CHAPTER 1

Three Weeks With Hans A. Bethe

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Hans Bethe started visiting the Kellogg Radiation Laboratory, accompanied by Gerry Brown, every winter starting in the late eighties. My first visit to Kellogg was in 1991 as a final year graduate student. I returned in January of 1992, while a postdoc with Gerry Brown at SUNY Stony Brook, and this would be my first of many winter months spent in the company of both Hans and Gerry. The following notes are literally "mental downloads" that I wrote down every evening after leaving dinner with Hans, Gerry, and sometimes other invited guests that year. I indiscriminately wrote down everything that I could remember from that day, whether it seemed important or not, hoping to edit it later. In the end, I decided to keep the editing very minimal in order to preserve the original text's immediacy and spontaneity. Besides grammar and punctuation, a few facts that I remembered incorrectly were restored. I also added references and footnotes that add explanations where necessary. The following is a transcript of the conversations that took place between 20 January and 20 February, 1992.

First Week

Monday, Jan. 20th 1992

I meet him for the first time in the afternoon. Gerry comes up to my office to tell me that there will be a discussion session with Grant Matthews from Los Alamos on problems of the early universe. I know that by that time, Hans has returned from Santa Barbara, and will be waiting in his and Gerry's joint office on the first floor of the Kellogg Radiation Laboratory. I am, while walking down the stairs, slightly nervous, because of all the anticipation of meeting him. When I enter the office with Gerry there is only him, Matthews hasn't arrived yet. Gerry introduces me to Hans, who

sits in a chair. His handshake is weak. I mumble that it's a pleasure to meet him. What impression do I have? He is old, but I knew what he would look like. His hands aren't trembling. He only has a little hair left around the back of his head, white, and almost no eyebrows. Yet his face, while wrinkled, is still somehow strong, probably because he's a good eater. When he leaves to get himself a coffee, he walks upright. He munches on raisins. Gerry notes that Matthews hasn't arrived and says that he'll come and get me once he does. I go back upstairs to my office. Five minutes later Gerry is back, to tell me that everything is set. Grant Matthews talks about inhomogenous nucleosynthesis. Hans listens attentively. Somehow, I can't really believe that Hans understands all this, him being 86. And every time he starts to make a comment, or ask a question, I expect to see that he cannot follow. However, that never happens. When he talks, he talks slowly, but surely. After maybe an hour of discussion this feeling slowly fades away. Hans knows what he is talking about. Nevertheless, he is very tired from the drive from Santa Barbara to Pasadena (he drove a rental car, all by himself), and around five they leave for the apartment. I join them at 6:30 for dinner. When I come in, Gerry tells me that dinner will take a bit longer (he is making a roast beef) and I sit down, across from Hans. Almost immediately, Hans addresses me:

"I have a request!", he says. I look very subservient, not knowing what will follow, and answer – "Yes?"

"Please," he continues, "can you speak at half the speed, and twice the volume? I am hard of hearing and I have this hearing aid." I am slightly embarrassed, as during the discussion in the afternoon I talked, as I always do discussing physics, admittedly very fast. I even remember worrying about it slightly, but then got swept up in the subject again. I apologize for that, Gerry makes the usual remarks about my fast-talking, and I try to speak slowly, and loudly. The conversation is not easy, I don't dare to ask questions, and so I only answer to his, about where in Germany I'm from. I tell him about Brussels (where I was born) and about Bonn University, where I studied physics. He asks me who is still on the Bonn faculty. I start with mentioning Rollnik, my advisor, but that name doesn't seem to ring a bell. I mention that he's on many committees, and now heads the one responsible for restructuring the East German physics departments. We discuss this a bit, then I mention Konrad Bleuler, knowing full well that he must remember him. They must be roughly the same age. Indeed he does remember, his face lighting up slightly when I mention him. Then I mention more names from the Nuclear Theory group in Bonn, but none

are familiar to him. Then he asks me if Wolfgang Paul is still there. Yes, of course, I answer, and tell him the anecdote about how they relegated him to a little office close to the janitor's closet in the cellar after his retirement, only to reverse this move after he won the Nobel prize. Hans laughs, and goes on to tell me that he first met Wolfgang Paul when he visited Werner Heisenberg in Göttingen, in 1948. I go on to tell the story of how Wolfgang Paul received the money from the German government to build the 500 MeV electron synchrotron in Bonn, the first of its kind in Europe. Namely, he just asked Heisenberg for the money, who was then in charge of distributing research funds in Germany, and a week later the money arrived on Wolfgang Paul's private account, just like that. Hans is amused, and says what a fine experimenter, and a nice person, Wolfgang Paul is. We all agree. I now remember another story about Wolfgang Paul, just as an aside, that I learned during my time in Bonn. Indeed, Wolfgang Pauli visited the institute, and under some circumstance Paul whispers to Pauli: "Finally I meet my imaginary part!"

We talk about more things, discuss the reunification of Germany, and he asks me how the East is doing economically. I talk about unemployment, salaries, etc. He seems genuinely pleased to hear that I expect that the Eastern part is slowly recovering. I tell him that the German government poured over a hundred billion marks into the East, which leaves him very astonished. Yet, the conversation is still difficult, as I mostly answer his questions. There are periods of silence in between, where I don't quite know where to look. Finally, dinner is ready. During dinner we don't talk much. Hans eats slowly, but he eats a lot. After dinner, Hans retires as he is tired from travelling. Gerry walks a piece of the way back with me as he wants to do some grocery shopping, and says that Hans and I still have to get to know each other; that today the discussion was somewhat superficial, but that he likes to talk about Germany.

