The Dilated Times

The newsletter of the Drew University Society of Physics Students

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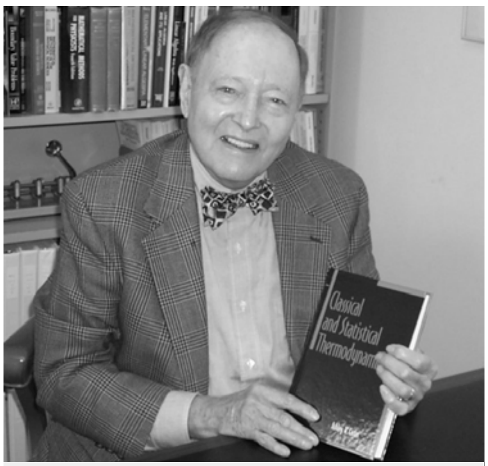
Editor: Natalya Katsap

Dr. Ashley Carter on Writing "Classical and Statistical Thermodynamics"



Dr. Ashley Carter

When people ask me why I wrote a textbook on thermal physics, I answer, "It happened by accident." They think I'm kidding. But it's true.

I began teaching thermodynamics at Drew in the early eighties, using a well-known book that I became increasingly dissatisfied with as I learned more about the subject. So I started to develop my own lecture notes, which I handed out to students, written in my own semi-legible handwriting. In 1996 Heather Ferguson, an expert in desk-top publishing, took the course and volunteered to type up the notes. By the end of the summer, she had produced a beautiful, spiral-bound volume with orange covers.

That fall a Prentice Hall sales representative stopped by my office and asked, "Are you writing a book by any chance?" I said no. She pointed to the volume on my table and said, "What's that?" When I told her what it was, she asked me if she could have a copy. I said sure.

Five months later, the astronomy and physics editor at Prentice Hall informed me that she had taken the liberty of sending my text to five reviewers, all of whom liked it and recommended its publication.

I signed a contract, and then the real work began. The reviewers had suggested some changes and some additions. One of them asked for a section on paramagnetism. I got interested in the subject and the result was a 26-page chapter on the thermodynamics of magnetism. Also, I had to add a lot of problems and work out the solutions to make sure they were doable. And so on.

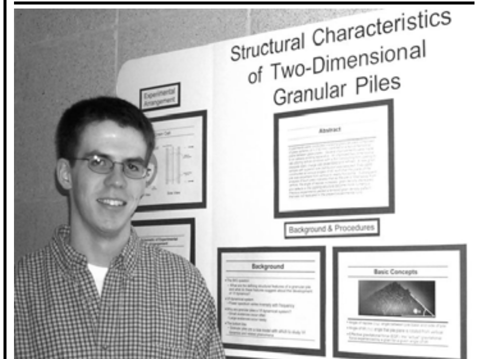
I finished the manuscript last fall and sent it off to the production editor. Six months of proof-reading followed. The production people had a nasty habit of making changes that weren't called for -- computer 'glitches,' they explained. The final miserable job was preparing an index. What complicated the whole process was that the home office of Prentice Hall is in Upper Saddle River, New Jersey; the executive editor's office is in Boston; the production editor is in Utah; and the book was printed in Indiana.

The book saw the light of day in May. It was fun signing copies and giving them away to my children and to some friends and faculty members at Drew. One of the leaders in the field said, "Your book is remarkably readable. I like it very much." That made me feel pretty good.

There's one thing I hadn't bargained for. The book is my lecture notes. So, in order not to bore my class to death, I have to prepare material that's not in the book. That's a downside to writing a textbook that I had not anticipated. Nevertheless, it's nice to have an ISBN number after your name.

Dr. Carter

Summer Science Poster Session



Joe Kinast presents his summer research at the DSSI poster session.

