

Contribution to the Memorial Volume for Geoffrey F. Chew
to be published by the World Scientific

**Geoffrey F. Chew (1924–2019): A Passion for Physics and
the Ph.D. Thesis Professor for Me and Seventy-plus Others**

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No words are adequate to express my deep sadness of having Geoff no more as a friend in this world and no words are adequate to express my deep gratitude to him for having been my Ph.D. thesis professor that launched my career as a theoretical physicist. Here I give a brief description of my experience with him as my Ph.D. professor, some other anecdotes, and an Attachment of three photos at the end. For the detailed accounts of his biography, accomplishments, publications, the list of seventy-plus Ph.D.s he had graduated, etc., please see other contributions to the Memorial Volume for Geoff, to be published by the World Scientific.

I could not be happier when studying physics as a graduate student at Berkeley in 1961–66.^a Geoff was then the most popular Ph.D. thesis professor in theoretical physics. I was happy that he accepted me as one of his Ph.D. candidate students in 1963. At one point there were thirteen of us! However, I felt that he was always available. I shared an office with another student of his at the Lawrence Lab on the hill. The office was right next to the door that led to the big balcony that looked west over the beautiful campus toward the San Francisco Bay, with the Golden Gate Bridge in view. Standing and walking around there, one can see the fogs flowing over the Golden Bridge or the sunsets! Such was the incredible place for me to do my graduate research, and being paid too! All these were arranged by Geoff.

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^aThe acceptance of me by UC Berkeley as a graduate student in physics was heavenly to me. Furthermore, the generous full year IBM Fellowship for my first year 1961–62 afforded me to live in the International House with room and meals, to have no teaching assistant duties, and to fully concentrate in studying! My streak of good luck of “being always at the right place at the right time” was brought to a new height — as told in the profile of me by my high school (1951–57), Tainan Girls School (TNGS) which celebrated its Centennial in 2017 and where the excellent science teacher cultivated my interest in physics and started my streak of good luck, https://tngs100.blogspot.com/2017/07/blog-post_70.html (The text is in Chinese, however there are English web links — in colored characters — that help to cover some of the contents in English.)

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At the time Geoff's research interests were to formulate a theory for strong interactions using the analyticity properties of the scattering amplitudes. He said to me that there was a need to formulate analytic scattering amplitudes for two-to-two particles with higher spins, beyond 0 and $\frac{1}{2}$. I began to look into the matter. To make the long story short, suffice it to say that the then known method of constructing analytic amplitudes for two-to-two particles with spins 0 or $\frac{1}{2}$ could not be generalized to higher spins.

Every morning when I got to my office, I would find papers that Geoff left on my desk for me to look into. Months went by. One day, I read a paper and suddenly I got an idea how to formulate a general method to construct analytic amplitudes for two-to-two particles with arbitrary spins. I told Geoff about it. He immediately liked the idea and encouraged me to go on, despite of doubts expressed by other physicists. Geoff's steady guidance (more anecdotes later), feeding me with relevant papers, quick insightful understanding of and strong stand for my idea were very important to me. Looking back now, I am still so impressed by and so appreciative of him.

I worked my idea out for arbitrary spins, and importantly checked that my results for spins 0 and $\frac{1}{2}$ are consistent with the previously known results but through different methods that could not be generalized to arbitrary spins. I wrote up the paper and published it in *Physical Review* (1966, Vol. 142, pp. 1187–1194). By then, the initially doubting physicists were also convinced. Afterwards I quickly wrote another paper applying the results to analyze scattering properties of particles with higher spins published in *Physical Review Letters* (1966, Vol. 16, pp. 756–760). Nicely, I did not need to type up my papers. They were typed up by the staff members (then called secretaries) at the Lab! All I had to do for my thesis was to have a covering page with acknowledgement to Geoff, stapled together with the two published papers, so no typing was needed for my thesis!

