

## Remembrances, West Chapel, U. of Maryland

Carroll Overton Alley, Jr. was born in Richmond, Virginia to Carroll Overton Alley, Sr. and Mittie Points Alley. He graduated from John Marshall High School, where he was a member of the Cadet Corps, a swimmer, and an all-around outstanding student. He earned his Bachelor's Degree—and later an honorary doctorate—at the University of Richmond, and both an MA and a PhD from Princeton University.

At the time of his death, Carroll was Professor Emeritus of physics at the University of Maryland, College Park, where he taught for 45 years. He is remembered for many accomplishments, from serving as the Principal Investigator for the Apollo 11 Lunar Ranging Retro-Reflector experiment to contributing to the design of a state-of-the-art lecture and demonstration hall in the John S. Toll Physics Building.

Carroll's beloved wife Elizabeth Delany Alley, whom he married in 1952, passed away in 2004. He leaves behind two daughters, Frances Alley Kruger and Margaret Alley Seymour; four grandchildren, Rebecca Leigh Brigham, Monica Elizabeth Garrett, Joshua Robert Kruger, and Emily Christine Massucci; as well as two great-grandchildren, Sylvia Elizabeth Brigham and Kason Jaymes Brigham.

The family suggests donations to the Wilmer Eye Institute, 600 North Wolfe Street, Wilmer 112, Baltimore, MD.21287 or call 410-955-2020.

### Frances Alley Kruger:

My father was a force of nature in his own right. Steadfast in his loyalty; impeccable in his scientific integrity; implacable in his search for truth. He loved physics—the mighty business of investigating the secrets at the heart of the universe—with all of HIS heart.

He also, as you all know, loved his gadgets! And he never threw ANYTHING away. In a lovely letter to the physics community, Drew Baden noted that he was the first person at the University to own an HP calculator—and guess what? I found

correspondence about that very purchase going through briefcases in his study!

My sister and I are forever grateful to him for many of our good qualities: brains, integrity, curiosity about the world, and dedication. We are less grateful to him for some of our NOT-so-good qualities; for instance, we learned the fine art of procrastination at the feet of a master.

We also learned to be good readers, and I was able to put that to use as his vision declined by reading physics to him over the phone. At first, when he could still use one of his fancy vision-enhancing gadgets, he would follow along—and ask me to stop when we got to an equation, because I would be like, “It looks like a capital A without the crossbar” and “I think it’s a little p with a squiggly tail.” Later, because of my chronic symbol-recognition impairment and because he could no longer decipher equations himself, we graduated to reading Science Times articles and history of science books. Sometimes we even stooped to science fiction!

The last sentence I read to him, the Sunday before he died, was a quote by Chandrasekhar, from Marcia Bartusiak’s book Black Hole: How an Idea Abandoned by Newtonians, Hated by Einstein, and Gambled on by Hawking Became Loved. “I have at last emerged not indeed with the anticipated joy with which I began [diving] into the Crucibles of Nature, but burnt, and smoking, . . . [and] tired.”

I think my father WAS tired, but he never wanted to stop doing physics. It is my fondest hope that he is somewhere out there among the stars, talking physics with Eugene Wigner, John Wheeler, Bob Dicke, Huseyin Yilmaz—and Albert Einstein. Maybe Newton, too!

I miss him terribly, and I thank you all for being here to celebrate his remarkable life.

### Drew Baden:

Greetings on this beautiful bittersweet day. We are here to celebrate, remember and reflect on the life and career of our friend Carroll Alley.

Here's what I know about Carroll Alley and his amazingly impressive career and accomplishments:

He was an early expert in quantum phenomena, starting in graduate school at Princeton working with Dicke on rubidium atomic clocks.

He was an early expert in laser physics from work at the Institute of Optics and Physics at Rochester.

He was recruited by John Toll in 1963, and became an expert in classical gravity and general relativity.