Dr. David J. McGee, Assistant Professor of Physics and Director of the Drew Summer Science Institute (DSSI), reports another successful summer of student research concluded with the annual Fall Poster Session, held on September 27th in the Founder's Room of Mead Hall. The poster session highlighted the work of DSSI students as well as other Drew science students involved in summer research. The DSSI program provides on-campus research opportunities for Drew students to work with faculty mentors during the summer break, while the National Science Foundation provides support for a number of off-campus research opportunities. Twenty students presented posters on a diverse range of topics in biology, chemistry, mathematics, physics, psychobiology, and psychology.

Representing the physics department were Dave Benjamin, Joe Kinast, Matt McMahon, and Tricia Missall. Dave presented results describing his analysis of elementary particle decay data while at Cornell University. Joe discussed his work at Lehigh University on granular

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Notes From the Outside

By Christianne Alevanja, Class of '96

Early in the fall of my senior year at Drew I decided to pursue a graduate degree in environmental engineering. The simplest way to describe the field, and perhaps the way I would have described it then, is that environmental engineers battle pollution. The field started with the efforts of civil engineers to provide clean drinking water and some sewage treatment for cities. It has grown since then to include treatment of a broad spectrum of air and water pollution problems. I was excited about a career explicitly dedicated to preserving the environment and human health, and so I started looking into environmental engineering programs.

Nervous about switching fields (and being somewhat of a slow writer, as Dr. F. can attest!), I agonized over eight applications during winter break. Engineering programs, unlike physics programs, typically require a student to obtain a masters degree before being admitted to a Ph.D. program. Because departmental funding is more difficult to obtain for masters students than it is for Ph.D. students, I also applied for several fellowships. I was happily surprised to get a fellowship from Bell Labs and to be accepted into several programs. After visiting a few departments, I headed off to Cornell University.

During that first semester at Cornell I struggled to make the transition from science to engineering. It took me most of the semester to stop trying to derive equations and to know when to look up an equation or parameter in a handbook. But eventually I adapted to the classes and started a research project. From that research project I learned a great deal about how I could be more efficient and effective in my next endeavor. When I had reached a reasonable conclusion for a masters thesis, I decided not to extend the research into a Ph.D. project and to consider other options.

When I chose Cornell I had a relatively primitive view of environmental engineering. After two years, I had a more thorough understanding of the field and was better able to consider my choices. I realized that I did not want to study ground water remediation, one of the strengths of the department at Cornell. In addition, I wanted to get involved with research that was more theoretically rigorous than my somewhat empirical work at Cornell.

I soon became interested in the research of my current advisor at U.C. Berkeley, Dr. David Sedlak. There are two main research focuses in my group of nine graduate students. Approximately half study endocrine disruptors while the rest, myself included, study metals. (Endocrine disruptors are pollutants that inhibit normal functioning of the endocrine systems of animals, including humans. Common examples are plasticizers, some pesticides, and some pharmaceutical wastes.) Metals enter the sewer system from both domestic and industrial sources, and they are removed from wastewater to varying degrees in treatment plants before the treated effluent is discharged into the environment. The goals of my research are to improve our understanding of the mechanisms of metal removal and to develop a method of increasing removal efficiencies. More generally, my research can be described as aquatic chemistry. In this sense, I often feel my work has more in common with physics than it does with civil engineering.

Most environmental engineering graduate students complete a masters degree and then go to work for an engineering consulting company. In this capacity an engineer may design different water or air treatment facilities, giving constant consideration to the details of environmental regulations. However, an engineer with a consulting company will most often implement ``tried and true" solutions and infrequently has the freedom to develop new treatment methods. It is not uncommon for a student to get a masters degree, work for a consulting firm for a few years, and return to graduate school for a Ph.D. From this self-selected group it is common and perhaps not surprising to hear that consulting can be dull. Not surprisingly, those engineers who do not return to school and remain with consulting companies describe the work more favorably.

Of those that do graduate with a Ph.D., many become professors. Others go to work for governmental agencies, or get jobs in private industry. A small fraction may also go to work for environmental engineering consulting companies, where they sometimes can exercise greater creativity in their work than engineers with only masters degrees. Engineers working for private industries are in the interesting position of trying to help a company succeed financially while minimizing its environmental impacts. An engineer I worked with at Lucent Technologies worked to anticipate the environmental issues that might be caused by the company's new products and explore potential solutions. His work is a great example of what an environmental engineer could do for a company. On the other hand, I recently heard a story of an environmental engineer at an oil company who was asked to find a way of recomputing the emissions statistics so that the company would appear to comply with federal environmental regulations. He refused, but was quickly replaced on that project. The allure of a governmental organization is that one could presumably work without such obvious conflicts of interest.