Tuesday, Jan. 21st, 1992

At around 11am, Gerry calls me for discussion, now with George Fuller from San Diego; later Grant Matthews joins in. Hans is a lot livelier. I'm observing him all the time. He gets up to write on the blackboard, he interrupts George Fuller: "I love the r-process, really, but I think we don't have to worry about this here." Fuller is slightly embarrassed, he won't mention the r-process again. This session is about neutrino physics, specifically neutrino oscillation and transformation. I am not an expert on this, but it is very interesting. I learn that Hans has in his mind a pretty well-rounded

picture of what the masses of the three neutrino species should be. Considering that the rest of the world is still wondering, or assuming that they probably all vanish, I find this quite remarkable. For the record: he estimates the electron neutrino to be basically massless, the muon neutrino to have a couple of milli electron volt, and the tau neutrino to have between 35 and 70 electron volt. Fuller and Hans agree that this should be enough to close the universe. Hans says: "I don't know much about inflation, but Alan Guth tells me that you need $\Omega = 1$, and here we give him $\Omega = 1$; he should be satisfied!" The subject turns to experiments to detect the $\mu - \tau$ neutrino oscillations, and Hans gets emphatic: "The only experiments they do are at Fermilab, but they are doing the wrong experiment! The conversion length is a few meters" (he and Fuller just estimated it on the board with Hans's formula), "but they are looking for kilometers! They will never find it that way!" He sits down again, and calms down. "I will have to write them a letter." With that he goes to lunch with Fuller and Matthews. Gerry and I go to the Kellogg "Journal Club", to listen to a talk about solar neutrino detection.

Later in the afternoon, Gerry calls me again, for more discussion with Fuller. This time, it is nucleosynthesis again. We are having a very lively discussion, but when I speak I'm always concerned about whether I'm not too fast for Hans. I try to talk slowly–have to slow down many times–but it's very hard to control. We talk about the QCD phase transition, and I tell them that I still suspect a first-order transition involving the electric gluon condensate, Fuller is very interested, Hans is a bit skeptical, but asks the right question: "At what temperature?" I answer that I suspect at the chiral restoration temperature, Gerry objects, I concede that it's speculation, and Hans nods. I try to give an argument why chiral restoration temperature is possible, but Hans interjects that we won't solve that problem today. He wants to go home. Dinner is at 6:30.

I arrive on time. Hans already sits at the table, with food on his plate. He makes no compromises in matters of food. During dinner we try to find the Italian word for 'vegetables', as Gerry cooked chicken with vegetables in an Italian way, and tries to say something like "polio al vegetabile". Hans suggests "verdura", but concedes that that might mean "salads". He goes on to say that he can guess the Italian equivalents of English words most of the time, and tells the story where, when he was in Italy, he wanted to buy some laxative, and asked for 'purgatorio'. The pharmacist smiled, but understood, and told him it's 'purga'. We talk about southern Italy, and

how Pierre[1] always maintains that he is tall for an Italian, yeah, maybe with respect to those in the South! Hans mentions that many Italians that he has known were quite tall. Fermi, he concedes, was considerably shorter than he, adding that at the time though he (Hans) was several inches taller than he is now, and that Fermi had an assistant (Rasetti) who was taller than he was then. We also discuss a little bit of physics, specifically Hans wants to hear about the talk Gerry and I went to that afternoon, about solar neutrino detection. I tell him that the girl who gave the talk, a first year graduate student, reported that they see too few neutrinos, just like in the chlorine experiment, but that these are low energy neutrinos from the pp fusion reaction in the sun. Hans of course obtained the Nobel prize for his theory of energy production in the sun, which predicts many more neutrinos then observed on the ground. Gerry says that Hans is pleased with this result (too few neutrinos) because of his new theory of neutrino transformation and oscillation that predicts just that, and goes on to joke that Hans always tries to grab at any straw that would prove that he didn't get the Nobel prize for a wrong theory. Furthermore he says that the SNO experiment will really decide about that, and Hans agrees.

After dinner, Gerry goes to lie down on the couch to have a short nap, while Hans is still finishing his chocolate cake and chocolate ice cream dessert. It is his third helping. I ask Hans about different solar neutrino experiments, and eventually we get to talk about the SNO experiment, in northern Canada. He explains the process, the technology, the difficulties, the one thousand tons of heavy water that are needed for that, at $200 per liter of heavy water (loaned from the Canadian government) and marvels at the neutrino detection efficiency. We discuss its applicability to supernova neutrino detection, and again he is enthusiastic.

Somehow, the topic returns to Germany. Hans says he grew up in Frankfurt, and still likes that city. He asks if my parents still go to Germany, and I answer: of course, since many of our relatives still live there. I tell him that my father's family lives in the 'Pfalz' (Palatinate), and he mentions that he also has some relatives there. I also mention that my mother's family lives in Ludwigshafen, and talk about where my parents come from originally. Then, as I realize that he likes to hear the names of German towns, I tell him that my father's family lives close to Germersheim. At that moment, his whole face lights up, and he exclaims:

"Germersheim! One of my earliest childhood memories is associated

[1]Pierre Pizzochero, former graduate student of Gerry's at Stony Brook

with Germersheim." After a slight pause he goes on: "I was born in Strassburg, and when I was six, my father obtained a call to a professorship at the University of Kiel. So, we took the train to Kiel. It was a night train, with sleeping compartments, and I was very excited. In the middle of the night, I looked out of the window, and saw the train station sign announcing Germersheim go by. This is all I remember, I don't know why this has remained. I was very excited, a little boy travelling in a sleeping compartment."