A short 6 years later he was a PI on an experiment to put a lunar ranging system on the moon, delivered by the Apollo 11 crew.

Because the laser used to bounce signals off the moon from Texas delivered less than 1 photon per pulse on the return trip, he became an expert in single photon detection.

Wow. Such an incredible breadth and depth.

Carroll was a truly a great physicist and among the great experimentalists.

Up there with some of the greatest experimentalists of the last 50 years.

He reminds me of people like Bill Fairbank and Robert Dicke, physicists who threw the book at whatever physics problem they were working on.

To me this is THE essence of what it means to be a physicist: the desire to know, and the chutzpah to use whatever technology and tools might help even if we have no right to consider ourselves experts there.

I got to know Carroll best when I became chair in 2006.

He worked really hard in everything he did, from research to teaching.

And especially teaching.

He told me about losing his eye in a baseball game when he was young, and just kind of brushing it off as one of those things.

We used to talk about the latest geeky technology to come out. Carroll was always the first to jump on such things. He had small computers hanging from his belt way before we were stuffing iPhones in our pockets.

He cared deeply about his students and was concerned that he couldn't see them well when they asked questions, so we found grad students to sit in his undergrad class to help with that.

I used to talk to Carroll a lot about general relativity, and why he believed that we need different approaches than the classical ones from Einstein and Schwarzschild and company.

I tried to learn GR from Carroll but he was just way beyond me! But I so enjoyed it when he would stroll into my office and engage me.

Can you imagine the relief I felt when I was in the middle of writing some meaningless report to a Dean or higher up, and then in walks Carroll Alley to talk about GR and Yilmaz and the latest controversy!

Carroll took a lot of heat for his determination to pursue such alternate theories.

I have nothing but respect for him for doing so. Because this is what science and the pursuit of science is all about.

And to quote the great Rene Descartes: if you would be a real seeker after truth, you must at least once in your life doubt, as far as possible, all things.

I think that Carroll and Rene were definitely on the same physical sheet.

Carroll pursued his physics with incredible honesty and integrity. He was quite a great man and will be sorely missed.

### **Jordan Goodman:**

Carroll Alley was my modern physics teacher my junior year in Physics 421 and 422 (now 401 and 402) in 1971 and 72. He was my colleague for more than 30 years and he was my friend. He was an extraordinary person, a scientist through and

through. He was as passionate about physics as anyone I have known. His classes were memorable. They were a mix of enthusiasm, brilliance, caring and chaos. His lectures didn't so much follow the book as stochastically wander through it. His class was filled with anecdotes and insight, but mostly they were filled with genuine passion for the subject and that was infectious. Carroll loved gadgets. He had the first HP 35 calculator when they had just hit the market (today's equivalent of the first person you ever saw with an iPhone). Carroll played a pivotal role – literally in the design of the physics lecture halls – he was the force behind the rotating stages – a design ahead of its time, which has served students and faculty for almost 50 years.

Carroll did legendary experiments – the kind of experiments that tested the most fundamental principles of physics – measuring the distance to the moon, flying atomic clocks around the world in different directions to measure the twin paradox. In 1975 he put six atomic clocks, three cesium beam clocks and three rubidium gas cell clocks, on a U.S. Navy P3C anti-submarine patrol plane which made five 15 hour flights in an elliptical (“racetrack”) path over Chesapeake Bay. He not only recorded the ground speed, altitude, etc. of the plane continuously but with both X-band and C-band radar so the integral of the time dilation could be calculated more accurately. After landing, the plane was parked alongside a group of six identical reference clocks so a direct comparison could be made. The clocks flown in the plane ran slower than the clocks that remained on the Earth. The magnitude of the predicted difference was  $47.1 \pm 0.25$  ns while the measured difference was  $46.5 \pm 0.75$  ns.