Thinking back to my education at Drew I remember how intimidated I was by electronics lab and A-lab, and how much I enjoyed them in the end. Graduate school is something like a long, complex, A-lab experiment, except that in A-lab the equipment almost always works. And though my research is most closely related to chemistry, I frequently spend days in hands-on study of electronics, thermodynamics, or optics as I try to understand and correct the strange behavior of a piece of fussy analytical equipment. At Drew I also had many chances to practice giving scientific talks, which I did not appreciate at all until I came to graduate school and realized how much better prepared I was for the world of scientific communication than many of my peers. For these and many other reasons, I believe my education at Drew was excellent preparation for the work I do now. For this I thank my professors, and also my fellow students, who helped me learn so much that has enabled me to follow this path.

A Nobel Oversight

Since 1901 ninety-three Nobel prizes have been awarded in physics. A prize can be given to as many as three individuals. Of the 163 recipients only two (1.2 percent) were women, Marie Curie and Maria Goeppert-Mayer. Since they both received a third of a prize, the grand total of women's Nobel prizes in physics is two-thirds. I am convinced that prejudice against women in physics has kept the number low. I'll bet that there have been women who deserved the prize and who did not even get nominated.

My favorite candidate for a woman who should have been a Nobel laureate is Emmy Noether. Who was she, what did she do, and why is it important?

Emmy (or Amalie, as she was named) was born in 1882 in Erlangen, Germany. Her father was a distinguished mathematician, having contributed to the theory of algebraic functions. Emmy and her younger brother followed in their father's profession. Her Ph.D. thesis, written at the University of Erlangen, was regarded as an awe-inspiring work that Emmy dismissed as a "jungle of formulas." When she later moved to Göttingen, she caught the attention of David Hilbert, probably the world's greatest mathematician at the time. Hilbert tried to get her a position on the Göttingen faculty but was met with fervent opposition because of her sex. In a faculty meeting debate, Hilbert declared, " I do not see that the sex of the candidate is an argument against her admission; after all, this place is not a bathhouse."

Hilbert prevailed; Emmy got an appointment--one that carried with it little obligation and no salary. In spite of that, by 1930 Emmy had established herself as a highly respected mathematician and an effective, innovative teacher. In 1933 the rise to national power of the Nazis led Emmy to leave Europe and accept a professorship at Bryn Mawr. She was also in demand as a lecturer at the Institute for Advanced Study in Princeton, where she became acquainted with Einstein.

Emmy's pleasant life in this country, doing the work she loved among her students and colleagues,ended abruptly only two years after her arrival here. Following an operation, she died in 1935 at the age of 53, at the height of her productivity.

Emmy was a forceful woman who was also kind, friendly and completely unselfish. She was often referred to as "der Noether" (with the masculine article) out of respect for her creativity and her having broken the gender barrier. Her friend, the mathematician Hermann Weyl, said of her at her death, "She was a great mathematician, the greatest, I firmly believe, that her sex has ever produced, and a great woman."

Emmy is best known to physicists for the theorem that bears her name. Noether's theorem is: every symmetry in nature yields a conservation law; conversely, every conservation law reveals an underlying symmetry. In physics a symmetry is an operation that can be performed, at least conceptually, on a system that leaves it <u>invariant</u>, that carries it into a configuration indistinguishable from the original one. A simple example is the rotation of an equilateral triangle through an angle of 120 degrees.

Consider the familiar conservation laws. The conservation of energy is associated with a translation in time (the law holds the same today as it did yesterday). Conservation of momentum arises from a translation in space; of angular momentum from invariance under a rotation; and of charge under a gauge transformation. Without actually proving Noether's theorem, it is fairly easy to show the connections. What a beautiful idea--that conservation laws are related to fundamental symmetries!