"When I was eight," he continues, "I moved to Frankfurt." I ask him whether he had ever returned to Frankfurt, after the war.

"Of course," he smiles, "the planes land there. Also, I returned after the war to visit my father, who still lived there. Also when I visit my sister in Neuwied, it's easiest to go by Frankfurt."

We talk a bit more, in a fairly relaxed way, about Brussels. He mentions that he went there a couple of times; for example for the 1961 Solvay conference, and we both marvel about the Grand' Place. He tells me how he always thought it unreal that people actually lived in the houses around the Grand' Place (Brussels' central square), and I'm surprised, as this is what always goes through my mind when I walk over there. I tell him that, and we seem to have a genuine understanding. I relay to him similar impressions that I got from Regensburg in Germany, from little streets with the facades of houses that seem to lean inwards. I tell of cobblestones, and of the marks that the axles of horse-drawn carriages have left at the corners of the streets, hundreds of years ago, and that, on a silent night, one can mistake this century for another, earlier one. He listens to this in genuine delight. We talk about the history of Regensburg, and how it became to be a 'Freie Reichsstadt'. I add that its decline later was probably due to its losing this status, and he interjects that this was probably due to Napoleon. We talk a bit more about Germany, and a bit of physics. I see that he's somewhat tired, and say that I should go back to work. On the way out I see that he picks up the more interesting parts of the newspapers lying around on the couch table. Gerry told me earlier that Hans likes to read sometimes several hours a day. Before going out of the door I raise my hand and say loudly: "See you tomorrow". He smiles and waves his hand.

Wednesday, Jan 22nd.

A quiet day. We meet at 11 am for discussions. This time around we have Edward Shuryak from Stony Brook. It's an interesting discussion but

nothing really stands out. Hans seems somewhat unconvinced about what Shuryak presents, I on the contrary find it quite impressive. I could always relate to Shuryak's way of thinking. Lunch at the Athenaeum: Hans, Gerry, Edward, and I. We all have 'Blanquette de veau', which is on today's menu. I note that it's a Belgian speciality. While not being absolutely sure, I assume that no one is going to contest it. From then on the subject is language, namely Dutch first, whether I speak it, etc. Hans asks me where I went to school in Brussels, and I tell him about the European School system.

Not much discussion during lunch. Gerry wants to show off Hans in front of Edward by telling some anecdotes, for instance the one about this problem in radiation from electrons, when Weisskopf got interested. Bethe told Weisskopf then: "Sure you can solve the problem, it will take you three weeks. I can do it in three days." And so he did; it is the Bethe-Heitler formula now. Then we come to speak briefly about Hans's time in Italy, and Hans mentions a paper he wrote in 1931 with Fermi, on the quantum mechanical interaction of electrons. Gerry then mentions another famous work of Hans's, solving, I believe, the problem of the magnetic spin chain, with the now so famous "Bethe ansatz". Gerry smirks that Fermi was totally uninterested in this work, and asks Hans if Fermi ever read that paper (as they were collaborating at that time). Hans shakes his head: "I believe not." Edward interjects that he finds that strange, seeing that one of the last papers of Fermi was the famous Fermi-Pasta-Ulam problem, from 1952, involving chains of nonlinear harmonic oscillators. They tried to solve that numerically, but couldn't get the system to equilibrate. This, it later turned out, was due to them having a set of parameters which made the model close to exactly solvable, of the Toda type. This of course was realized much later. Anecdote: at the end of Hans's paper on the one-dimensional spin chain he says that the solution to the two- and three-dimensional problems are 'forthcoming'. Needless to say, they still are. Hans asks if anybody ever solved them, and Gerry answers negatively. Hans shakes his head: "After all this time!" After lunch we grab our coffee mugs and have more discussions. Gerry mentions on the way to the office that the Soviet (Russian!) Embassy had called to tell Hans that they had a letter for him from President Yeltsin. I make a mental note to inquire about that at dinner.

It is 6:45pm, and Gerry has made pork loin roast. He gets to be pretty good at this cooking thing. We don't talk about physics at all that evening, (at least not with Hans). The subject is college, generated by Gerry having been called by his wife Betty on some affairs involving their son Titus's college plans. Specifically, we discuss Stony Brook as an option, and when

Gerry says that it is not that easy anymore to get into Stony Brook, that they had to turn hundreds away last year, I just mention that probably they raised their academic requirements such that they don't admit anybody with a criminal record. Gerry answers dryly: "Sure they admit criminals". Then I go on to relay my first-year teaching experience at Stony Brook doing PHY 100, and about the person having all the trouble in the world to obtain the result for one thousand divided by one thousand. Hans hardly believes it; during the story I constantly have to make it clear that I'm not making it up. Hans is amused. Somehow we move to the subject of Hans's family again, in fact, it is a consequence of Gerry mentioning that he had a half-brother born in 1899. Hans mentions that he also has a half-brother, who is 27 years younger. He tells about his father having a 'new batch' at age 61, says that it was nice when the children where small, but that it was hard when they were teenagers, as their father then was 'decrepit', as he puts it. He also talks about the hardships of war during that time, his father's house in Frankfurt having been bombed such that they had to move to a small town a hundred kilometers north. Also, he says, the Nazis didn't like his father ("That feeling was mutual", he adds) and forced him to retire early. After the war however, the Americans gave him back his job as professor for physiology at the University of Kiel, at age 74. He says that there were a lot of students, but not much material or labs. His father's only help was the lab assistant. Gerry throws in the anecdote of the assistant of Sommerfeld, in fact the machine shop assistant, who owned a ski lodge in the mountains, where Sommerfeld would always take his guests.

