERATURE ; LIQUIFACTION OF GASES BY THROTTLING PROCESS

(a) ROEBUCK EXPERIMENT + THE ISENTHALPIC DIAGRAM



(1) If we choose enough pts (P_f) close enough together we are able to draw a smooth isenthalpic curve for every (P_i, T_i) .

(2) THE PTS ON EACH CURVE WHERE $\left(\frac{\partial T}{\partial P}\right)_H = 0$ ARE CALLED INVERSION TEMPS. ; MAX. INVERSION TEMP. CANNOT BE EXCEEDED AS A (T_i) IF WE ARE TO GET COOLING. For best results in liquefying we start the throttle at a pt. ON the inversion curve.

Robert and Barbara Brugger

Slow neutron scattering experiments with neutrons from reactors were what caused John and Bob to meet. John was performing such experiments at the Ford reactor at the University of Michigan where he was a member of the faculty of the Nuclear Engineering Department. Bob started slow neutron inelastic scattering measurements in the late 1950s at the Materials Testing Reactor in Idaho and became aware of John's similar research. But it wasn't until the 1960s that their paths crossed at a meeting at Los Alamos. Barbara and Bob enjoyed John's company at that meeting and realized that here was a real gentleman scholar. During the following years they kept in touch and met at meetings. Bob visited the University of Michigan several times and was a visitor in Betsy and John's home. We could always find things to talk about when our paths crossed. John managed a challenging career along with loving care of Betsy.

When Bob moved to the University of Missouri in 1974 he started a program of having a visiting scholar at the MURR each year. In 1976–1977 John became the fourth visiting professor at the reactor and we were so pleased to have him come. This was the year that Barbara and Bob really got to know Betsy and John. John and Betsy got an apartment a block from campus in a development behind the Phi Delt house. That provided some lively entertainment for them at times. Their apartment was next to Hal and Trudy Graver's and through the Kings we met Trudy and Hal who along with their daughter Anne have become close and continuing friends ever since.

During his year in Missouri John also became attached to the Physics Department where one of John's former PhD students, Sam Werner, was a member. Sam and Laura enjoyed having John and Betsy close by. John and Bob volunteered to teach the beginning physics course that year—John taking the fall semester and Bob taking the spring semester. This class was one of those lecture hall affairs with about 150 students. For the first test Bob and John thought they would start the test with an easy 10 points by asking the question, "What are the names of the lecturers for this class?" More than half the class failed this question.

At the reactor John started to build a small angle neutron scattering facility (SANS) which we had wanted for several years but needed the expert guidance of someone with experience. That was John. A number of innovations had to be introduced into the design. Because of limited floor spacing the scattering path had to be run up the face of the reactor biological shield. This was because there wasn't enough length

on the beam port floor between the biological shield and the containment building wall. The SANS didn't get completed until after John had returned to Michigan, but it worked well when it did start to take data. Another important part of John's contributions was interacting with the MURR staff. His experience and encouragement affected every one.

Over the years Bob has greatly appreciated John's insights, views, and opinions. John was a great proponent of research reactors for universities and it was a great disappointment to him when the Ford reactor had to be shut down. He was also a positive supporter of power reactors. John's knowledge of the field of neutron scattering was extensive and his comments about the research and the researcher were always valuable to hear. Early in his career John spent several years in the nuclear Navy program and his experiences were always enlightening. One experience was that John had accompanied Admiral Rickover on his visit to the Russian icebreaker when it visited a USA port.

Knowing John and Betsy King has certainly enhanced our life experiences.

*Prof. Robert Brugger
University of Missouri/Columbia
Columbia*



James J. Duderstadt
Dean

Chrysler Center
Ann Arbor, Michigan 48109-2092
313/764-8475

College of Engineering
The University of Michigan

EXCELLENCE IN RESEARCH AWARD

CITATION

JOHN S. KING

During his twenty-five years as a member of the faculty, Professor King has established a record of outstanding research accomplishments. He has been named Fellow of both the American Physical Society and the American Nuclear Society, a clear indication of his outstanding international reputation.

Professor King is a pioneer in the application of small angle neutron scattering, a technique that is growing rapidly in its application of the study of structure and dynamics of a wide variety of materials. His activities in this area extend overseas involving additional experiments at the world-class neutron scattering facilities at Oak Ridge National Laboratory and Grenoble, France. He has a long-standing collaboration with the Ford Motor Company in the use of neutron scattering to investigate properties of materials.

In addition to a record of exceptional research accomplishment, John is a fine teacher who has counseled many doctoral students to successful completion of their Ph.D's. He served as Chairman of the Department of Nuclear Engineering from 1974-1979.

Dr. King is known for his remarkable spirit of dedication. He has invested long hours of personal attention to details that constitute high quality experimental work. His work is distinguished by uniformly high quality and scientific integrity. His firm dedication to scientific honesty and critical evaluation of his own work are attested to by the excellent reputation he enjoys among his colleagues here and throughout the world.

It is a privilege to honor a colleague whom we admire and respect.



John and Betsy, University of Michigan College of Engineering Excellence in Research Award ceremony, 1983

Brent J. Heuser

John King was the embodiment of everything that is right about scientific inquiry and, equally important, everything that is right about how to live your life and how to treat those around you. It is a memory of the latter that I would like to share here.

I wrote this about John in the acknowledgement of my PhD thesis:

My friendship with Dr. King is one of the benefits of my candidacy. He has taught me how to be a better person as well as a better scientist. His cautious approach to science, his ability to recognize critical factors immediately, and the capacity he has for teaching students how to do good science are traits I will try to emulate during my scientific career.

George Summerfield told me about a year later how pleased these words made John feel. While I am not sure how successful I have been in emulating these traits, I do know that I am a better person for the time I spent with him. I am very grateful that I was able to convey, in this small way, the admiration I felt for him.



Brent Heuser, 1990

*Centre d'Etudes Nucléaires de Saclay, Gif-sur-Yvette,
France, 1990*

John and I spent an extensive amount of time together on the road performing experiments from about 1988 to 1995. We traveled to Saclay, France, three times, to NIST twice, to ANL several times, and to Los Alamos twice. We shared many meals together, drank countless glasses of beer and wine together, and spent too many sleepless nights trying to make experiments work. I knew then how special a person John was, how what he had to say was important and that I should listen, and how the manner in which he treated everyone we came in contact with was the right way.

I would like to share one memory of how caring and generous John was. It is from our second trip to Saclay, France, and is about Remi, the technician in charge of the instrument we used. The technicians and the scientists at Saclay formed two separate and unequal groups. John and I talked about this subtle but apparent inequity, something we noticed during our first trip. Neither of us felt the technicians were treated with complete respect by the scientists at the lab. This inequity bothered John because, I believe, he felt a person should be treated with respect, irrespective of economic or social status. In any event, Remi's wife had their first child at the beginning of our two-week stay. We met him the first day and he was then gone for 5 days on leave, coming back two days early to help at the beginning of our experiment. On our last day, when we said goodbye to Remi, John gave him a greeting card, which included the equivalent of \$100 in French francs for a baby gift, and a note to Remi's wife telling her how much help Remi had been to us and thanking her for the sacrifice they both made by Remi coming back to the lab early. Remi was clearly touched by John's generosity and the note to his wife; I suspect he could not believe a scientist, and a well-connected one from America at that, would do such a thing.

I worked with John at the twilight of his career and was the sole benefactor of much of his time. I often marveled at his desire to continue to remain scientifically active after he retired. John refused to surrender to old age, refused to let his mind or body go. I feel very fortunate to have been his student and his friend.

Brent J. Heuser
Dept. Nuclear, Plasma, & Radiological Engineering
University of Illinois
Urbana

David Wehe

JSK: The Elegant Gentleman Scientist

I was a 17-year-old freshman who happened to wander into an open building and knocked on the first door I saw. The tall and stately gentleman who sat behind the desk, John King, stood and extended a welcome hand. It was the start of a 40-year relationship that extended from the classroom, to the laboratory, to the tennis courts, and beyond, and would teach me, like many others who were blessed to know him, not just how to be a scientist, but more importantly, how to live life.

Professor King didn't tell his students or colleagues how to live their lives—he lived his and we admired what we saw and tried to emulate him. It was not just his brilliance or work ethic or the respect that other revered professionals showed him—it was the charisma that someone who lives by high standards exudes: honor, integrity, the importance of keeping truth and beauty in life, the expectation of excellence in one's self but the acceptance of less from others, the pure joy of personal discovery, the comradeship of friends and sharing their feelings, meeting hardship head-on with quiet dignity, humility, and an unyielding personal commitment to family and profession.

Two of his favorite relative words were “spectacular” and “feeble”—the former used when describing others' comparative accomplishments and the latter used in reference to himself (e.g., used prior to your humiliation on the tennis or squash court). In actuality, we all knew that he had these terms reversed.

There is a crater-sized hole in all of our lives and hearts formed by his passing. In our last conversation a few months ago, he told me that the present should be considered as that, i.e., a present—a gift—that should be embraced, appreciated, and not squandered. He was our professor—our teacher—to the end. We will pass his lessons and legends along to the next generations, but we will miss him dearly for the rest of our days.

Thank you Professor King.

Prof. David K. Wehe
College of Engineering
Department of Nuclear Engineering and Radiological Sciences
University of Michigan
Ann Arbor

(as presented at the memorial service for John, St. Andrew's Episcopal Church, September 21, 2007)



Jens Zorn, May, 2000



UM Nuclear Engineering and Radiological Sciences

University of Michigan Department of Nuclear Engineering, 1988

Left to right, first row: Zia Akcasu, Chihiro Kikuchi, Mary Brake, John King, Terry Kamash, David Wehe.

Second row: Glenn Knoll (Chair), Dieter Vincent, Ron Gilgenbach, Bill Martin, Michael Atzmon, John Lee.

Top row: Bill Kerr, Gary Was, George Summerfeld, Mike Williams, Ed Larsen.