The great thing about this is that symmetry principles have provided the guidance for new advances in physics, especially in gravitational field theory, in particle physics, and in string theory. So-called supersymmetries are thought to be crucial to the search for a unified theory of the four forces, the 'final theory' of physics.

The relationship between symmetries and conservation laws is frequently mentioned in the literature without reference to Noether's theorem. That's utterly shameful, because her discovery is a cornerstone of contemporary physics. In my opinion, Emmy's work should have been honored with a Nobel prize.

Dr. Carter

Sigma Pi Sigma 2000 Congress

On the weekend of September 15-17, I had the opportunity to attend the Sigma Pi Sigma Congress at the American Center for Physics in Greenbelt, Maryland. Held every five years, the Congress invites members of Sigma Pi Sigma from all over the country to come together for a weekend of talks, reflection, and discussion on various aspects of physics. This year the topic was "What Would You as a Sigma Pi Sigma Member Like to Tell the Physics Community?", and approximately 100 members were present to describe their experiences. While Sigma Pi Sigma is the physics honor society, a great many of its alumni are not working in fields where they are identified as physicists. In fact the term, "hidden physicist", has been coined to describe the large number of people with physics degrees, but not doing physics, who are now spread throughout the workforce in this country.

The keynote speaker for Friday evening was William D. Phillips, who described his 1997 Nobel Prize winning work on atom cooling and trapping. He's a very animated and enthusiastic speaker, telling his story with frequent and plentiful pouring of liquid nitrogen on the floor. On Saturday we heard physicist and author James Trefil, known for his interest in writing for non-scientists. He discussed the difficulties in communicating science to the general public. Saturday evening science photographer Felice Frankel presented a slide show of her spectacular photographs. Her photos have appeared on the covers of Physics Today, Nature, Science, and others, and she is coauthor of *On the Surface of Things*, a copy of which she kindly autographed for me!

Breakout sessions addressed such issues as "Process, Content, and the Physics Major", "The Public Faces of Physics", "The Range of Sigma Pi Sigma Members' Creativity", and "Diversity Within the Physics Community". Career ideas were also a constant part of the weekend as I heard person after person describe their careers and how their initial physics training was serving them well. Industrial physicists presented some of the challenges facing them from the pressures of running

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Summer 2000 Internships

Matt McMahon

This summer I did research at Vanderbilt University in Nashville, TN, as part of the Summer 2000 Research Experience for Undergraduates in Physics, sponsored by the National Science Foundation. I worked on fabrication of nanoscale holes in silicon using a focused gallium ion beam drilling technique combined with wet etching in hydrofluoric acid. One possible application of this process is fabrication of optical transistors.

The program consisted of ten students chosen from schools as far apart as New Hampshire and Texas. The students worked in many diverse areas of physics, including particle physics (two students actually helped build one of the detectors for the Brookhaven RHIC); living-state physics, including mathematical modeling of processes leading to fibrillation of the heart; and solid-state physics.

I enjoyed the summer very much. The living arrangements were quite good (at Vandy, the suites have full kitchens!) and we all had plenty of time to explore Nashville. I also got a taste of what real day-to-day lab research is like, which will aid in my future career decisions. I highly recommend the REU program to any student who wants to get a sense of what graduate school might be like.

David Benjamin

This past summer I was at Cornell University, in Ithaca, NY doing particle physics research. The REU program at Cornell emphasizes particle physics a great deal, likely because they have a synchrotron on campus (which accelerates electrons and positrons to 5.3 GeV), so they have easy access to the machine and data. My particular project was in experimental particle physics, searching for the decay chains of certain mesons. However, other people in the REU focused on other aspects, such as the orientation of the magnetic fields in the synchrotron, the developing and updating of code that runs to the machine to testing superconducting chambers used in the synchrotron.