He turned Wheeler's gedanken delayed choice experiment about if and when a photon decides to behave as a particle or as a wave into reality in his lab. In this experiment, one arm of an interferometer is either open or blocked after a photon has entered. Carroll showed that even though the space-like separation of the events excludes communication of this decision to the photon, it still somehow knows.

As you know, for many years, Carroll's eyesight was deteriorating. He couldn't see well enough to do demonstrations, but he arranged to have someone help him because he believed passionately that students needed to see the physics with their

own eyes. However, Carroll was not going to let his failing vision keep him from “seeing” our weekly colloquium. As usual he came up with a technological solution. He got a video camera that he would use to enlarge and record the colloquia every week. He also would not let his health keep him from attending every faculty meeting and, unlike some of us, reading all the material ahead of time.

For all of his wonderful attributes, being neat was not among them. The man had crap everywhere – a trailer parked behind the physics building, the basement, his office. Once many years ago, I was in his office when the phone rang and it was piled under so much junk that he had to go to the next office to answer it. I believe that taking people down to the basement of the cyclotron in the Toll building and showing them Carroll's space piled with papers and junk from floor to ceiling played a role in convincing them we needed a new building.

Carroll could be stubborn. He believed passionately in things – he believed as a matter of principle that faculty shouldn't have to turn in yearly activity reports. (Maybe after this year's experience with Lyterati, many of us will agree with him). In later years, Carroll became a follower of an alternative theory of gravity by Huseyin Yilmaz and he did this the way he did everything else – with passion and zeal. It became the focus of his scientific life and while he would always bring it up, he remained respectful of his colleagues who equally passionately disagreed with this theory. To me, this is what academic freedom and tenure are all about - the ability to pursue an unpopular and probably even wrong theory.

Carroll was a scholar and a gentleman, and I am proud to have called him my friend, colleague and teacher. So when you go out at night and look at the full moon, maybe you'll catch a glint of light reflecting off of the corner reflector on the Sea of Tranquility and know that Carroll is winking at you!

### **Doug Currie:**

I'll review some more personal aspects of Carroll's early career. Things that took place while Drew and Jordan were both still high school kids.

We initially met over 55 years ago at University of Rochester then again at Princeton. Although at that time I was a theorist, when I joined Carroll at Maryland, he was in the midst of developing the Lunar Laser Ranging project. Intrigued by the science, I joined the action.

I'm going to focus on Carroll's Lunar Laser Ranging project, started during the Apollo missions that has greatly enhanced our knowledge of the moon and the cosmos.

Carroll had a phenomenal ability to identify, contact and convince the authorities that were relevant to advancing this esoteric project. As some of you know!

The conceptual ideas of Lunar Laser Ranging originated in Bob Dicke's group at Princeton during the 1960s. When Ted Maiman invented the laser and President Kennedy said we were going to send a man to the moon, the theoretical concept became possible. Carroll was selected as Principal Investigator for the group that included Bob Dicke at Princeton, Pete Bender at JILA and Henry Plotkin at Goddard and others.

When our proposal was reviewed, we were told that one cannot point a laser with the requisite accuracy. The last Surveyor spacecraft was about to be sent to the moon, so Carroll and I, as a young assistant professor, met with the Science committee for Surveyor at the Cape. Carroll convinced them to allow us to do a pointing test using the Surveyor on the surface of the moon.

The required laser pointing hardware was built here at the University and was sent to McMath Observatory in Arizona. After landing, the Surveyor's camera was pointed back at the night side of the earth and the laser beams were sent up from McMath and a JPL station in California. The tests were successful, and even made Life magazine. In this image of the crescent earth the two laser spots due to the laser transmissions from McMath Observatory and a JPL station in California are indicated. The experience also defined the laser pointing procedures that are still used today at lunar and satellite ranging stations.

In order to understand what the astronauts would be physically capable of performing during an EVA

on the lunar surface, we met with Jack Schmidt, the future astronaut and Arizona senator, to plan the best approach in the design of the package.