Then I took the oral examination, facing five professors — giving a talk about my thesis and answering their questions, not only about my thesis but also whatever they thought that I should know. Geoff's pleasant and relaxed presence was very helpful. I gave my talk and answered all the questions — a pleasant surprise to myself. Then I stepped outside and waited. Soon they opened door. All are smiling, Geoff's was the biggest, as usual. Each professor congratulated me with a hand shake. Geoff said loudly, "Ling-Lie, I wish all my other students had done as well as you did!"^b

^bOnly years later, unexpectedly Geoff revealed one of whom he had in mind. In 2007, David Gross was invited to give a public speech at UC Berkeley and the title was "The Coming Revolutions in Fundamental Physics." David was one of the thirteen Ph.D. students of Geoff's in the early 1960's as I was. He shared the 2004 Nobel Prize in Physics with H. David Politzer and Frank Wilczek, <https://www.nobelprize.org/prizes/physics/2004/summary/>. It was a highly anticipated event, to be held at the auditorium of the International House on the Berkeley campus. The then Physics Chair, Prof. Frances Hellman, Geoff and I were chatting at the pre-talk reception. She said quietly to Geoff, "I am going to introduce David before his talk. It will be nice to say something fun about David in my introduction." Without hesitation Geoff said with a big smile, "Yes, I have one for

After my Ph.D. in 1966, I stayed on in Berkeley as a researcher, and published three more papers,^c till 1967 when I was offered a two-year postdoctoral position at Institute for Advanced Study without my having to apply. (Also without applying, I was offered an assistant professorship at a good university but I declined). I am sure that Geoff's reputation had helped. That started my streak of good luck of having never had to apply for a job.

Besides individual meetings with his research students, Geoff also held the weekly group meeting. At first the weekly meeting was held in the theory seminar room in the Lab. Soon many postdoctoral physicists also come to attend. Geoff then changed to hold the group meeting with his research students at his home. Those were most fun and inspiring meetings, in the beautiful home of Geoff and his first wife Ruth (sadly she died later too young because of an incurable health condition). The topics of discussion were not limited to physics, especially considering those were the days of the Free Speech Movement era at Berkeley. We all enjoyed and learned so much. Surely, it was major work for Geoff and Ruth to hold those meetings at their home. I will forever fondly remember those meetings.

In 1986 I was recruited to UC Davis, after two years at the Institute for Advanced Study 1967–69 and seventeen years at Brookhaven National Laboratory 1969–86. Geoff and his second wife Denyse gave me a wonderful welcome dinner party with the attendance of other physics guests, at their beautiful home overlooking the campus with the San Francisco Bay and the Golden Gate Bridge in view. They made me feel that I had returned home.

Davis is about one hour driving to Berkeley. Whenever I had a chance I would meet with Geoff, often at the Lab for lunch. His lunch was almost always just a big cup of soup with some crackers. Usually he was so occupied with talking about the physics he was working on that he forgot to eat, only hurried to finish at the end. This was the pattern how he ate his meals whenever I had a meal with him, no matter who else were present. He would happily entertain other topics that were injected into the conversation, but soon he would return to talking about what he had in mind about his physics. Once in a big banquet at the posh Ritz-Carlton Hotel in San Francisco, Geoff sat between Stanley (Mandelstam) and me among others at a table. The main course was a nice big steak. When most people at the table had finished, Geoff had eaten only a little bit and kept on with his talking. The waiter came, without asking, took his plate. I thought that was rude and

you. At David's oral examination he gave a fantastic talk about his thesis. However, during the questions, he could not answer any of them." There was a pause from Frances. I then quickly said, "I think I have a better one, more appropriate and more fun. I am sure David would be proud of it." I continued, "David was one of the 800 students got arrested during a sit-in demonstration in Sproul Hall during the Free Speech Movement!" Frances made a creative use of the one-sentence story in her introduction to David's talk and got loud applause from the audience, as documented in the video <https://www.youtube.com/watch?v=AM7SnUlw-DU>, 0:02:30–0:03:30/1:39:09. David gave a brilliant talk, as he usually does, and also documented there 0:03:30–1:39:09/1:39:09.

^cOne of them was with Stanley Mandelstam. The interesting way the paper came about was told in Footnote 52 of my paper remembering Stanley published in the Memorial Volume for Stanley Mandelstam (World Scientific Publishing, 2017).

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said quietly, “That’s not right!” He just laughed and murmured, “It happens, it happens.” Stanley kept his usual quiet with an understanding smile. I ran after the waiter with a smile and told him quietly that the professor had not yet finished. The waiter was embarrassed and brought Geoff a new plate of hot full steak!