Ithaca is a nice city, relatively alternative. I've been there before and I enjoyed it. It is not large but not too small either. The living situation at Cornell was good as well. They gave us the choice of living in a co-op, or we could find housing on our own if we wanted. I chose to live in the house with 12 other students. It provided a good chance to get to know the other students better and interact with them on several levels. But living in the house did not exclude us from the other REU students, we interacted with them a great deal in the lab.

Overall I had a good experience, met a lot of interesting people, and learned a great deal. My mentor was lacking in mentoring qualities, such as caring about the progress of my work, but I don't think that it accurately represents the program as a whole. I suggest the REU at Cornell to anyone interested in particle physics or other areas as well.

Tricia Missall

This past summer I performed developmental neurobiology research at the Washington University Medical Center in St Louis, MO. My lab was located in the new McDonnell Pediatrics Research Building. All of the research that was being done around me was in the biomedical field, but Washington University is a large research institution with much variety, including some great physics stuff.

I didn't actually go through a set program to get to Wash U., I just emailed the PI of the lab and asked if he would like to hire a hard working physics major to do biology research for the summer. After convincing him that I definitely wanted to do biology research, (he was willing to give me names of people to do physics research with) I went to St Louis and stayed for three full months, working an average of 70 hours a week - and loving it! In addition to my research, I also enjoyed being a part of the whole research community by attending weekly research talks of some really well known labs and just informally discussing science with neighboring labs.

So basically, if your REU programs fall through or you have your heart set on working at a certain place, my suggestion would be to search the web for a lab that sounds interesting to you and just ask them if they'll take you. It worked for me! (By the way, the pay was comparable to any of the programs I looked into.)

Joe Kinast

I participated in Lehigh University's REU program this past summer, working in the area of statistical physics. More specifically, I was examining the structural characteristics of two-dimensional granular piles, and how these characteristics might give rise to 1/f dynamics in such piles. While progress was slow at times, it was nevertheless a valuable experience.

Lehigh's REU program has a decided experimental emphasis. Roughly 15 students from across the country participated, working on diverse lines of research. Specifically, a significant portion of research positions were in optical or atomic physics.

In general, students who participated in the Lehigh REU had a positive experience. While my experience was not quite as satisfying as some of my peers', the program provided an excellent opportunity to "try on" a research position for 10 weeks.

Jane Rhone Heads for the Country

After more than thirteen years of working with both faculty and students of the physics and chemistry departments, our secretary Jane Rhone has moved on to a new career in the banking business near her home in Laporte, PA. Jane could always be counted on to be there when any of us needed assistance. She was a staunch supporter of SPS activities helping with setting up our meetings, assisting at parties, and of course, was our accompanist for the physics carols at the Holiday Party! We wish her well in her new life and will miss her cheerful disposition here at Drew.

Career Corner

On Monday, October 16, David McGee and Bob Fenstermacher presented an SPS session on career opportunities and resources for career exploration for both batchelor and graduate degree holders in physics. Dr. McGee featured an excellent overview of career possibilities for all physics majors including the main aspects of working in industry, government, and academia. The new CD-ROM and video produced by the American Institute of Physics and the Sloan Foundation was demonstrated. Distributed to all physics departments in the country, the material profiles over a dozen persons with physics degrees in a wide variety of careers at all degree levels. Using the CD-ROM, students may access statistics on salaries, skills most valued in the workplace, types of jobs available, and diversity related issues among others. The features of specific careers may be compared to the career aspirations of individual students. The persons on the disk also give sage advice regarding the undergraduate preparation of physics majors. All physics students, and especially those just beginning down the physics path, will find this an interesting exploration. The disk may be used by students any day in S-203 or S-206.

Many of the statistics found on the AIP/Sloan disk and others are updated regularly and can be found at AIP or APS websites. Actual job offerings and other information can be reviewed. Sites include:

American Physical Society Career and Professional Development website:
http://www.aps.org/jobs/cpdl/

American Institute of Physics Employment Statistics website:
http://www.aip.org/statistics/

American Physical Society Career List-serve:
http://www.aps.org/newhypermail/archives/www-cpdl/

INTERESTING FACT: Drew University was cited in a recent AIP report as one of only twenty public and private colleges and universities in the country with 40% or more women physics majors from 1994-98. The list specifically excludes women's colleges. Only four of the twenty schools offered graduate degrees in physics.