KING, John S.
Professor of Nuclear Engineering
The University of Michigan

*Resume, c. 1992, with thanks to Brent Heuser
for several more recent entries*

DATES OF APPOINTMENT TO VARIOUS ACADEMIC RANKS AT THE
UNIVERSITY OF MICHIGAN:

Associate Professor	1959
Professor	1962
Chairman	1974–1979
Professor Emeritus	1989

EDUCATION:

B.A. (Political Science), Princeton University, 1942
B.S.E. (Physics), The University of Michigan, 1948
M.A. (Physics), The University of Michigan, 1949
Ph.D. (Physics), The University of Michigan, 1953

FULL-TIME INDUSTRIAL EXPERIENCE:

Research Associate, General Electric Company, Knolls Atomic Power Laboratory (KAPL), 1953–1955
Supervisor, Critical Experiments (KAPL), 1955–1957
Manager, Reactor Physics (KAPL), 1957–1959

CONSULTING:

General Electric Company (KAPL), Neutron Physics, 1959–1966
U.S. Atomic Energy Commission (USAEC), Washington, D.C., Education Division,
Education Grants, 1966–1967
Argonne National Laboratory-Argonne Universities Association (ANL-AUA)
Applied Physics Division Review Board, 1971–1976, Chairman, 1975, 1976
Pennsylvania State University Press, 1972–1973
John Wiley and Sons, 1975
Site Review Committee Chairman, University of Missouri Research Reactor, May 1980

SCIENTIFIC AND PROFESSIONAL SOCIETIES OF WHICH A MEMBER:

American Physical Society (APS), Fellow
American Nuclear Society (ANS), Fellow
ANS Board of Directors, 1976–1978
ANS Physics Division, Program Committee, Past Member
ANS Physics Division, Honors and Awards Committee, Past Chairman
ANS Education Division, Honors and Awards Committee, Past Member
American Chemical Society, Associate Member

SERVICE ON U.S. TECHNICAL COMMITTEES:

Fellowship Committee, National Academy of Sciences, 1967–1970
Argonne Committee on Intense Neutron Sources (CINS), Member, 1968, 1969
Nuclear Physics Panel, Subcommittee Member, Physics Survey Committee, National Academy of Sciences,
1969–1970
Biology-Polymer Subpanel on Low and Medium Energy Neutrons, National Research Council,
Assembly of Mathematics and Physical Sciences, 1977–1978
Invited speaker, National Science Foundation (NSF) Workshop “Small Angle Neutron Scattering,”
Washington APS Meeting, March 30–31, 1978
Users Committee, Executive Committee Chairman, National Center for Small Angle Scattering Research
(NCSASR), 1979–1981
Site Review Committee Member, Oak Ridge National Laboratory (ORNL), National Center for Small
Angle Scattering Research, NCSASR, July, 1980

COMMITTEE ASSIGNMENTS IN DEPARTMENT, COLLEGE, AND THE UNIVERSITY:

Nuclear Engineering Department, Executive Committee, Member, 1963–1972, 1979–1983
Nuclear Engineering Department, Fellowship Committee, Chairman, 1964–1972
The University of Michigan, Reactor Advisory Committee, Member, 1965–1985
Engineering College, Honors and Awards Committee, Member, 1969–1970, 1984–85
Nuclear Engineering Department, Ad Hoc Departmental Review Committee, Chairman, 1970
Rackham Divisional Board for Physical Science and Engineering, Member, 1970, 1971, 1972, 1973;
Chairman, 1972–1973
Rackham Nominating Committee for Rackham Graduate School
Executive Committee and Divisional Board nominations, Member, 1972–1973
Nuclear Engineering Department, Ad Hoc Review Committees:
Promotion of John Lee to Full Professor, Chairman, 1980–1981
3-Year Review of Assistant Professor Gary Was, Chairman, 1982
Promotion of Assistant Professor Ron Gilgenbach, Chairman, 1983
Promotion of Assistant Professor Gary Was, Chairman, 1984
Tenure Review Committee for Associate Professor Gary Was, Chairman, 1985
Nuclear Engineering Department, Ad Hoc Departmental Review Committee, Member, 1984
Executive Committee, Engineering College, 1987
Executive Committee, Applied Physics Program, 1987

SABBATICAL LEAVE:

University of Missouri at Columbia. One-half time appointment in the Physics Department and one-half time appointment at the Missouri University Research Reactor, 1976–1977

RECENT ACTIVITIES OUTSIDE OF ACADEMIC APPOINTMENTS:

(Summer conferences, lectures, special assignments, etc.)

Lecturer, Engineering Summer Conference, “Radiation Effects in Semi-Conductors,” 1967
Discussant, Gordon Research Conference, “Infra-Red Spectra,” 1968
International AEC Summer Institute, “Neutron and X-Ray Diffraction and Related Techniques in Chemical and Biological Problems,” Massachusetts Institute of Technology (MIT), August 6–10, 1973
Speaker, Gordon Research Conference, “Polymer Chemistry,” 1976
Study Group Member, Energy Research and Development Administration (ERDA) Materials Sciences Workshop, “X-Ray, Neutron, and Electron Scattering,” ORNL, April 13–15, 1977
Invited speaker, American Crystallographic Association, Workshop on Small Angle Neutron Scattering, University of Missouri, March 1983
Physics Department Solid State Seminar, Iowa State University (Ames), March, 1983
Member, Technical Program Committee, and Session Chairman, International Symposium on the Use and Development of Low and Medium Flux Research Reactors, MIT, October 16, 1983
Invited speaker, NCSACR Users Meeting on Small Angle Scattering, ORNL, April 30, 1984
Supported participant, User Workshop for New High Flux Reactor Project, ORNL, May 30, 1984
Planner and organizer, University-wide Lecture Series, “Symmetry and Imperfections in the Solid State,” given by Distinguished Visiting Scholar Dr. Ganesan Venkataraman, September–December, 1985
Invited/supported participant, National Bureau of Standards (NBS) Workshop on Design Requirements for new U.S. High Flux Research Reactor, December 16–17, 1985
Session Chairman, International Conference on Applications and Techniques of Small Angle Scattering, Argonne National Laboratory, October 26–29, 1987

PRINCIPAL RECENT PUBLICATIONS:

“Neutron Scattering in Stretch-Oriented Polyethylene,” (with W. Myers and G. C. Summerfield), Journal of Chemical Physics, 44, No. 1, pp. 184–187 (January 1, 1966)

“Propagation of Bragg-Reflected Neutrons in Bounded Mosaic Crystals,” (with S. A. Werner, A. Arrott, and H. Kendrick), Journal of Applied Physics, 37, No. 6, pp. 2343–2350 (May, 1966)

“Fast Neutron Spectra in Water and Graphite,” (with L. Harris and G. Sherwood), Nuclear Science and Engineering, 26, No. 4, p. 571 (December, 1966)

“Neutron Scattering in Normal and Deuterated Polyethylene,” (with J. E. Lynch, G. C. Summerfield, and L. A. Feldkamp), Journal of Chemical Physics, 48, No. 2, pp. 912–917 (January, 1968)

“Lattice Dynamics of Cubic Zinc Sulfide,” (with L. Feldkamp and G. Venkataraman), Solid State Communications, 7, pp. 1571–1573 (1969)

“Rapid Inverting of the Polarization of a Neutron Beam Using Large Amplitude Oscillating Magnetic Fields,” (with H. Kendrick, S. Werner, and A. Arrott), Nuclear Instruments and Methods, 79, No. 1, pp. 82–92 (1969)

“Neutron Scattering in Deuterated Polyethylene,” (with L. A. Feldkamp), Molecular Dynamics and Structures of Solids, U. S. Department of Commerce, National Bureau of Standards Special Publication 301, edited by R. S. Carter and J. J. Rush, pp. 543–546 (June, 1969)

“Dispersion Relation for Skeletal Vibrations in Deuterated Polyethylene,” (with L. A. Feldkamp and G. Venkataraman), Neutron Inelastic Scattering, the Fourth International Atomic Energy Agency (IAEA) Symposium, Copenhagen, Denmark (May 20–25, 1968)

“Lattice Dynamics of Cubic Zinc Sulfide by Neutron Scattering,” (with L. A. Feldkamp, D. Steinman, N. Vagelatos, and G. Venkataraman), Journal of Physics and Chemistry of Solids, 32, pp. 1573–1583 (1971)

“Crystal Structure Refinement of SrMoO₄, SrWO₄, CaMoO₄, and BaWO₄ by a Neutron Diffraction,” (with E. Gurmen and E. Daniels), Journal of Chemical Physics, 55, No. 3, pp. 1093–1097 (August 1, 1971)

“External Modes in CaWO₄,” (with D. K. Steinman and H. Smith), Paper IAEA/SM-155/B-4, Neutron Inelastic Scattering, Grenoble, France (March 6–10, 1972)

“Neutron Spectroscopy in Chain Polymers—A Critical Review of Polyethylene,” Chapter VII of Neutron, X-Ray, and Laser Spectroscopy in Chemistry and Biology, edited by S. Chen and S. Yip, Academic Press (1974)

“Phonon Dispersion and Phonon Densities of States of ZnS and ZnTe,” (with N. Vagelatos and D. Wehe), Journal of Chemical Physics, 60, No. 9, pp. 3613–3618 (May 1974)

“Neutron Scattering from Polymers,” Journal of Macromolecular Science B: Physics, 12, p. 13 (1976)

“Investigation of Heterogeneities in Solid Polyethylene by Small Angle Neutron Scattering,” (with R. Ullman and G. C. Summerfield), Journal of Polymer Science B: Polymer Physics, 15, pp. 1641–1646 (1977)

“An Inexpensive Method for Testing Position Sensitive Particle Detectors,” (with R. Berliner and D. F. Mildner), Nuclear Instruments and Methods, 152, p. 431 (1978)

“Small Angle Neutron Scattering from Solution-Crystallized and Melt-Crystallized Polyethylene,” (with G. C. Summerfield and R. Ullman), Fourth International Conference on Small Angle X-Ray and Neutron Scattering, Gatlinburg, Tennessee, October 1977, published in Journal of Applied Crystallography, 11, pp. 548–551 (1978)

“Neutron Scattering from a Solution of a Polymer in a Polymer. The Effect of Long-Range Heterogeneities,” (with G. C. Summerfield and R. Ullman), Macromolecules, 11, p. 218 (1978)