Finally, I ask about the letter from Yeltsin. Gerry had told me earlier that evidently Hans had written a letter to Boris Yeltsin with his idea of how to make the Ruble convertible. So I ask what Yeltsin's reaction to his proposal was, and Gerry jumps in and asks, "What proposal was that anyway?" So Hans begins:

"I guess now I can talk about it. I was thinking about why the Russian economy wasn't working, and I reached the conclusion that nobody has any confidence in the currency. If somebody is producing goods, then he's not selling them because he doesn't trust the money he obtains. So I thought about the experience we had in Germany in 1923, when everybody had lost confidence in the Reichsmark, and the value of the money changed by twelve orders of magnitude. Then they introduced the Rentenmark, and backed it by the value of the agricultural land in the country. While success was not expected, the scheme actually worked, and the $1 : 10^{12}$ ratio remained approximately constant. So I wrote to Yeltsin that they should

do the same, but not back it this time with land, but with their oil, as they have huge oil reserves." After discussing this ploy a little bit (it turns out Hans knows a lot about economy and finances; one of his sons, Henry Bethe, is a vice president with Chase Manhattan bank, and the inventor of the "variable return preferred stocks", an instrument that it seems was of some importance some time ago). Gerry recalls how astonished Edward Shuryak was when Hans was picking up the telephone and it transpired that he was speaking with the Russian Embassy, answering them that, yes, he would like a translation of Yeltsin's letter as he couldn't read Russian. Gerry maintains that Hans did this just for his ego, that he timed it perfectly to show off to Shuryak, and Hans grins.

We talk a bit more about money management (Gerry likes to talk about it) and pension funds. I throw in my two cents' worth, and Hans is amazed. "Where do you know all this from?" "Well," I answer, "I just started this job as a postdoc, and they gave me a two hour lecture about TIAA/CREF and the like, but it's not as if I am thinking about retirement." "Yes" he says, and grins.

After dinner Hans says good night and disappears in his room with a book. I have another discussion with Gerry about Shuryak's talk, then go back to the Lab where I'm sitting right now, writing this.

Thursday, Jan. 23d

No visitors today. At noon we have lunch at the Athenaeum: Hans, Gerry and I. I don't remember much from the discussion now. We talk about recent news, Algeria for instance, and about the difficulty of choosing sides. Hans has his plate heaped up with what looked to me like legs of some animal, while Gerry and I have fish that seemed miniscule in comparison. Hans calls his dish: "Quite a responsibility". After having gossipped about Ismail's[2] recent marriage, Gerry throws in that Rose Bethe's mother was, as he sees it, very much in favor of her daughter's suitor, and Hans agrees, revealing that he had already known Rose when she was a twelve year old girl, and was often asked to take her for a walk. Also he quips that Rose often would tease him by saying that he would really have wanted to marry her mother. So the subject changes slightly to Hans's wife's mother, Ella Ewald, who in turn was the wife of the famous crystallographer Paul Ewald.

[2]Ismail Zahed, professor of theoretical physics at SUNY Stony Brook, and my graduate thesis advisor

They talk about Ella as if she were still alive, so I ask, and indeed she is. Gerry mentions that she had her 100th birthday last year, and that many of her sons and daughters came, all between 70 and 80.

Gerry somehow changes the subject to mention how he became famous, when a certain "Professor Sucher"[3] published a paper on the autoionization of atoms, mentioning in a footnote that the effect and its calculation were already known, and done by Brown and Ravenhall in 1951.

"Well", I said, "this happened to me too, but the other way around". Not without trying to impress Hans, I tell about my work on charmonium suppression in havy-ion collisions, and how it is the exact analogue of an effect described in the book 'Quantum Mechanics of One- and Two-Electron Atoms', by Bethe and Salpeter (which I don't mention as it is obvious), that book having been written about forty years earlier, I presume. But I tell Hans that I just had to change the differential equations in his book slightly, the rest was almost the same. I tell him that the result was that the charmonium states get ripped apart at the instant the colorelectric fields are of the same order of magnitude as the QCD string tension, and he quietly responds that, yes, this had to be expected, and Gerry agrees. I mention that this work proceeded very quickly, in about a month, and Gerry counters that I'm impressing nobody with one month, as Hans calculated the famous 1020 megacycles of the Lamb shift in the train to Schenectady in New York coming back from the Shelter Island conference (I believe this was in 1947). Gerry mentions the names of everybody who was at that conference (all the big shots) and how they discussed this new thing "Quantum Electrodynamics", and at the end of the conference agreed that one should calculate something. Gerry goes on to say that all the big shots weren't particularly pleased that Hans got the jackpot immediately after the conference, on the train no less, but Hans replies that this is probably not quite accurate, as many people expressed the feeling to him that they were very grateful, and that without this result the others might not have pursued the matter. I have to mention that this calculation of the Lamb shift is one of the mile stones of quantum field theory, and to accomplish this calculation without the technique of Feynman diagrams borders on the impossible. Yet it was done on the train, and, of course, correctly.