Later, Carroll led a "delegation" to Cape Kennedy to show Buzz Aldrin how to deploy the retroreflector array on Apollo 11. Of course NASA already had a book an inch thick on how to do it, but it was fun. The "delegation" consisted of Carroll and Harry Kriemelmeyer, then our department's facility manager who some of you might remember and others shown in this picture.

McDonald Observatory at Fort Davis, Texas was configured as a permanent station for the lunar laser ranging. McDonald became a visiting target for junior astronauts. These are pictures of Carroll during a visit by Don Lind and Phil Chapman. And when Betsy and the girls accompanied Carroll to Fort Davis, Marge remembers that Francis saved a little girl in the motel pool. Marge and I, and our girls, have fond memories of good times with Betsy, Francis and Margaret.

The laser program is still going after 45 years, our only operating experiment on the surface of the moon.

The Apollo retroreflectors and the Lunar Laser Ranging program are the subject of a nice diorama at the Air and Space Museum downtown.

What are the Scientific Results of all of this?

1. Fifteen years ago, this program discovered the liquid core of the moon and measured its size and shape.
2. It has provided most of the best tests of gravitation and general relativity,
3. The analysis of the lunar laser ranging data has also addressed various theories of Dark Matter pointing toward a better understanding of the physics of one third of the content of the universe.

And as an illustration of the continuing legacy of Carroll's contribution, an image of the next generation retroreflector that is planned to be deployed on the moon next year appeared in Monday's Wall Street Journal.

One other contribution is familiar to all in the Physics Department. Carroll was the major force behind the rotating stage in our main lecture hall. It allows lecture demonstrations to be set-up prior to a lecture. This is still an essential feature after half a century and was an inspiration for other Universities.

I've brought along several articles and pictures to share here and at the reception.

### **Bill Norwood:**

This first part is from Ari Diacou who had, sometime in the early 2000's, performed the lecture demonstrations for Prof. Alley when he taught. This assistance was needed because of failing vision which ALSO was preventing him from seeing when a student raised a hand – he always relished the opportunity to answer student questions.

### **From Ari:**

“- Dr. Alley had a passion for teaching. In his later years he taught a “physics for poets” class. which uses less math than the sequences required of physicists, engineers and pre-meds. (actual course title is: “Physics in the Modern World”)

- He firmly believed that physics should be, and could be, grasped by anyone, and he truly enjoyed teaching students from the “other side” of campus.

- Each lecture began with a demonstration from UMD's large collection, and was usually followed up with 1 or 2 others (many of them explosive).

- It's sad to think there won't be a Dr. Alley giving students their only taste of STEM before they join the workforce.”

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### **A few of my own comments:**

- Professor Alley created some lasting memories for me at the Lecture Demo Facility where I worked for 29 years starting in 1970. Walking by the side door of a lecture hall I would get inspiration from hearing him building into his lectures the great

physicists of yesteryear some of whom he had known personally.

- And during his first lecture of the semester, when some students were already trying to catch some post-party sleep, he would have us fill a lectern-tethered weather balloon (large gesture) with hydrogen. He would light up a candle on a pole and raise it to the balloon, and there would be one horrendous boom and fireball, and that ended the sleeping for the semester!

- And then there was his favorite, the rocket tricycle, propelled by a large fire extinguisher. Seeking to arrive by surprise he would have us open the side doors to the lecture hall just as he would go careening in, in a terrible roar, with a funnel of vapor exiting a nozzle at the back. Since gravity had a greater effect on him than on most of us, it took some distance for the trike to reach higher speed, but one time it did, and, despite the application of brakes, he crashed into the wall on the far side – thankfully no one was injured.

- And he would usually have us provide about a dozen demo's even if he had no chance of getting to all of them. His idea was that the students should at least see as many experiments as possible as often as possible.

- And the backstage chatter, among Dr. Alley and other professors, before the stages got rotated, was always most illuminating and made me most glad of my own study and experience in physics.

Thank you.