Information on current and future internships is available at the **Career Center**, and can be accessed on the internet: http://www.depts.drew.edu/career/

An interesting set of units and dimensional conversions:

Ratio of an igloo's circumference to its diameter:	Eskimo Pi
2000 pounds of Chinese soup:	Won ton
Weight an evangelist carries with God:	1 billigram
Time it takes to sail 220 yards at 1 nautical mile per hour:	Knot-furlong
365.25 days of drinking low-calorie beer because it's less filling:	1 lite year
Shortest distance between two jokes:	A straight line
453.6 graham crackers:	1 pound cake

DSSI Poster Session

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piles, while Matt described how to etch silicon with ion beam drilling at Vanderbilt University. All three students participated in the National Science Foundation Research Experience for Undergraduates Program (NSF-REU). Showing the diversity of our physics majors, Tricia Missall presented a poster on her biomedical research during summer work at Washington University in St. Louis.

Although it is only fall, we are already planning another summer of research opportunities for Drew science students. Ask any physics major and they will tell you that participating in a summer research program is a great way to get experience in hands-on science, earn some money, and make important contacts for graduate school and beyond.

For more information on DSSI, contact Dr. McGee or visit the website at http://www.depts.drew.edu/dssi/.

Sigma Pi Sigma 2000

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a small research company, to the technical operations of a biomedical research foundation. Finally a panel of retired physicists presented a picture of doing physics as it was done in government and industrial labs from the 1940's up into the 1960's. It seemed to be the traditional image that many of us who are older have when thinking about a physics career - exciting and satisfying large projects often funded by the government and the defense department in particular. For me, their descriptions contrasted sharply with the stories of today's young physicists in a world where physics is less funded by the federal government- people often moving among many jobs, and bringing their physics skills to a wider variety of career possibilities.

On the trip home on Sunday I thought about all the information I had heard and was buoyed by the significant evidence presented that a physics degree indeed prepares one effectively and successfully both for careers in physics and for areas not even imagined while still in college.

- Bob Fenstermacher

Upcoming SPS Events...

November 13, Monday
SPS/Physics Department Lecture
Dr. Philip Anderson
Ramapo University
"An Application of Physics From Concept to Market: A Personal Experience"
4:30 pm S-244
Refreshments Served

December 11, Monday
Annual SPS/Physics Holiday Party

An Adventure with Alumni

On Friday, October 27, the physics faculty ventured by van into New York City as guests of the Drew New York Alumni Club. Professors Boeshaar, Carter, Fenstermacher, and McGee met the group of approximately 50 alums at the new Rose Center for Earth and Space in the American Museum of Natural History. The reborn Hayden Planetarium is located in an 87 foot diameter sphere standing on a tripod inside a 120 foot mostly glass cube - visually stunning. The $210 million Rose Center opened in February 2000 to excellent reviews and long lines of visitors. Our group was treated to the 20 minute Tom Hanks tour of the universe in the Space Theater, a 3 minute dramatization of the Big Bang, and a walk down the spiral Cosmic Pathway representing 13 billion years of evolution at about 3 million years per inch of walkway. On this time scale, all of human history was represented by the width of a human hair at the end! The group finished up the evening at a local restaurant where faculty and alums caught up on personal news and waxed nostalgically about the old days at Drew! Besides the physics faculty present, four physics alums were on hand - Rick Fuest, ‘68, Brad Schoening, ‘85, Bill “Barney” Pezzuti, ‘85, and Jon Spanier, ‘90. It was good to see them again and hear of their latest adventures. Thanks again, alumni, for inviting us.

- Bob Fenstermacher

Check out the Physics Department Web Page at
http://www.depts.drew.edu/phys/

The Dilated Times

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Address Correction Requested

inside… Dr. Carter on his book, D.S.S.I. Poster session, Sigma Pi Sigma 2000, Summer 2000 Research, Career Corner…

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