Dinner was scheduled at 6:45 and was ready at 7. We start by discussing the politics of the election year, and about Democratic candidate Bill Clin-

[3]Joe Sucher, professor of physics at the University of Maryland

ton since he appears on the cover of 'Time' magazine (Headline: "Is Bill Clinton For Real?"). Hans postulates that the Democrats can only win with a candidate from the South: "They have to carry the South". We talk briefly about Mario Cuomo who I favor for the 1996 elections, but Gerry gives him a bad record in funding education, seeing that the State Universities have to take a 15% cut this year. Hans and Gerry blame it on him, having reduced taxes last year, and having spent too much in the prosperity years. I disagree somewhat, as it makes no sense to not spend money when it's there, to not repair this or that bridge because there could be worse times. In bad times, one borrows. We're drifting into economy again, via a discussion of interest rates. Gerry maintains that after the recession the US will tumble into another inflationary period. "Mark my words", he says. He and Hans agree that Germany is very careful with its interest rate policy, and I remark that the country with the most stable currency in the EC (European Community) nowadays is Spain, owing to its very high interest rate. Hans is surprised, and Gerry nods, saying that in general Spain is doing very well, that it reminds him somewhat of the US in that businesses are sprouting very quickly, and only the fittest ones survive. We talk about the influence of Franco, and Hans says that he is very grateful to Franco for some things. I wonder what this could be and ask him, and he says it is a little known fact that Franco stood up to Hitler in the 2nd World War. He continues to tell the story (Hans is clearly a history buff) of how Hitler proposed to Franco that he should let him march unhindered through Spain, and that he would conquer Gibraltar for him. Franco refused, very wisely we all agree. This is all the more astonishing, I remark, as Hitler helped Franco in the civil war, bombing Guernica with his Air Force in 1937.

Somehow, Gerry brought the subject onto Wolfgang Pauli; I don't remember what was in between. In his typical manner Gerry remarks that: "Pauli was a smart guy". I am about to make my usual remark that he might have been smart but that he didn't publish much original stuff, when I realize that Hans probably knew Pauli personally, and thus would have a *slightly* better judgment of this fact than I, so instead I say: "I suppose he was", and turn to Hans. He, however, doesn't say anything. Then Gerry continues that after Pauli had had Weisskopf as a postdoc for one year, he was walking around shaking his head saying: "If only I had taken Bethe!". So I ask Hans if there was a choice and he says no, he never offered him the job. Gerry asks if he would have taken it, had it been offered to him. Hans thinks for two seconds then says: "I think not. I would not have survived it". We don't say anything for a while, then Gerry changes the subject. We

didn't ask him why that would be so.

During dessert the word 'supergravity' falls, and Hans asks me spontaneously what it is. So I try to explain to him what little I know about supersymmetry, gravity, and its unification, being slightly aware that I probably should not venture too far into gravity. He is satisfied at one moment, but I am not, as I remember that there was a bit more to supergravity than I could just summon up from my memory. However, I do tell him the story (that Peter van Nieuwenhuizen had related to us students at Stony Brook) of how they [4] discovered the supersymmetry of their theory at three in the morning, staring at all those vanishing coefficients of the computer-generated variation, printing on the output one by one. Hans likes that story, since it has this unmistakable scent of discovery to it. Later, still during dessert (remember Hans eats a lot) I tell him about the new CERN collider project, the LHC, and its competition with the SSC. I suppose we arrived there from my mentioning that supersymmetry might be found at these next-generation colliders.

While Gerry talks to Betty on the phone, Hans asks me whether I would prefer a (postdoc) position in Europe or in the States. I answer that it is basically a toss-up, and that I applied (as serious places) only to CERN and to Caltech, and would like to have the opportunity to choose. He agrees that it is always better to have a choice.

Friday, Jan. 24th

I am writing slightly later today, as tonight was "story-telling night", so to speak. Nothing to report during lunch, as we had the scheduled Friday lunch of the whole Kellogg Radiation Lab group at the Athenaeum. Hans skips those because he doesn't like crowds, as he can't hear if too many people are speaking at the same time. I went to work out in the afternoon, and arrive at Gerry's and Hans's apartment at 6:30. Hans is on the phone with his wife, and when we sit down to eat at 7, (Gerry made three big trouts) he tells us that he just heard he has a new grand nephew. For part of the meal we talk about Hans's grandchildren, and we also talk (or better, I tell) about the way history was taught at my school, this on the tail end of a thread that began with why I didn't have to go through military service in Germany. Hans asks whether I felt any animosity from the Belgians because of my nationality (a question that followed a discussion of the

[4] D.Z. Freedman, P. van Nieuwenhuizen, S. Ferrara, Phys. Rev. **D 13** (1976) 3214

German habit of marching through Belgium, and German war atrocities in Belgium), which I answered negatively. He also wonders whether history was taught to us in a biased way or not. Hans is delighted about my description of history class at the European School in Brussels, namely learning facts and thoughts through studying contemporary documents, and putting them in perspective. He said that this was very different at the time when he went to school, when it was all just dates of wars and battles.

He asks how my father went to school, so I tell him about his first years in school in Marienfeld in Romania, about how they were forced to learn the Romanian language, to when they had to flee from the Russians in 1944. I tell him about the vagaries of that time just as my father had recounted them to me, of grenades, pistols and rifles lying alongside deserted streets, with the kids picking them up to play; of carriages that smelled atrociously, with bodies falling out at times and nobody stopping to pick them up. While I'm at it I tell the story of my mother's flight from Silesia (now in Poland), of the house they left, thinking they would be back soon, the dowry for the girls that her mother had been sewing and knitting for years, all in the big suitcases that they had brought to the train station, only to have them stolen by a man who pretended to help with the luggage. Hans and Gerry are listening quietly. I tell of the children wearing whatever they could put on, all clothes on top of each other in layers, and now, with the mother crying helplessly, the father imprisoned in a war camp, the oldest daughter, my mother at age ten, having to take charge and ordering everybody into the train. It was to be the last train out of the city, the night train, and the war planes were circling like vultures. With every light out, the train thunders through the night, westwards at full speed, under enemy attack, glass shattering under the airplane's strafing fire, and children wailing crouched under the seats and tables in narrow compartments. Only the fire gushing from the overheated smoke stack betrays the fleeing train, visible by the frightened children as the train races through bends on the track. I finish the story and there is a little moment of silence. Then Hans says that, of course, they would use the planes to intercept the trains, as it was the only remaining means of transportation, the trucks having run out of gasoline. And trains were easy targets too.