### **Margaret Alley Seymour:**

#### *Planned remarks:*

We have heard some wonderful descriptions of my father today, but the truth for me is that for most of my life, my father was an enigma to me. As a child, all I really knew was that he was gone a lot, **but** when he returned from his worldwide travels, we would get great presents. We would swarm him and beg for him to open his suitcase – before he even had a chance to sit down.

Smart decision on his part.

I also learned early on not to ask him for help with my homework. What was sure to follow was a very long lecture that NEVER concluded with the answer. What was the point of having such a brilliant father if I couldn't get an advantage??

Very disappointing.

So, I found it very difficult to describe him to those who hadn't met him – and equally challenging to explain him to people who had.

My mother was easy. She was kind, overly accommodating, and a lovely to everyone she met.

Fortunately, Hollywood came to my rescue a number of years ago when they developed the TV show the Big Bang Theory! After that, all I had to say was “Imagine Dr. Sheldon Cooper grown old!” - A perfect description for those who know the TV series! Problem solved.

I have been pondering what stories to tell you about my father since the day he died. Two in particular came to mind – and they give me great pleasure.

Story One involves the first – and maybe only - time that I remember making my father laugh. It was a number of years ago, before my mother died. We were sitting in my living room in Lubbock and discussing (don't ask me why) coed colleges and universities. The conversation of course turned to Princeton (when talking about education – the only acceptable topics were Princeton and the University of Maryland). I think there must have been some controversy or lawsuit regarding some of Princeton's eating clubs allowing women to join.

I was bored with the conversation, but said, “Daddy, even if they admit women, they'll never accept them.”

My father laughed – a lot! Not something he did often and I was so proud! I felt elevated to a new status!

The second story took place many years later. After my mother had died and I think after he retired. We were sitting around his dining room table. I am sure that the conversation took place

during a TV commercial (which he muted), because we weren't allowed to talk during the news! Seemingly out of the blue - he announced that women were superior to men – and significantly so. (I wanted to say, “Well, yeah, and this is news how?") Astonished, I listened to him describe how much women were able to accomplish and how much they understood – while men tended to be too narrow in their thinking and their activities.

Now mind you – we were not raised in a sexist household. I never felt less than because of my gender. The only thing I ever felt that my sister and I were judged for was our lack of interest in physics. Our turn to disappoint.

Of course I understood what prompted his comments – the loss of his beloved wife (who did just about everything for him) and his increasing dependence on others – mostly women. But it was a poignant moment for me.

Next, I would like to tell you some things about my father that you may not know.

You heard that he was a member of the Cadet Corps – very proudly. But he also achieved the highest rank possible – First Captain and Regimental Commander of A Company.

In fact, his original plan was to attend West Point. A dream thwarted when he lost his eye playing baseball.

He was on the radio show Quiz Kids.

His father owned a successful travel agency in Richmond, VA.

He and my mother enjoyed square dancing. (Can you imagine? Just try to picture it!)

And most importantly, he had a beautiful bass/baritone voice. He sang in many choirs in church and all through college/graduate school and even sang with June Carter (later Cash). As he got older, it was difficult to get him to sing, but when our begging was successful, his go-to song was Swing- Low, Sweet Chariot. Those were chilling and thrilling moments we all remember.

So you will understand why our next solo - and all of today's music – means so much to us.

At the risk of offending some, I would like to conclude by sharing a poem of sorts that I wrote – with my sister's help – many, many years ago (as teenagers).

I think those of you who knew him will understand what inspired our irreverence.

Our Father who art in Physics, hallowed be your study.

Thy theory come, thy will be done – at home as it is at the University of Maryland.

Give us this day our daily pat on the head.

And forgive us our boyfriends and we forgive your time away from us.

And lead us not into the liberal arts, but deliver us from mediocrity.

For thine is the universe, and the power of gravity, and the center of attention

For ever and ever.....

Thank you for being with us today.