“Small-Angle Neutron Scattering,” Chapter 5.4 in Methods of Experimental Physics—Polymer Physics, Vol. 16A, edited by R. Fava, Academic Press, Inc. (1980)

“He-Release from Copper,” (with D. Myers, W. Halsey, and D. Vincent), Radiation Effects, 51, pp. 251–252 (1980)

“The Technique of High Concentration Tagging in SANS: R_g for Bulk Polystyrene,” (with C. Tangari, G. C. Summerfield, R. Berliner, and D. Mildner), Macromolecules, 13, pp. 1546–1548 (1980)

“A Large Area Position Sensitive Detector,” (with R. Berliner, D. F. R. Mildner, and O. A. Pringle), in Nuclear Instruments and Methods, 185, pp. 481–495 (1981)

“The Small Angle Neutron Scattering Spectrometer at the University of Missouri Research Reactor,” (with D. R. Mildner, R. Berliner, and O. A. Pringle), in Journal of Applied Crystallography, 14, pp. 370–382 (1981)

“Small Angle Neutron Scattering on Bulk Polystyrene with Mismatched M_w ,” (with C. Tangari and G. C. Summerfield), Macromolecules, 15, pp. 132–136 (1982)

“Multiple Scattering in Small Angle Neutron Scattering Measurements on Polymers,” (with P. S. Goyal and G. C. Summerfield), Polymer, 24, pp. 131–134 (1983)

“Measurements of Polymer Solutions by High Concentration Labeling,” (with W. Boyer, G. D. Wignall, and R. Ullman), Polymer Preprints, 24, No. 2 (August 1983), American Chemical Society, Invited Speaker

“Radii of Gyration and Screening Lengths of Polystyrene in Toluene as a Function of Concentration,” (with W. Boyer, R. Ullman, and G. D. Wignall), Macromolecules, 18, No. 4, pp. 709–717 (1985)

“The Influence of Localized Stresses and Strains on the Iodine SCC Behavior of Zircaloy-2 Tubing,” (with B. N. Nobrega, R. B. Adamson, and G. S. Was), Journal of Nuclear Materials, 131, pp. 126–135 (1985)

“Improvements in the Design and Analysis of the Segmented Expanding Mandrel Test,” (with B. N. Nobrega, G. S. Was, and S. B. Wisner), Journal of Nuclear Materials, 131, p. 99 (1985)

“The Concentration Dependence of Dimensions of Flexible Polymer Molecules in Solution,” (with W. Boyer, G. D. Wignoll, and R. Ullman) Physical Optics of Dynamic Phenomena and Processes in Macromolecular Systems, edited by B. Sedlacek, Wolter de Gruyter and Co., Germany (1985)

“Concentration Effects in Polymer Solutions as Illuminated by Neutron Scattering,” (with H. Benoit and R. Ullman), Macromolecules, 19, pp. 183–188 (1986)

“Intramolecular and Intermolecular Interactions in Polystyrene Solutions,” (with R. Ullman), Physica, 136B, pp. 210–212 (1986)

“Forward Scattering of 4.75 Å Neutrons in Hydrogenous Liquids,” (with W. Boyer), Journal of Applied Crystallography, 21, pp. 812–822 (1988)

- “SANS Measurement of Deuterium-Dislocation Correlation in Palladium,” (with B. J. Heuser, G. C. Summerfield, and J. E. Epperson), Neutron Scattering for Materials Science, Materials Resource Society (MRS) Symposium Proceedings, 166, p. 273 (1990)
- “Small Angle Neutron Scattering from Bimodal Melts of Polystyrene,” (with C. Tangari, R. Ullman, and G. D. Wignall), Macromolecules, 23, No. 25, pp. 5266–5269 (1990)
- “Nuclear Fusion from Crack-Generated Particle Acceleration,” (with Frederick J. Mayer, and John R. Reitz), Journal of Fusion Energy, 9, No. 3, pp. 269–272 (1990)
- “SANS Measurements of Deuterium Trapping at Dislocations and Grain Boundaries in Palladium,” (with B. J. Heuser, G. C. Summerfield, J. E. Epperson, and F. Boue), Acta Metallurgica et Materialia, 39, No. 11, pp. 2815–2824 (1991)
- “Absolute Measurements of Neutron-Spectra in High-Enriched and Low-Enriched Uranium Materials Test Reactor-Fuel,” (with D. K. Wehe and T. J. Schmidt), Nuclear Science and Engineering, 110, No. 1, pp. 56-78 (1992)
- “SANS Observation of Deuterium Trapping at Grain Boundaries in Pd,” (with B. J. Heuser, and G. C. Summerfield), Defect-Interface Interactions, Materials Resource Society Symposium Proceedings, 319, p. 339 (1994)
- “SANS Measurements of Deuterium-Dislocation Trapping in Deformed Single Crystal Pd,” (with B. J. Heuser), Journal of Alloys and Compounds, 261, pp. 225–230 (1997)
- “Effect of Dislocation Trapping on Deuterium Diffusion in Deformed, Single Crystal Pd,” (with B. J. Heuser), Metallurgical and Materials Transactions A, 29A, pp. 1593–1598 (1998)
- “Small-Angle Neutron Scattering Measurements of Deuteride Formation in Single Crystal Pd,” (with B. J. Heuser and W. C. Chen), Journal of Alloys and Compounds, 292, pp. 134–147 (1999)
- “SANS Investigation of Deuteride (Hydride) Precipitation and Decomposition Morphology in Single Crystal Pd,” (with W. C. Chen, and B. J. Heuser), Journal of Applied Crystallography, 33, pp. 442–446 (2000)

CONFERENCE PAPERS:

- “U-235 Fission Spectrum Measured from Reactor Neutrons to 20.0 MeV,” (with G. C. Sherwood), Transactions of the American Nuclear Society, 10, No. 2, p. 555 (November 6, 1967)
- “Lattice Dynamics of ZnTe and the Significance of Shell Model Calculations,” (with N. Vagelatos and L. Feldkamp), Bulletin of the American Physical Society, (presented at San Diego Meeting APS, March 19–22, 1973)
- “Neutron Spectroscopy for Polymer Systems,” Polymer Preprints, 15, No. 2 (September 1974)
- “Small Angle Neutron Scattering from Polyethylene,” (with G. C. Summerfield and R. Ullman), Polymer Preprints, 16, No. 2 (August 1975)
- “Small Angle Neutron Scattering from Polymers,” invited talk, Gordon Research Conference on Polymer Chemistry, Andover, New Hampshire (1976)
- “Small Angle Neutron Scattering of High Polymers,” (with R. Ullman), invited talk, American Chemical Society, Chicago, September 1977, Polymer Preprints, 18, No. 2, p. 131 (August 1977)

“Neutron Scattering of Polyethylene,” (with R. Ullman and G. C. Summerfield), Bulletin of the American Physical Society, 22, p. 258 (1977)

“Design and Preliminary Test of a Large Area Position Sensitive Neutron Detector,” (with R. Berliner, D. F. Mildner, R. M. Brugger, S. A. Werner, W. B. Yelon, and O. A. Pringle), Bulletin of the American Physical Society (March, 1978)

“Comparison of Small Angle Neutron and X-Ray Scattering on Polyethylene,” (with S. J. Bai, G. C. Summerfield, J. E. Anderson, R. Ullman, P. Chumbley, and P. N. Schmidt), Bulletin of the American Physical Society, 24, No. 3 (March 1979)

“Neutron Scattering from Thermally Annealed Polyethylene,” (with S. J. Bai, G. C. Summerfield, J. E. Anderson, and R. Ullman), Bulletin of the American Physical Society, 24 (March 1979)

“Concentration Dependent Thermal Release of Helium Implanted in Molybdenum,” (with W. Halsey), TMS-AIME (The Minerals, Metals & Materials Society - American Institute of Mining, Metallurgical and Petroleum Engineers) Fall Meeting, Milwaukee, Wisconsin (September 16–20, 1979)

“Thermal Flux Distributions from Rhodium SPND in Research Reactors,” (with D. Wehe, and K. Flint), Transactions of the American Nuclear Society, Las Vegas, Nevada (June 1980)

“Inverse Kinetics Analysis of Rhodium SPND for Thermal Flux Mapping,” (with D. Wehe, J. Carpenter, and R. Fleming), Transactions of the American Nuclear Society, 35, p. 571 (November 1980)

“SANS with Mismatched Marked and Normal Chains,” (with C. Tangari and G. C. Summerfield), Bulletin of the American Physical Society, 26, No. 3, p. 364 (March 1981)

“Ford Nuclear Reactor High Enrichment/Low Enrichment Demonstration Experiments—Part I,” (with D. K. Wehe), International Meeting on Research and Test Reactor Core Conversion from HEU to LEU Fuels, Argonne National Laboratory, Argonne, Illinois (November 8–10, 1982)

“Small Angle Neutron Scattering on Bimodal Melts of Polystyrene,” (with C. Tangari, B. Hammouda, Z. Akcasu, G. C. Summerfield, and G. Wignall), Bulletin of the American Physical Society, 28, No. 3, p. 405 (March 1983); also published in American Crystallographic Association, II, No. 1, p. 18 (March 14–18, 1983) Winter Meeting, Columbia, Missouri

“The Analysis of SANS Experiments on Polymers,” (with R. Ullman, W. Boyer, and G. D. Wignall), Bulletin of the American Physical Society, 28, No. 3, p. 437 (March 1983)

“Subcadmium Flux Measurements in HEU and LEU Cores Using Rhodium SPND and Wire Activation,” (with D. Wehe, C. R. Drumm, J. C. Lee, W. R. Martin, and M. M. Bretscher), International Symposium on Use and Development of Low and Medium Flux Research Reactors, MIT, Cambridge, Massachusetts (October 17–19, 1983)

“Influence of Localized Stress-Strain State on the Iodine-SCC Behavior of Zircaloy-2 Tubing,” (with B. Nobrega, R. Adamson, and G. Was), Transactions of the American Nuclear Society, New Orleans, Louisiana (June 1984)