"Of course," he begins, "I saw these things from the other side. I was very lucky in a way". Gerry interrupts to ask Hans to tell the story of how it all started when he was on vacation in Switzerland, in 1933. Somewhat reluctantly he begins to speak, says: "not all the details", but goes on:

"I was in Switzerland, and I get a postcard from my graduate student, it might still be preserved, and it reads: 'You have just been fired, what am I going to do?!' " Gerry asks what kind of position he held then, at the University of Tübingen, and he says that he was a lecturer giving classes in electrodynamics and nuclear physics. Later Hans tells the story of how before he got fired he was supposed to give a talk on the new paper by Chadwick on the discovery of the neutron, and how after some Nazi students were threatening to disrupt his lecture, Gerlach and another physicist suggested he should abstain, and he did. Hans continues how on his return from Switzerland they gave him the formal dismissal letter, mentioning that he would still get this month's (April) salary, but that he should pack his bags and go to his mother. He then went on to Munich were he obtained a position as Privatdozent. However, he was dismissed from this position soon after. I take the opportunity to ask Hans if they ever gave any reason for those dismissals.

"Oh," he said, "my mother was Jewish; this was all the reason they needed." I express my feelings how incredible this all appears to me, and he picks that up:

"It sounded incredible to my father too. He sat down and wrote a letter to Sommerfeld, somehow this letter is preserved–Sommerfeld kept it–and asked for advice. Sommerfeld was a very nice man, and helped all of his former students, so he wrote to Bragg at the University of Manchester, and Bragg offered me a one-year position there."

"There," Gerry interjects, "you learned how to live, in the care of Mrs. Peierls. She showed you how to cook, to wash your clothes, to clean the pans..."

"Yes" Hans smiles, "and they were some of the most productive years, these years 1933-1934. It was such a great atmosphere, so much going on! So very different from the time in Tübingen and even Munich". Gerry mentions some of his works from that time:

"You did the photodisintegration of the deuteron, the electron problem",

"Bethe-Heitler!" Hans throws in and literally beams,

"The theory of alloys!" Gerry continues.

"That was an idea of Chadwick" Hans interrupts again, as they exchange a battery of works and ideas.

"I never met Chadwick" Gerry reflects, "but he seems to have been a nice man". Hans objects:

"He was a sour man. He was nice as a person, but he was sour, a

queer personality. Very unlike Bragg, who was charming." I ask whether Chadwick also worked in Manchester, and Hans answers no, that he was at Cambridge.

"Peierls and I would take the train to Cambridge, it was a terrible journey, the trains were so slow. Once, Chadwick had invited us and told us that they were doing these new experiments, and they were getting results, but he bet with Peierls and me that we couldn't calculate them. So on the train back, we solved the problem, I mean we still had to do some calculations, but we understood it, it was the photodisintegration of the deuteron." We're all laughing; Gerry says that Chadwick shouldn't have bet with these two smart devils, but Hans, still laughing, says that Chadwick probably made the bet so that they would work on it for sure! This is when Hans tells the story of how he was to give a talk about Chadwick's discovery of the neutron in Tübingen in 1933 (which I relayed earlier). The discussion then turns to Gerlach.

"He was a very nice man" Hans maintains, "also Stern."

"Unlike Stark", I interject.

"Stark was a terrible terrible Nazi!" Hans's face grows grim. "Much like Lenard, they were terrible people."

"But Gerlach wasn't nice to Trudi Goldhaber?" Gerry asks.

"No," Hans answers, "they didn't get along well. I don't know what it was, he wasn't nice to her." I inquire about Trudi Goldhaber and find out that she is the wife of Maurice Goldhaber, now at Brookhaven Labs, and was herself at Brookhaven until they 'let her retire'. She proceeded to accuse the Lab of discrimination which, Gerry admits, was probably true, and was so dismayed at being let go (while her husband stayed on) that she got so sick that she had to stay in the hospital for months, without anybody being able to find anything wrong with her.

"It was all psychological", Gerry shrugs. I find out that Trudi still lives, and that she's doing much better now. Gerry and Betty visit her at times. Trudi Goldhaber is also the mother of Fred Goldhaber of Stony Brook, and the sister-in-law of Gerson Goldhaber, to complete this family of physicists. Trudi Goldhaber is German, Gerry points out.

It is now Gerry's turn to tell a story, and it is spurred by the reminiscence of all these British physicists. It is the story of how he wrote a paper with D.R. Hartree.

"Oh you did?" Hans is surprised.

"Well" Gerry continues, "I had pretty much figured out how to do the Lamb shift in heavy atoms to all orders in perturbation theory, using

Green's functions. So all I needed was some wave functions to calculate it, and Hartree had this potential ready, and he was very good on the computer. Well it wasn't really a computer, it was one of these mechanical things where you have to crank, but he was a real wizard with it, so we sat down and he was putting in the potential and doing the calculations for me. Then I wrote the paper for the Royal Academy of Sciences, and in the acknowledgements I wrote 'I thank D.R. Hartree, D.Sc, F.R.S. for doing the calculations for me', and when Peierls saw the draft he almost gagged, because "you don't thank a fellow of the Royal Society for doing your calculations!"