I organized outings with Geoff and family and Stanley, e.g. the visit to the Oakland Museum when the treasures from the Forbidden City of China were shown there (a truly outstanding exhibit, many treasures were shown there that I had not seen in my several prior visits to the Forbidden City) and then the dinner at the Jack London Square; the visit to the Asian Museum in San Francisco; etc. Often Geoff’s family members said, “Ling-Lie, thank you for inviting us to these outings. Usually Geoff would not do this sort of things!” One day I found out that there was a Jewish museum in Berkeley, The Magnes Collection of Jewish Art and Life. I organized a visit to it. While walking around there, Geoff learned that Stanley did not know the existence of the museum after having lived in Berkeley for so many years! Geoff laughed and said jokingly, not so quietly, “Stanley, Shame on you — being a Jew, you did not know about this museum?!” Stanley just smiled. Apparently Stanley also “usually would not do this sort of things”. I am proud that not only did Geoff and Stanley agree to go along with the outings I organized, during one visit to SFMOMA in San Francisco, they even let me making them part of the arts!^d

In 1999, to mark the new millennium I began to host New Year’s Eve dinner with Geoff, his family members, and Stanley. Geoff and Stanley had always attended. We had fun talking about everything, and Geoff would always go back to talk about his physics ideas and progresses. Sadly, Stanley passed away in 2016. With Geoff and family members we continued the New Year’s Eve dinner get-together. Sadly Geoff passed away on April 11, 2019. Geoff always sent me a gracious thank-you email after the New Year’s Eve dinner. His last one was:

2019-01-01, 09:17 Geoffrey Chew wrote:

Dear Ling-Lie,

Frank and I enormously enjoyed the treat you gave us last night. It will be long-remembered. As I review the paper that Pauline and Frank have helped me to write, I shall keep in mind your remarks about its current form.

Happy New Year!

Geoff and Frank

(Note: Pauline is Geoff’s younger daughter of two and Frank his youngest son of three. The email was copied to both.)

I will forever remember the joyous times I had with Geoff, Stanley, and Geoff’s family members.

For years, as far as I know from all my get-togethers with Geoff since 1986 when I moved to Davis, sometimes alone with him at the Lab and mostly together with

^dSee the photo, Fig. 7, of my paper in the Memorial Volume for Stanley Mandelstam (World Scientific, 2017).

Stanley, Geoff was looking for an all-encompassing theory for physics. However, I could not understand nor could Stanley what he meant to get done — but we always had fun getting together. Though he seldom talked about his S-matrix theory approach of his earlier years, he was proud of it. I remember clearly he said that among all his physics work he was most proud of his original idea of associating particles to the poles in scattering amplitudes. Following that he developed the bootstrap idea and the analytic S-matrix approach. Surely, his historical encounter with Stanley when Stanley was an unknown postdoctoral, his instantaneous recognition of the importance of Stanley’s work of generalizing the single-dispersion expressions to double-dispersion expressions for scattering amplitudes and bringing Stanley to Berkeley^e was a major event in both of their lives as well as in the development of theoretical physics. What he had advocated and worked so hard for the S-Matrix approach had laid the fertile ground for the development of the string theory, a theory that many have been advocated for decades to have the potential to become the theory of everything and are still working hard toward that goal. Stanley, a leading field and string theorist,^f insightfully said in his talk at the conference celebrating Geoff’s 60th birthday in 1984, published in the Proceedings “A Passion for Physics” published in 1985 by World Scientific, p. 97, “*Before I go further, let me emphasize one thing that will be well known to the older members of the audience; the string model originated as a model for the S matrix, and it may well not have been discovered if S-matrix had not been vigorously pursued at the time. It is therefore intimately related to the work of Geoffrey Chew. Of course this does not imply that he necessarily supports later developments after the model.*” Indeed, Geoff had other ideas. He tried hard to develop them for decades, till the end of his life as indicated in his 2019-01-01 email to me copied above. Though he did not bring his ideas to a clear fruition, he had joy in developing them.