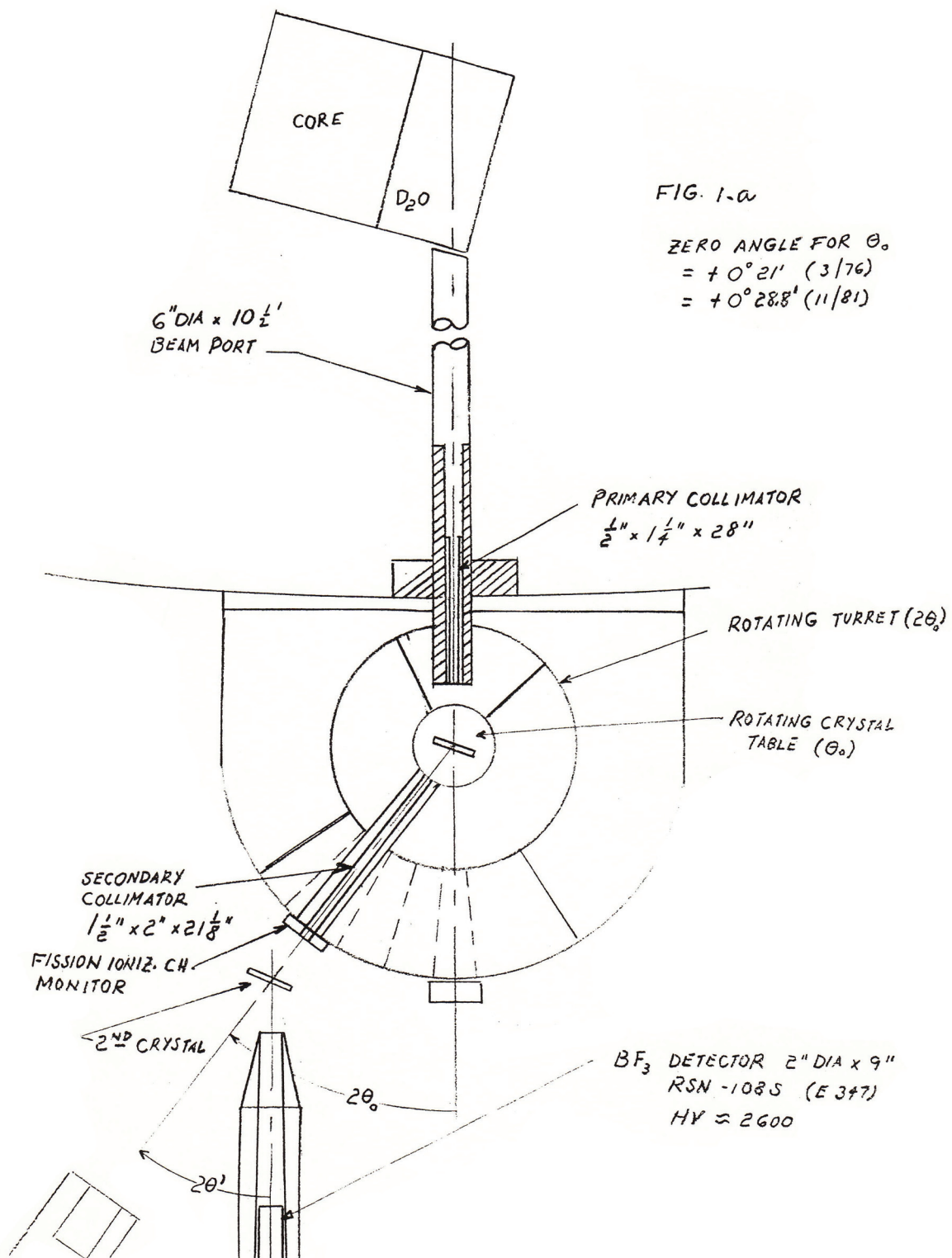
“The Concentration Dependence of Dimensions of Flexible Polymer Molecules in Solution,” (with W. Boyer, G. D. Wignall, and R. Ullman), International Union of Pure and Applied Chemistry (IUPAC) meeting, Prague, Czechoslovakia (July 1984)

“Neutron Scattering Measurements of Intermolecular Interactions in Polymer Solutions,” (with G. C. Summerfield, and R. Ullman), Polymer Preprints, 25, No. 2, pp. 140–142 (August 1984), American Chemical Society

“Dislocation-Hydrogen Correlations in Metals,” (with G. C. Summerfield, B. Heuser, and J. E. Epperson), International Conference on Applications and Techniques of Small Angle Scattering, Argonne National Laboratory, Argonne, Illinois (October 26–29, 1987)

“Forward Scattering of 4.75Å Neutrons in Hydrogenous Liquids,” (with W. Boyer), International Conference on Applications and Techniques of Small Angle Scattering, Argonne National Laboratory, Argonne, Illinois (October 26-29, 1987)

“Hydrogen-Dislocation Correlation in Palladium,” (with B. J. Heuser and G. C. Summerfield), presented by J. S. King at 1990 TMS-ASM (The Minerals, Metals & Materials Society - American Society for Metals) Fall Meeting: session “Application of Neutron and X-Ray Scattering of Materials Problems III,” (October 7–11, 1990)



Schematic diagram of an experimental setup on the beam-hole floor, G-port, Ford Nuclear Reactor, John S. King, undated

Days and Nights of Neutron Scattering Research at the FNR

John S. King
Nuclear Engineering and Radiological Sciences
University of Michigan
Ann Arbor, MI 48109-2104

During the interval of approximately 1960 to about 1980, the FNR was host to the birth, life, and then slow decline of a wonderful confluence of excited people and exciting experiments. The excited people included NE faculty and visiting scientists, and, over the years, some 26 remarkable graduate students. From ground zero spectrometers were designed, built, and put into operation at A, F, G, H and J ports. A few of the students were theorists; but most had to master daunting experimental techniques and at the same time be able to exploit the new generalized neutron scattering theory¹. PML and the FNR beam port floor were lighted 24 hours a day, and the population was about the same at 2:00 AM as at 2:00 PM. The confluence brought together an unusual collaboration between theorists and experimentalists because the neutron data were complex and depended strongly on theoretical calculation. Excellent contact developed with an international community of spectroscopists, three UM international symposia were orchestrated by NE's Paul Zweifel in Michigan, and for many years a graduate seminar course pulled in an audience of 20 to 25 people to learn how to use quantum mechanical and group theoretical techniques to interpret scattering data. The best lectures were often those prepared by our students! It is fair to say that in that atmosphere, the UM-NE/FNR program took its place among the leading world laboratories in neutron spectroscopy.

Why was there such excitement? I believe there were three key reasons. Foremost was our recognition, along with the rest of the world, that thermal neutrons possessed unique properties for probing condensed matter, which conventional probes, i.e. Raman scattering, x-ray scattering, infra-red absorption, electron spectroscopy, and NMR- did not have. Those properties will be recalled briefly in this talk. Second, the necessity to manage both instrumentation and complex theory at the same time had great intellectual appeal. Third, new experimental methods, particularly TOF phased choppers and the "constant-Q" technique for triple-axis crystal spectrometers were just being published, and we were eager to emulate them. I might add a fourth reason which I am sure will beg some disagreement: our choice of experiments was "wide open"; there were not many restrictions required by "programmatic" or "strategic" research funding in those days.

What scattering experiments were done? A broad spectrum of experiments were undertaken. Elastic and inelastic scattering measurements were made on pressurized molecular gases, on molecular liquids, and on crystalline and glassy solids. Crystal structures for simple metals and for complex molecular crystals were observed by Bragg diffraction. Both coherent and incoherent inelastic scattering was done on semiconductors and on polymers. Aniferromagnetism was characterized in chromium and in metal oxides. Inelastic experiments at a 1.0 to 2.0 Mw light water reactor took blind faith and heart. We had some of both.

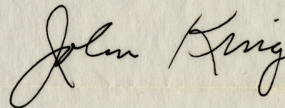
What did we accomplish? A number of physical or chemical parameters, which have withstood the test of time, were established for the first time by these experiments. A number of important experimental innovations were created as well. This paper will attempt to list them. But surely the greatest contribution was to give 26 great students an extraordinary education.

1. A. C. ZEMACH and R. J. GLAUBER, *Phys. Rev.*, **101**, No. 1, 118 (1956)

TO HELEN WITH GRATITUDE, August, 2000

For 39 years- almost all my years in NE and within Phoenix, there has been Helen Powers, then in 1967 Helen Lum. Many people leaned on Helen, Bill Kerr, Lenny Greenbaum, certainly JSK, Glenn Knoll, later Ron Fleming, and John Lee, and over the years, some 500 graduate students. That happened because Helen always made herself available to help solve YOUR PROBLEM! She was never an administrative barrier, never disinterested, never too busy to attack your problem with you. It was the kind of professional support every chairman, every director, every faculty, indeed every student prays for but rarely finds. Along the years she learned many people skills, and these just added to her indispensability. Yet she was always modest, always quiet about her role and her wise council. After all YOU were running the show, right? Yeah, right!

It is difficult for us old hands to see how we can now manage anything at all without being able to turn to Helen. It is a huge understatement to say she will be missed!

A handwritten signature in black ink, reading "John King". The signature is written in a cursive style with a large, stylized "J" and "K".

Lester Van Winkle

Remembering JSK

Considering what very few hours I spent in John King's presence, I am amazed at the depth and quality of our friendship. Instantaneous rapport is rare in my life. I think this was not true for John, for he never seemed the least surprised at our friendship. Women I love loved John and found him a courtly gentleman. I found him as clear and honest as a farmer. His intelligence could be startling, his focus unswerving, yet his wit and humor were absolutely robust and endearing. I recall our first meeting in his daughter's loft and our immediate, long conversation concerning boats, the sea, and our love of sailing. I recall our farewells: John standing in the afternoon sunlight as serious and straight as Horatio Hornblower and warm and friendly as Lucky-Jack Aubrey. Regretfully, we never had our sail, but we had our correspondence and an occasional phone conversation to remind one another that the mystery of friendship had not eluded us.