"But Hartree probably wouldn't have minded, he used to thank his father for doing calculations in his papers", Hans adds.

"Of course not", answers Gerry, "he wouldn't have minded. I think I put Peierls name on the paper too, afterwards."

The discussion shifts toward the drudgery of being on committees, and Hans quips that he has learned from Karman how to deal with these matters: When somebody calls you if you could be on this or that committee, you ask if they want you to work, or whether they only want the name. Then they would stutter somewhat on the phone and then admit that, yes, in fact all they were interested in is to have the name on the committee. Then you agree, and that is that. I ask Hans about (von) Karman, and he immediately sets out:

"You know that he was here at Caltech, of course." (That is hard to miss, as several buildings here are named after him.)

"In 1940, when Paris fell to the Germans, Teller and I decided that it was time to do something for the war effort. We decided it was best to ask Karman, as he was knowledgeable about these things. So we drove down here...'

"You drove from Cornell?" Gerry asks.

"No, I was at Stanford at the time", says Hans, and Gerry insists:

"What were you doing there?"

"I was lecturing at a summer school."

"So we drove down here and Karman tells us we should look at shock waves, shocks in a medium, and how it chemically changes as the shock wave passed through. So we looked at it, and it became a very nice paper, but of course we couldn't publish it because it was secret. We found how the medium would become very dense and heat up as the shock passes through it, and, if you have air for example, then first the molecules would get excited and you have some energy absorption from the vibrational modes,

but that's not the important effect, the oxygen molecules get dissociated, and then ionized, and NO forms behind the shock. All this eats up a lot of energy so the temperature behind the shock falls rapidly, and we calculated all the observables, the temperature behind the shock and at what distance. It was later published in an obscure place, the 'Aberdeen Proving Grounds' in Maryland, because we weren't supposed to put it into a renowned journal." Gerry asks if it is declassified now, and Hans says that it was never really classified, it was just not to be published. Gerry mentions how he was asked to give the hydrodynamics class when he was in Birmingham, when Peierls gave him the notes he himself was using, which were largely Hans Bethe's notes on shock wave formation and propagation, and how he used them over and over again; also when he did the supernova, and how he got together with Hans then and Hans (referring to the supernova) decided to "make the thing explode, come hell or high water". Gerry assures that he still has these notes, in perfect condition, that everything is in there, and starts giving examples, any one of which make Hans nod enthusiastically:

"Adiabatic flow at the beginning of the shock..."

"Yes, yes!"

"Theory of convection, transfer matrices..."

"Ah, yes..."

They lost me quickly in this exchange, as I know absolutely nothing in this field, and therefore can't remember more of the technicalities they were mentioning. Gerry also relays the anecdote where Hans is giving a talk in Seattle about convection currents (these seem to be associated to shocks, one of Hans's preferred subjects) and mentions that a specific equation wasn't directly solvable analytically, and this woman in the audience asks him what he did, and he says that he put it into the form of two coupled differential equations, and solved them numerically. Gerry, grinning now, says he already knew Hans pretty well then and later walked up to him and asked him "How many points did you use" [to discretize the equations] "four or six?" Bethe is laughing out loud "Four of course!", the joke being that Hans never used a computer but did the whole thing on a slide rule! Hans is unbelievable with a slide rule.

We (they, really) talk a little more about the convection currents, and why there is no mixing of material, then we make appointments for breakfast, and the following hike in the mountains. Hans says that it's going to be a slow hike because he can't walk that fast anymore, but Gerry gives me a paper that he received that day and says that I can report on the electric condensate tomorrow during the hike. I take the paper, though I know that

Gerry isn't really serious about the report. Also, I didn't have time to look at it since just before dinner, when I had a quick peek, mainly because I had *this* stuff to write up...

Saturday, Jan. 25th

A long hike in the morning until afternoon, dinner in the evening, and a lot of stories. I wish I could take notes, but of course I can't. I don't think they would talk as freely if they knew I 'recorded' everything. For instance, tonight at dinner, Gerry told a story that involved him and C.N. Yang, his direct boss at Stony Brook, in 1967. He said it's not for public knowledge, but here it goes. He (Gerry) was at the time in some way involved with T.D. Lee, either directly or indirectly, I don't remember. It must be said also that although Yang and Lee had the most fruitful time in their career collaborating, obtaining the Nobel prize for discovering CP-violation, they are now in a constant and bitter feud, which, to make it short, mainly was about who would be first author on their joint papers. So Gerry, having something to say about his relation with T.D. Lee, told Yang: "Well, you know how it is to work with him", upon which Yang turned slightly red and asked Gerry into his office. There, he announced quite solemnly and slightly angrily, that "Since I've worked with Fermi, I've never worked with anyone. People worked with me!". Gerry clearly felt reproached by that episode, but adds that he later became one of Yang's best friends, and that he always greatly admired him.