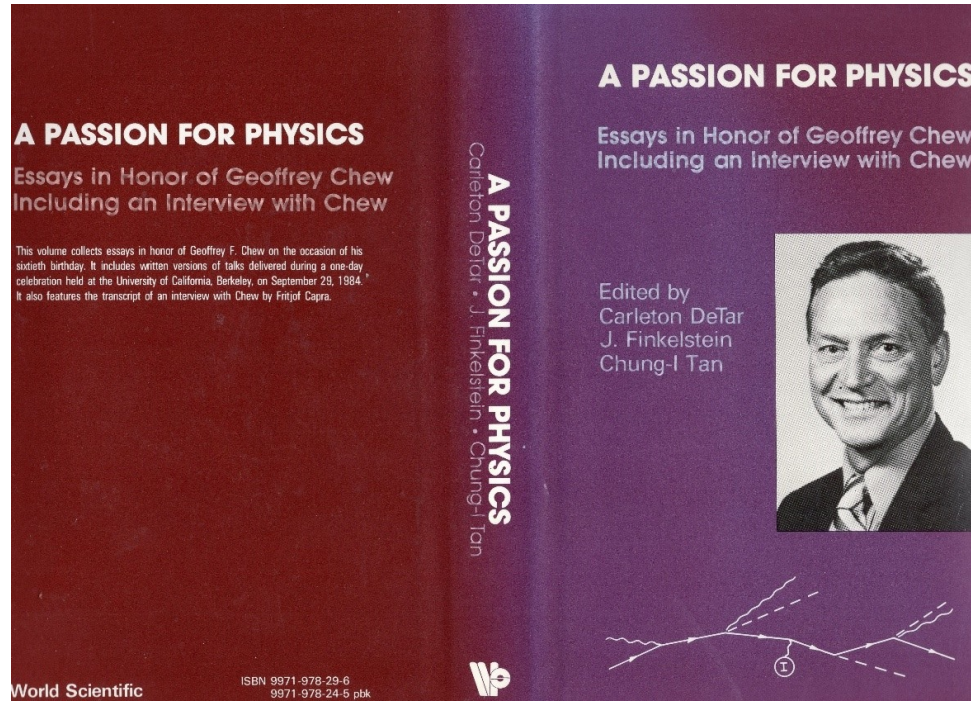
We miss Geoff dearly — his heartwarming big smiles and laughs and his passion for physics. His impact on physics and physicists will live on — in the continuing search for an all-encompassing fundamental theory for the physical universe.

^eSee Chew’s paper in the Memorial Volume for Stanley Mandelstam (World Scientific, 2017).

^fSee the Memorial Volume for Stanley Mandelstam (World Scientific, 2017), my Physics Today Obituary for Stanley, May 2017 issue, <http://chau.physics.ucdavis.edu/Chau-PhysicsToday-obi-Mandelstam-2017May.pdf>, and its extended version as my paper in the Memorial Volume for Stanley, <http://chau.physics.ucdavis.edu/Chau-biogSlctPapR-Mandelstam-Memo-WS-2017-dstPost.pdf>.

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Attachment: Photos



(Photo 1) The cover of the Proceedings of celebrating Geoff's 60th birthday in 1984 at UC Berkeley, published in 1985 by World Scientific.



(Photo 2) Five Chicago University Classmates in the mid-late 1940s: From left to right, Lincoln Wolfenstein, Geoffrey Chew, Chen-Ning Yang, Marshall Rosenbluth, and Jack Steinberger, taken at the Yang's Retirement Symposium, "Symmetry & Modern Physics", at SUNY Stony Brook, May 21–22, 1999, and printed in the Proceedings published by World Scientific. I am proud and happy that I orchestrated the taking of the photo. I got the idea of orchestrating such a photo when chatting with Steinberg at the party and mentioned the idea to him. He rejected my idea. So I kept quiet about it while walked around to chat with people. After a while, Steinberg came back to me, saying "I've changed my mind. I now think it is a good idea!" So I went about bringing them together. Notice that Chew, Yang, and Rosenbluth were looking at me while I was orchestrating and taking a photo using my camera. The official photographer of the conference took this one. I thank World Scientific for permission to reprint the photo here.

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(Photo 3) New Year's Eve dinner get-together (Dec 31, 2009); from left to right: Frank Chew (Geoff's youngest son of three), Stanley Mandelstam, Ling-Lie Chau, and Geoffrey Chew.