The shade of John King's being soothes my loss and keeps his image fresh in my memory. Yet the planet is a lonelier place without friend John. He was my kind of guy. And the thought that I shared equal status in his esteem is ultimate flattery.

Lester Van Winkle
Deltaville, VA

Bill Heider

John King was a friend for many years. We first met when he joined our French class in preparation for one of his several trips to the Institute for Atomic Energy near Paris. The class is called Conversational French and each Wednesday, a group of seniors of interesting backgrounds meet and give little talks mostly based on their life experiences. The stories inevitably reveal a great deal about the speaker. In John's case it was soon obvious that he was no ordinary Francophile, whether he spoke of his work on early atomic submarines, his visits to France, or his travels. One humorous tale involved John's attempts to bypass French bureaucrats and get some scientific equipment out of his lab under cover of night, only to find himself stranded, miles from nowhere, waiting hours for the arrival of a mechanic after the key to his rental car had broken off in the door lock.

In his scientific work he always tended to give credit to others. The full scope of his extraordinary achievements did not become clear to us until we read his obituary. In talks of a more personal nature John revealed his total devotion to his family, especially his wife during her prolonged illness. When John was no longer able to attend the class we maintained contact and managed to have long lunches at a favorite restaurant, usually in company with his dear sister-in-law, Nancy Chickering.

The French Class has over the long years of its existence become almost family. Given the average age of the group, losses are inevitable and deeply felt. None, however, was as wrenching as John's passing. He left a gaping space among us and will be sorely missed, but not forgotten. Instead of "Goodbye, dear John" we wish him a heartfelt "Au Revoir!"

Bill Heider
Friend, classmate
Ann Arbor

(as presented at the memorial service for John, St. Andrew's Episcopal Church, September 21, 2007)



John King and Joan Matthews, Paris, 2002



Denver, Colorado, May 2003

Left to right, first row: John Wheaton, Kim Wheaton, Henry Wheaton, Abigail Nowell, Peter Nowell, Susan Matthews Brown.

Second row: John King, Joan Matthews, Tom Nowell, Cary Nowell, Peter Matthews.

Third row: Willy Matthews, Audrey held by Poppy Wheaton Bernasek, Liz King, Lara Becker, Roger Brown.

Top row: Tim Bernasek, Will Wheaton, Alistair Matthews, Austin Matthews.

Frieda H. Morgenstern

On the occasion of John King's move
to University Commons, 2004

That man so diligently washing wine glasses so they wouldn't break in the dishwasher at a recent Common time is a most welcome new resident, John Swinton King, a UM emeritus professor. John studied politics at Princeton, worked in applied physics at Johns Hopkins during the war and earned his PhD in physics at Michigan in 1953. He later was at GE's Knolls Atomic Power Lab where he was made Manager of Submarine Reactor Physics.

Coming back to Michigan in 1959 and, in his own words, "succumbing to an irresistible offer of twice the work at half the pay," he became a full professor and chairman of the Department of Nuclear Engineering. He has served on various scientific committees, including the National Research Council.

He and the former Elizabeth Chickering were married in 1943 in Detroit. She died in 1985. Their son John, Jr., who lives in England, has a PhD in chemical physics and is an editor; daughter Frances is an editor and writer living in Marblehead, Mass., and daughter Elizabeth is a sculptress in Richmond, Va. There are four grandchildren, two of whom are adopted from China.

Frieda H. Morgenstern

Friend, Resident, University Commons

Bill Stebbins

John King, Neighbor, Colleague, and Good Friend

My wife and I first met John many years ago in a French class for seniors taught under the auspices of the Ann Arbor Recreation Department and very helpful for people planning a trip to France. We had all taken French in college but were obviously in need of a refresher. Years later John moved to University Commons, a senior retirement community for alumni and faculty at the University of Michigan over 55 years of age. Katie and I had moved in a few years earlier. In no time we were enjoying each other's company again. John had a frank and open manner and was always very approachable. We had in common a career on the faculty at Michigan, a love of sailing, and a broad interest in scientific and political issues.

We folks at the Commons are sometimes reserved and may be unintentionally a bit clannish. We take dinner with those we know and sometimes exclude the single newcomer in preference to those with whom we are already acquainted. John in his early days at the Commons experienced that "no room at the table" response and was deeply offended. Since we knew him, he often ate with us, and this, of course, gave him the opportunity to meet others, and in a short time the problem disappeared. He was invited and sought after. Why? Perhaps it was that wry smile of his that won us over. He was a good listener. He was engaging. But more important, he had a great deal to offer in a thoughtful and articulate manner. John was just that sort of interesting, charming (in the best sense of that word) and friendly, not effusively so but in his often tempered and quiet way.

We will miss John; he had become an integral and significant part of our community and we had recently elected him to our Board of Directors—a measure of the respect and popularity that he had earned from all of us in his short tenure at University Commons.

Bill Stebbins

Friend, neighbor

University Commons

Ann Arbor

Bette Michael

It's nearly what would've been your 86th birthday, and almost two months since you departed this earth. I've struggled with putting some feelings and thoughts about our four-year friendship and your final days to paper. It's still hard, but here goes.

What are some words and phrases that describe the John King I knew?

First and foremost, he was a family man
Loved his three children, bragged about them often
Missed his wife Betsy whom he adored
Strong-willed and sometimes stubborn
Gracious and gentle
VERY intelligent, but sly about letting you know it
Enjoyed a good joke
Modest
Friendly
Caring
Courageous
Frugal
Reclusive
Lonely
Stoic in pain
Avoided conflict, he was a fixer
Accepted help, but never asked for it
Loved strawberry shortcake

Some memories: I can still see you sitting by my fireplace as we often talked about meaningful things like our families, our kids and how we got where we were, around my dinner table as we settled political and community issues, laughing as you sprayed whipped cream in my kitchen because you (an engineer) didn't have the beaters in securely, standing at the bar in the Brass Rail Café sharing a glass of wine, then sitting around after Common Time when everyone had already left and talking some more, watching as you walked the University Commons grounds and asked all of us if there were any concerns or problems that you could help with, driving to the Oncology Department at U Hospital for your "witch's brew" when you'd let me do that, sitting with you at lectures, concerts and resident meetings. Listening to your introduction of Elizabeth at a 5 o'clock talk. And looking at you in utter amazement at a community meeting just two days after your brain surgery! John, you were a shoo-in candidate for our Board of Directors, and I was delighted that you agreed to run despite your medical condition at the time. You loved life and lived until you died. What a guy!

I'm sad that we never got around to having that cup of tea in your apartment or lunch at Schoolcraft College. Or got to the Humanities Weekend or to see the Capitol Steps together. I wish I could've worked a miracle for you.

So, au revoir, dear John.

Your loving friend,

Bette Michael
Friend, resident
University Commons
Ann Arbor

Charles Kelly

Anything I might say out of friendship, respect, and admiration for your father would be lost in a very large number of similar thoughts. Therefore, I will simply remind you of my most unique moments with John King, moments that reflect on a lifetime of good will. He was my guest at a very nice event over in Grosse Pointe, and I was introducing him to Lin Morison. I got to the point where I announced that he was the retired chair of the Nuclear Engineering Department of the U of M, and my dear friend Lin cut me off. In a flash of recognition she said, "Cut out the schmaltz, I know this man. It is Johnny King. I played with American Flyer trains with John and his brother when we were ten." The two of them had not seen each other in 70 years. Of course, they were inseparable for the balance of the evening, and I am still hearing about it whenever I am over on that side of town. Also, that evening, your father and John Rather, the respected astrophysicist, became acquainted. Those two hit it off famously, and Dr. Rather always hoped he would have the pleasure of spending more time with your father. Rather said something that was similar to what Samuel Johnson said of Edmund Burke. The essence of it was that even if you had just met this man and spent a little time with him, you would have the feeling that you had met a remarkable person.

Chuck Kelly
Friend, resident
University Commons
Ann Arbor

Diane Kirkpatrick

These few words are created to share with John's children and their families a bit about the man who was my chum and neighbor for a few years at University Commons.

To find a new friend late in life is a special blessing. John King bestowed that gift on many in the University Commons Community during his years here. An intensely private man, who yet is remembered for his welcoming smile and apparent openness to each of us, I suspect John, by the time he arrived in our midst, had become a master at beaming aspects of his being at each person through a separate facet of his outer cover. Speaking to others in our community since John's death, I find that each person seems to feel they knew him best, enjoyed a special rich relationship with him, and thus miss him perhaps most of all community members. What an incredible legacy to leave. And each seems to have been with a rich but different person than the guy I got to hang out with on occasion.

John learned I was an art historian, and discussed with me images of his daughter Elizabeth's art work, then when I had read some essays, some of her published ideas. He showed me other works by the California-based woman he proudly proclaimed his fiancé, and proudly introduced me to her when she paid a brief visit. When I wanted some information on global warming, John suggested a colleague to give a presentation. After the talk, he complained to me that it really wasn't targeted well for our audience and lent me a book with marked pages that would put the argument clearly, which it did.

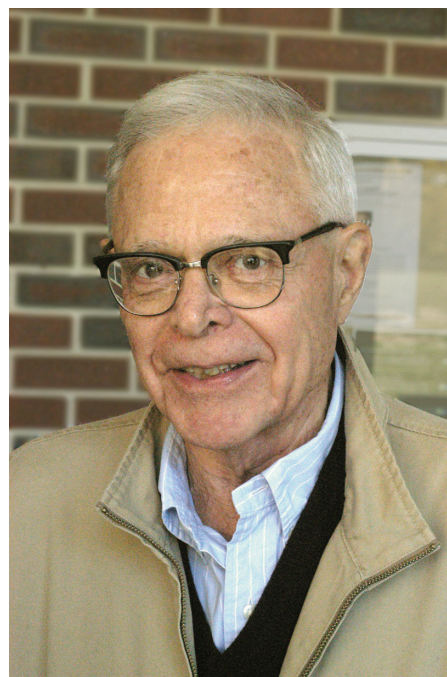
John became one of the most faithful attendees at the computer sessions I offered for Commoners who wished to learn to use their computers better. To each class, John brought his somewhat vintage Mac laptop meticulously following handouts to duplicate on his machine whatever instructions were being executed with the teaching machine on the projected screen at the front of the class. Never did John hesitate to halt proceedings when I managed to be obscure or to go too fast. Always this was done with his inimitable tilt of head, impish smile and the inaugural words, "Well, I don't know Diane—" The others in the class would all relax, lean back in anticipation, for, of course, if he hadn't caught it, they could have the clarification without the embarrassment of admitting they didn't know what was going on. John attended a training session aimed at developing a cadre of residents to provide tech support for our public programs. My illustrations were digital photos. John wanted "box diagrams." I suspect neither would have served the needs of the group, who just wanted a few tips and no true information about care of the equipment, etc. When I saw the elegant notebook drawings with which John filled his own science course notebooks, I could understand his frustration.

We met most often in the public spaces of the Commons, at dinner, Common Time (where John was a welcoming presence to all attendees), before and after UC events. We also had conversations from time to time about his children and what was happening in each of their lives. Occasionally he talked about how research had changed in his field, making the books and notes he had collected over his lifetime less valuable to posterity than he had hoped.

Word of John's illness arrived via email midway through one of my annual stays in London. By the time I returned, John had embraced the opportunity to live privately, fully alert to what had and was happening, and fully open to all that life and he could still offer each other. The only overt public change would be the quiet acknowledgement that certain times and days were difficult. John did not talk about his faith, but clearly he lived it, messily and heroically, and as best he could right to the end.

For those who were allowed to be his "buddy" on occasion, he brought unforgettable warmth and joy and laughter. And he brought the final gift of being able to share some time with his remarkable son and two daughters.

Diane Kirkpatrick
Friend, resident
University Commons
Ann Arbor



Jens Zorn, November, 2005



Diane Kirkpatrick

Ann Arbor University Commons, November 2006
Standing: Charlotte Fogel, Nancy Rugani.
At table: Anneliese Bowlby, John King, Nora Howell.

Stefan Fajans

(as presented at the memorial service for John, St. Andrew's Episcopal Church, September 21, 2007)

Reverend Dennison, Family, and Friends of John King:

It is a distinct honor and pleasure to have been asked by Elizabeth to say a few words at today's memorial and celebration of John King's life. You have heard from other speakers about John's distinguished career as a groundbreaking and innovative nuclear physicist. My remarks will continue to recall other aspects of John's life.

I did not know John personally before he joined University Commons. However, within a short period of time after his arrival, we formed a friendship which deepened rapidly. This was enhanced by several personal links.

In the late 1940s or early 1950s, as a graduate student, John took a course in physical chemistry with my father, Kasimir Fajans, who was a well known scientist working in the early days of radioactivity and whom John respected greatly. Then, it became clear that our children, Elizabeth King and Peter Fajans, were classmates, knew each other well, and had mutual close friends. Thus, the King and Fajans families have had bonds over three generations.

More importantly, I would like to speak about what John meant to me personally as well as to the whole University Commons community. John was respected, admired, and loved as a true, warm, and charming gentleman with a broad range of interests and knowledge. Conversations ranged from science to world and local events, sports, and just fun. University Commons is well known for its many varieties of intellectual stimulation and John added to them importantly. He was of good cheer and displayed a deep sense of humor, wit, and a hearty laugh. He was a favored companion at dinners and at our weekly Friday afternoon get-togethers. Because of his wisdom and collegiality he was elected to the Board which runs University Commons.

After his diagnosis, throughout his tiring treatments, and to his last days John never complained about his fate. He had words of admiration for his physicians and their new techniques of diagnosis and treatment, and showed great humility and equanimity. Although I am a physician, unfortunately, I had little to offer other than friendship, some comfort, and conversation that took John's mind off his deep concerns. We did establish a little ritual. One day John had some palpitations and I took his pulse to make sure he did not have atrial fibrillation. Thereafter, I took his pulse whenever I came to see him. One day, while in a good conversation, he suddenly stuck out his hand and said: "Aren't you going to take my pulse?" A few weeks later when his face showed that he was in great discomfort and I am sure in pain, I mentioned that one of his daughters was coming the next day. Suddenly his face turned into a huge radiant smile of joy and satisfaction. This is the face of John King that I will remember forever. As does his family, we shall all miss John very much at University Commons.

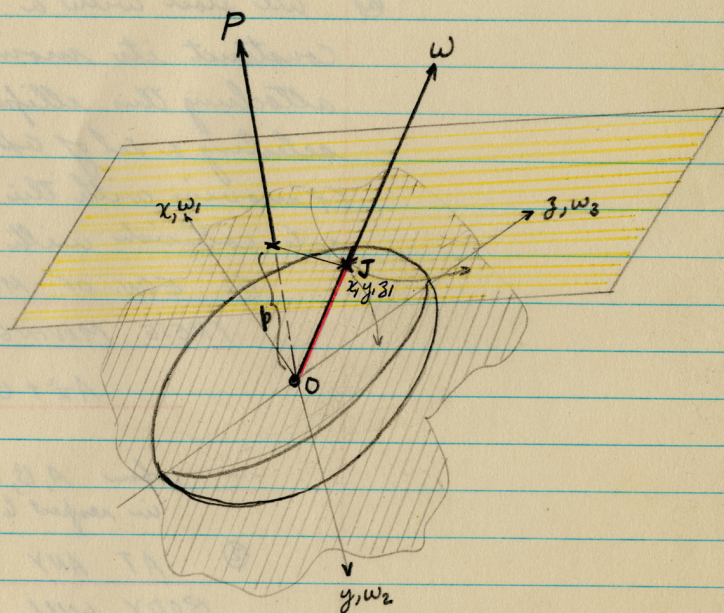
Stefan Fajans

Friend, resident

University Commons

Ann Arbor

THIS KINETIC ENERGY IS THE INSTANTANEOUS
KINETIC ENERGY WHEN THE BODY IS ~~THE~~
ROTATING ABOUT THE INSTANTANEOUS AXIS OF
ROTATION ($\vec{\omega}$)



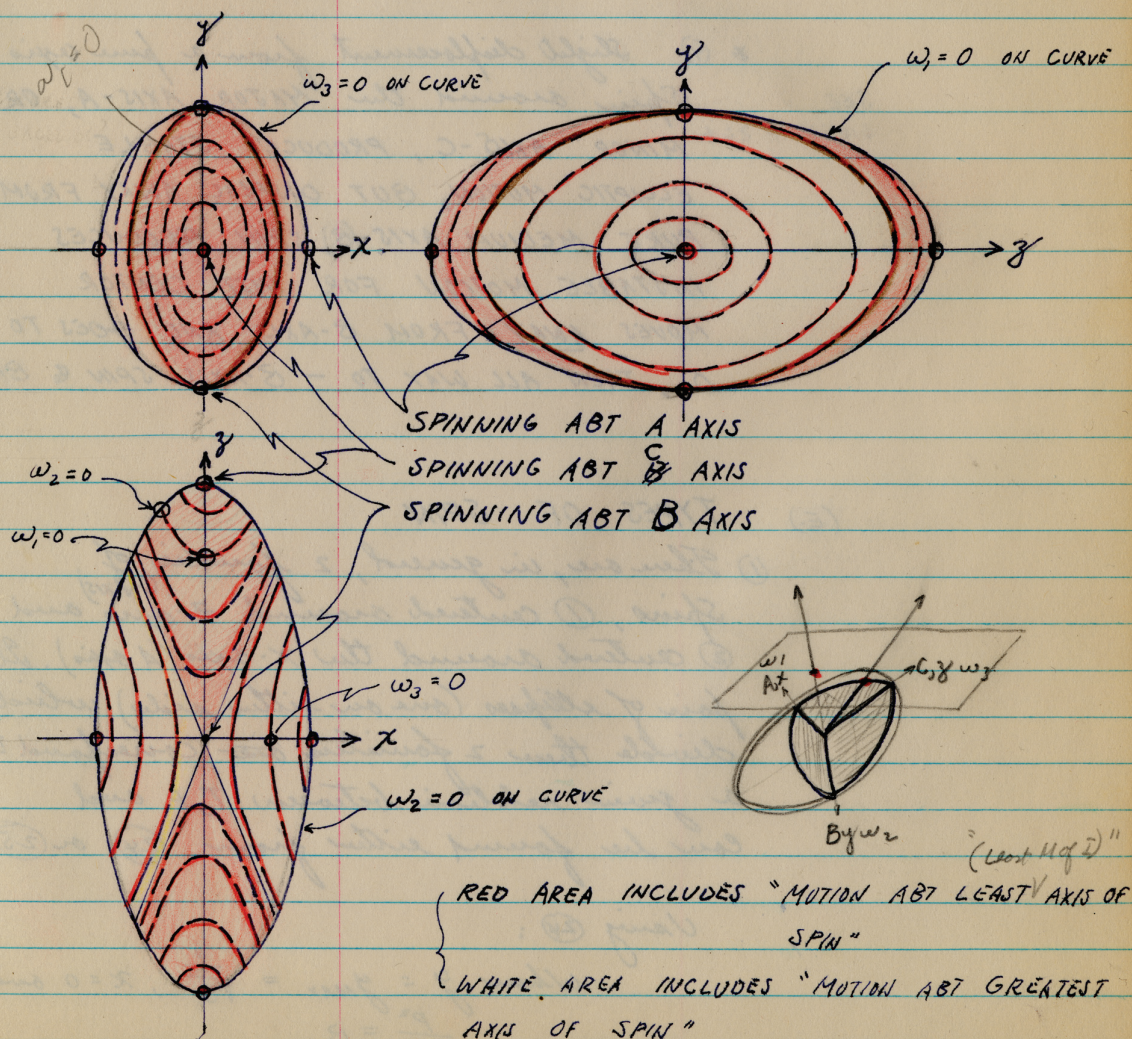
$$A(A-B)x^2 + C(C-B)z^2 = \left(\frac{P^2}{2T} - B\right)$$

+ - +, -

(26)

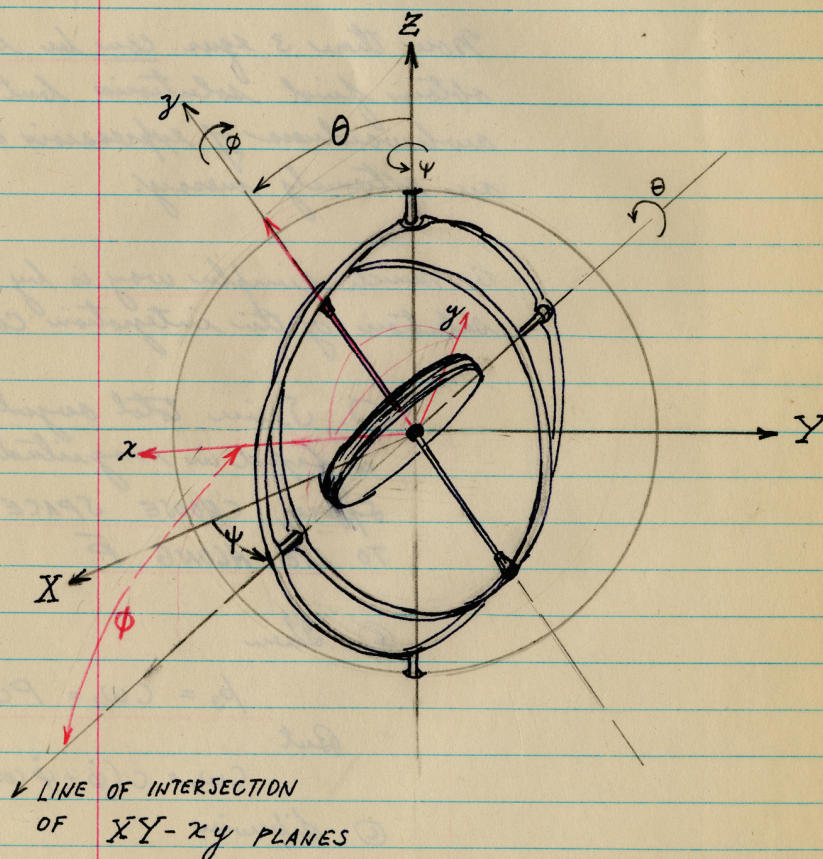
NOW THIS REPRESENTS FAMILIES OF
HYPERBOLAE

(D) GRAPHICAL REPRESENTATION



D. SPECIAL FORCE FREE MOTION ($A=B, C$)
GYROSCOPE MOTION

This motion in terms of θ, ψ, ϕ is just the motion of a gyroscope mounted in gimbals, the general position of the flywheel being obtainable by 3 independent rotations, θ, ψ, ϕ , about the gimbal axes:





Ron Cowie

*Marblehead, Massachusetts, June 30, 2007, the wedding of Francie and Robert
Left to right: Katherine Koch, Elizabeth Koch, Carlton Newton (standing behind Elizabeth),
Elizabeth King, Robert Erbetta, Francie King, John King, John King Jr., Carol King, and Miles King.*

Nuclear Engineering and Radiological Sciences

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In Memoriam

We are sad to report the passing of one of our most respected and beloved faculty, Professor John King, on August 30, 2007. Many alumni will remember him as their instructor for the reactor laboratory or radiation measurements course. His expertise in experimental methods was legendary. Prof. King was the Manager of Reactor Physics at KAPL during the exciting years of the first nuclear submarines, and recalled lively stories of working with Admiral Rickover (the father of the Nuclear Navy) and Henry Hurwitz (GE's genius reactor physics theoretician). When his wife grew ill, he moved his family to Ann Arbor to take advantage of the superior health facilities, and joined the new Department of Nuclear Engineering in 1959. With his background in experimental reactor physics, he gravitated to the new Ford Nuclear Reactor and began a glorious career utilizing the neutrons for materials science studies. He mentored many doctoral students through their research while developing a global reputation for innovative experimental methods and facilities in neutron scattering. A Fellow of the American Physical Society and the American Nuclear Society, a former chairman of our department, and the winner of the College's excellence in research award, his contributions to the department and our students have been nothing less than spectacular. After retiring in 1986, he continued his research with his close colleagues up until his recent illness limited his activity. He was an elegant gentleman scientist, and we will all miss him dearly.



Photo by Jens Zorn

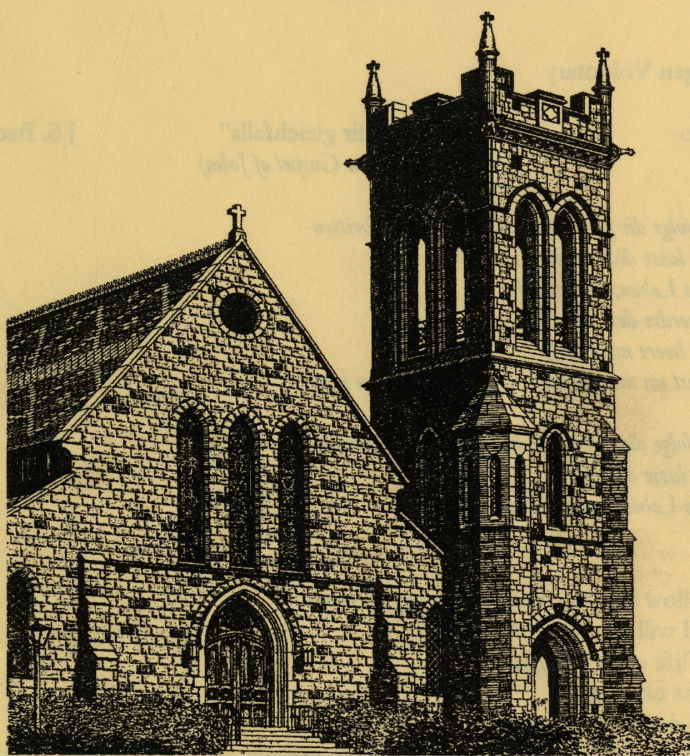
The family of John King has established the John S. King Memorial Fund at the U-M, dedicated to the support of research and instruction in NERS. Contributions (checks payable to "University of Michigan John S. King Memorial Fund") may be sent to the College of Engineering, Robert H. Lurie Engineering Center, 1221 Beal Avenue, Ann Arbor, MI 48109-2102 (phone 734-647-7040).

Those who would like additional information regarding the remarkable life and career of John King may read the obituary, which appeared in the [University of Michigan Record](#) on September 24, 2007.

NERS Obituary, September 26, 2007

SAINT ANDREW'S EPISCOPAL CHURCH
memorial service

To the Glory of God
and in Celebration of the Life of
John S. King
October 31, 1920 – August 30, 2007



St. Andrew's Episcopal Church
306 North Division Street, Ann Arbor, Michigan 48104-1497

St. Andrew's Episcopal Church Memorial Service, Ann Arbor, Michigan, September 21, 2007

To the Glory of God and in
Celebration of the Life of
John S. King
1920 – 2007

Organ Voluntary

Solo

“Ich folge dir gleichfalls”
(from the Passion Gospel of John)

J.S. Bach

*Ich folge dir gleichfalls mit freudigen Schritten
und lasse dich nicht,
mein Leben, mein Licht.
Befoerdre den Lauf
und hoere nicht auf,
Selbst an mir zu ziehen, zu schieben, zu bitten.*

*Ich folge dir gleichfalls mit freudigen Schritten
und lasse dich nicht,
mein Leben, mein Licht.*

I follow on your heels, with joyful steps
And will not leave you,
My life and my light.
Press on then,
and don't cease
to draw near to me, to compel me, to ask me.

I follow on your heels, with joyful steps
And will not leave you,
My life and my light.

Resurrection Anthems Prayer Book, page 491
Collect page 493
Hymn "I heard the voice of Jesus say" Hymnal 692

The Liturgy of the Word

First Reading Psalm 139
Psalm 121 page 473
Second Reading II Corinthians 4:16 -- 5:9
Psalm 23 (KJV) page 476
Gospel Reading John 14:1-6
Remembrances
Solo "Vocalise" Sergei Rachmaninoff

The Prayers
Commendation page 499
Benediction

Dismissal

Leader: Let us go forth in the peace and consolation of Christ.

People: *Thanks be to God.*

Hymn "Joyful, Joyful, we adore thee" Hymnal 376
Postlude

***All are invited to a reception immediately following the service,
University Commons, 827 Asa Gray Drive, Ann Arbor
(just off Huron Parkway), 4:30 to 7 p.m.***

Liturgical Leaders

Presider	The Rev. Bryant Dennison
Organist	Mr. Timothy Huth
Soloist	Carol Chickering
Readers	First Reading, John King, Jr. Second Reading, Elizabeth Koch Katherine Koch Third Reading, Miles King
Remembrances:	Jack Carpenter David Wehe William Heider Stefan Fajans Frances King Elizabeth King

The liturgy for the dead is an Easter liturgy. It finds all its meaning in the resurrection. Because Jesus was raised from the dead, we, too, shall be raised.

The liturgy, therefore, is characterized by joy, in the certainty that "neither death, nor life, nor angels, nor principalities, nor things present, nor things to come, nor powers, nor height, nor depth, nor anything else in all creation, will be able to separate us from the love of God in Christ Jesus our Lord."

This joy, however, does not make human grief unchristian. The very love we have for each other in Christ brings deep sorrow when we are parted by death. Jesus himself wept at the grave of his friend. So, while we rejoice that one we love had entered into the nearer presence of our Lord, we sorrow in sympathy with those who mourn.

Gospel Reading: Miles King

John 14:1-6

Jesus said 'Do not let your hearts be troubled. Believe in God, believe also in me. In my Father's house there are many dwelling-places. If it were not so, would I have told you that I go to prepare a place for you? And if I go and prepare a place for you, I will come again and will take you to myself, so that where I am, there you may be also. And you know the way to the place where I am going.' Thomas said to him, 'Lord, we do not know where you are going. How can we know the way?' Jesus said to him, 'I am the way, and the truth, and the life. No one comes to the Father except through me.'

[from the New Revised Standard Bible]

We offer here the texts of readings and remembrances in the order in which they were spoken in the church service. Remembrances by Jack Carpenter, David Wehe, William Heider, and Stefan Fajans we have placed earlier in this book (pages 20, 41, 53, and 60 respectively) where, together with subsequent contributions from other friends and colleagues, they form the essential chronology of "Milestones and Tributes."

First Reading: John S. King Jr.

Psalm 139:1–17

Thou hast fashioned me behind and before:
and laid thine hand upon me.
Such knowledge is too wonderful and excellent for me:
I cannot attain unto it.
Whither shall I go then from thy Spirit:
or whither shall I go then from thy presence?
If I climb up into heaven, thou art there:
if I go down to hell, thou art there also.
If I take the wings of the morning:
and remain in the uttermost parts of the sea;
Even there also shall thy hand lead me:
and thy right hand shall hold me.
If I say, Peradventure the darkness shall cover me:
then shall my night be turned to day.
Yea, the darkness is no darkness with thee,
but the night is as clear as the day:
the darkness and light to thee are both alike.
For my reins are thine:
thou hast covered me in my mother's womb.
I will give thanks unto thee,
for I am fearfully and wonderfully made:
marvellous are thy works,
and that my soul knoweth right well.
My bones are not hid from thee:
though I be made secretly, and fashioned beneath in the earth.
Thine eyes did see my substance, yet being unperfect:
and in thy book were all my members written;
Which day by day were fashioned:
when as yet there was none of them.
How dear are thy counsels unto me, O God:
O how great is the sum of them!

[from the 1928 Book of Common Prayer]

Second Reading: Elizabeth Koch and Katherine Koch

Ecclesiastes 3:1–8

To every thing there is a season,
And a time to every purpose under the heaven:
A time to be born, and a time to die;
A time to plant, and a time to pluck up that which is planted;
A time to kill, and a time to heal;
A time to break down, and a time to build up;
A time to weep, and a time to laugh;
A time to mourn, and a time to dance;
A time to cast away stones,
And a time to gather stones together;
A time to embrace, and a time to refrain from embracing;
A time to get, and a time to lose;
A time to keep, and a time to cast away;
A time to rend, and a time to sew [sow];
A time to keep silence, and a time to speak;
A time to love, and a time to hate;
A time of war, and a time of peace.

[from the King James Bible]

(Note: the reading from Ecclesiastes was substituted for the originally planned reading from II Corinthians, printed in the church service program)

Memorial Service Address by Francie King

My father was a very determined man, as you have certainly heard today.

It took me nearly 40 years to fully appreciate this.

When I was nine, and had once again been humiliated at the blackboard over a long division problem I could not do, my father decided it was time to approach and conquer.

We sat down together after supper at the small desk in the living room at 7 p.m.

By 8 p.m., I was in tears.

By 9 p.m., he was shouting and pacing.

By 9:30, I declared I would never “get it” and didn’t need math anyway.

By 9:45, he had finished his soliloquy on why math mattered, and why he himself continued to struggle with it.

By 10 p.m. I said I needed to quit for the night, again in tears.

By 10:30, he, with head in hands, bade me do the problem again.

And again.

And again.

By 11:15 p.m., I had learned how to divide 153 by 7 and knew what a “remainder” was.

I never became a whiz at math. But miraculously, I somehow manage a $\frac{3}{4}$ million-dollar budget for a nonprofit arts institution in Boston.

I can still hear him chuckling... (or perhaps weeping with relief!)

Memorial Service Address by Elizabeth King

My husband Carlton once sent my Dad a photograph of a wonderful machine in the Museum of the History of Science in Florence. An elegant spiral track down which a brass ball rolled, hitting tiny bells spaced at successively greater distances from one another. Carlton wrote: "What do you think of this machine, Dad?"

Couple days later we got a letter back:

"Dear Carlton and Liz,

A ball of mass m that falls through a height y gains speed v such that

$M \text{ times } g \text{ times } y = 1/2 m v \text{ squared}$ "

And then two straight pages of an equation, with square roots, parabolas, stuff crossed out and recalculated, and finally ending:

"...resulting in the square root of $2 gy$ times T all over 2 [].

The device is a clock!

Love, Dad"

Is math a language that can express love?

Only in the hands of a master.

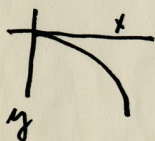
By conservation of energy, a ball of mass m that falls through a height y gain speed v

$$mgy = \frac{1}{2}mv^2$$

$$y = \frac{v^2}{2g}$$

(i)

A parabola is described by



$$y = ax^2$$

(ii)

where a is a constant.

Imagine that instead of a spiral, the machine consists of a succession of rings with radius x .

Then at a distance y from the top, the speed of the ball will be $v^2/2g$ and the radius of the ring will be x . The time it takes the ball to go around the ring is $T = \frac{2\pi x}{v}$. Turning this around we get

$$x = \frac{vT}{2\pi} \quad (\text{iii})$$

Combining (i) and (ii)

$$\frac{v^2}{2g} = ax^2$$

substitute x from (iii)

$$\frac{v^2}{2g} = a \frac{v^2 T^2}{4\pi^2}$$

$$T^2 = \frac{4\pi^2}{2ag}$$

~~independent of~~
This is constant.

2

Solve (i) to get

$$v = \sqrt{rg}$$

Solve (ii) to get

$$x = \frac{\sqrt{g}}{a}$$

Then from (iii)

$$\frac{\sqrt{g}}{a} = \frac{\sqrt{rg} T}{2\pi}$$

The significant point is that \sqrt{g} cancels from this equation, leaving T as a constant, independent of which ring is considered.

\therefore The ball traverses each ring in equal time.

\therefore The device is a clock!!

Letter from John to daughter Elizabeth and son-in-law, Carlton, 1982



ANN ARBOR UNIVERSITY COMMONS

reception guest book

Eugene & Agnes Haugels - Knew John fairly at UC

Yi-tsi + Al Fewmarker -

a wonderful person to know at UC, John
Evelyn Thomas

Bill Parkman

David Hildner

Alexina Rote

Bruce Jensen

Gay & Don & LuAnn was
"doved like my dad"

Kent Carpenter

Diane Kirkpatrick

Betty Graham

Jean Smith

Jessie & Bill -

Tony & Penny Young

David Weber (life student of Prof. King)

Reg Porter - former neighbor &
friend

Miles (Mike) S. King - "John King, our family's
favorite mate, may your spirit sail God's
Oceans with a Fresh Breeze and Gentle
Swell and may it stay in our hearts
forever".

Bill Kinley

Milo Hartman

John, you were the perfect,
wonderful, caring man
I have known
Nelly Ullman

Ellen + Jeff Strass
John + Dot Reed - fans!

Tom Powell

Vijaya Nagesh - We will miss John!

Harriet Gales
Alice + Cash + Hank Weidner

Helen + Henry Luros

Ruth and Helen Tapans

Bette Michael - w/ love!

Yvonne Bowly - fondly!

Ed Thomas (UC) - a fine man!

Leon + Marcia Friedman - ^{your Dad} a treasure for all of us
here at UC -

Anne Glawe goodbye to a wonderful friend!

Kathy Arnold - It was an honor
& privilege to meet & spend time with
the King family - Thank you!! ☺

Doris Green - 734-7178
Cynthia Sasini - cyndi-in-red@yahoo.com (Impassioned Young Man)
FARVER Baltimore

Catherine & Ed Marcus Welby Marcus @ 808 Yahoo.com
Kay & Gayle Ness - what a prince of a man.
Ernie Wasserman We will all miss you very much!

Mary Kinley - always that smile
and good humor!
We'll miss him.

Geneva Christensen - what a gentle man and it was
A LITTLE TLC such a pleasure to care for him
in his final days -

Broad & Lydia Bates Not sure what we'll do without
John taking up guard duty at
Common Time!

Bessie Carlman's family We will always cherish Uncle John's
gentle spirit and laughter - he leaves
big shoes to fill!
Mick H. Morgenstern - Good friend! Will be missed!

Catherine Enggass

George & Sue Greenwood
Bonnie West

Le Ca/Casse & Francois
Vive le Roi

We'll miss all your humor.
We were in French class together
+ I thoroughly enjoyed knowing John

Nancy Chickering - Much love

John B. Chickering Jr.
Zija and Malahat Akpasa

(Uncle) John, you are missed already.
'Safe Journey!' 'Bitch'
Thank for your encouragement on my
first day in the department!

Bill Martin with friendship
that Martin with Love.
Ed and Bea McLozen we'll miss a delightful
neighbor very much

Jane + Bob Gehman honored to have known you.

Ben King a very lucky nephew

Maurice Watson grateful - TK
Ron Fleming student & friend

Sam and Laura Werner, Friend, former student.
colleague for 46 yrs.

JOHN & KAREN CHICKERING
& JOHN JR.

UNCLE JOHN
WAS THE BEST!

Jack & Rhonda Carpenter

John M. Carpenter
You taught us. We
loved you
friend & neighbor

Victor Douvan

We miss him acutely.

Elizabeth Dexter
George + Margaret Matthews
Lois

With respect.

Glenn + Gladys Kuell

He was a really nice man!

George + Serena Ford

a friend and colleague,
a lovely man!

Winta + Fred Juri

funny + neighbor - UC
Colleague.

Ronald R. Bulmer

Pamela S. Kitcher

Kim WHEATON

ALL THE MATTHEWS
WISH THEY COULD HAVE
BEEN HERE.

Irene Olecki

John thank you for being at U.C.
We enjoyed you a lot!

David Gildersleeve

John, enjoyed our conversations.

Michael Atzman

Greene Ward Dining Room Mgr.

Dr. King was a gracious + kind man -
I enjoyed "serving" him + I liked his
twinkle in his eyes :)



Marblehead Harbor, 1986

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The John S. King Scholarship Fund at the University of Michigan is dedicated to the support of research and instruction in the Department of Nuclear Engineering and Radiological Sciences. Contributions (checks payable to "University of Michigan John S. King Scholarship Fund") may be sent to the College of Engineering, Robert H. Lurie Engineering Center, 1221 Beal Avenue, Ann Arbor, MI 48109-2102 (phone 734-647-7040).



John King, Bob King, and confederates, Detroit, Michigan, 1920s