I was at the apartment at 8:30 am, for breakfast. We left at 9:00 and drove up Mount Wilson. Slightly below the peak we parked the car and went on a trail that presented a handful of breathtaking vistas of mountains and cities in the mist, which I wish I could have the time to describe, but haven't, as I only have these couple of hours after dinner to write down these notes. I was slightly worried how the hike would go, how Hans would manage it, but as always he surprised me. We left on the trail at 10 in the morning and came back to the car at 3 in the afternoon, and Hans still looked fresh, and quite obviously pleased with his performance. We had set out on the trail on a slightly overcast morning, which made the hiking much easier. Hans walks steadily, with his upper body slightly angled forward and his hands folded behind his back. Wearing sunglasses and a brimmed hat he almost looks disguised, and moves steadily, and certainly not hesitatingly. As I still have sore muscles from the workout the day before, I'm glad he is setting the pace. So we walk along the trail, over difficult terrain, up and

down, large sections through treacherous snow that covers the shaded sides of the mountains. Wearing only sneakers I almost slipped a couple of times, while walking about a meter behind Hans, hoping to catch him should he fall. Of course, he never did or came close to it (unlike I), not to mention that I probably couldn't have held his weight. We do not talk much on the way down to 'Inspiration point' where we would eat, rest and then return. When we did talk we chatted a bit about his family, of his daughter who is married to a Japanese man, has two kids and lives north of Kyoto in the mountains, and his son Henry and grandson Paul, named after Paul Ewald, his father-in-law.

Hans also talks about how his children learned German after the war, vacationing near Munich in a house or mansion that once belonged to Rose's grandmother, and that was returned to them after the war. Gerry and I also discuss some physics, but I'm not really interested, so Gerry quits after a while. On the way back we discuss school, after Gerry complained that his son Titus never does school work, and complains about me having given him a bad example by telling him that I hadn't either[5]. I defend myself by saying that I told him also that you have to work hard at least once in your life, and that I did so in the first years at Stony Brook. Hans thinks back and notes that he worked hard from age 13 to 16 learning calculus, thus just after the first war, and that that gave him enough of an advantage for the rest of his school years. I continue my thread telling about how I took my qualifying exams after two years (trying to impress Hans all at the same time, of course) and when Gerry asks whether I passed the exams as the best of the year, I told him that I did pretty well, but wasn't the best, and as defense mentioned that I didn't have the time to study more than a month, being in the middle of finishing a paper. Asking me about what paper that was, we come to talk about my charmonium paper[6] again, and since I smell a way of getting some stories out of Hans again, I tell him again how I only had to somewhat change the differential equations, which I got out of his book. So he turns to me and asks:

"So you think I had already done everything, then?" Naturally I say yes, which in fact is pretty close to the truth, at least concerning that paper, and he smiles and says: "That is nice to know." I then go on to ask him about Cornelius Lanczos, who wrote the original papers about the strong-field Stark effect, only to find out that he never read these papers (although

[5]Titus is now finishing his Ph.D. in biology at Caltech
[6]Phys. Lett. **B 217** (1989) 5

the results appear in his book). Immediately then I turn to Schrödingers original papers about the low-field Stark effect (which I had read at the time) and of course, those he had also read. We take turns marveling at some details of these really very nice papers, and go on to Schrödingers personal life, as is inevitable. Schrödinger was, as supposedly everyone knows, a compulsive womanizer. Hans maintains that he in fact kept several mistresses at the same time, while all the time not only his colleagues, but also his wife, knew all about it. Hans describes how despite everything she always would stick to him, but would finally have a lover herself, which we found, after all, was just fair. Because of his unstable life Schrödinger had difficulties of finding a permanent position after he quit the University of Wien, and ended up in Ireland, from where he would take frequent trips to the States. Strangely enough, Hans remarks, Schrödinger never achieved anything of similar importance after his series of papers on quantum mechanics. He didn't do anything worthwhile before, and after that he was so famous he thought it better to write more philosophical papers. The Schrödingers, as it turns out, were close friends of Hans's parents in law, the Ewalds.

We talk briefly about Kramers, whom Hans genuinely admires, touch on Nazi war atrocities against the Dutch (Kramers being Dutch) and somehow end up talking about the first neutron time-of-flight detector made by Bob Bacher, who was later in the Atomic Energy Commission. Hans mentions that before that Bacher was the leader of the experimental division in Los Alamos, and that for me is the signal to ask about his Los Alamos recollections. Hans, of course, was the leader of the theoretical division. We talk briefly about the general structure of the Los Alamos project, which consisted of the divisions just mentioned and the engineering division. Each division had a number of groups, with group leaders coordinating the efforts. Somehow we end up talking about the calculational effort, and I ask Hans what Feynman's contribution was. Hans maintains that his contribution was enormous. He was named the group leader for computation after a while by Hans, and singlehandedly led the team to success. In the beginning, they were doing their computations on hand-held mechanical machines, a tedious and time-consuming task. Then someone suggested that they should get "one of those IBMs". Of course, money, or any resource for that matter, was no object, and inside a couple of days a great many crates arrived, with minimal unpacking instructions. This proved to be the challenge that Feynman, and his assistant Nelson, needed. Of course they knew nothing about computers to start with. Nonetheless, they had the machines running after

slightly more than a week. Ten days after delivery, an IBM specialist was sent to set up the machine and just couldn't believe what he saw. The technician conceded that this had never been done before. After that, the task began to program the machines and obtain results. Millions of cards were punched and filed, and results were pouring in one by one. All the while, Feynman was supervising the effort and coordinating the calculations. (His account of that is in his book [7]. I remark that it's strange that a man of Feynman's abilities would be overseeing the numerical activities, and Hans answers that this was a critical piece in the bomb effort, and that Feynman had a great talent for things mechanical. Besides, he says, Feynman could do absolutely anything. He further tells the story that earlier, the group leader in computation was a young physicist by the name of Frenkel. He was very much in love with these machines, and would play with them all day, which Hans said he could understand. Nevertheless, one day he decided that "this will not do", and asked Feynman to take over, giving Frenkel to Oppenheimer. At the same time, he ordered another young physicist to assist Feynman, by the name of Metropolis, who, as Hans puts it, "took to the computer as a duck to water". With Feynman and Metropolis on the program, the computational problems were solved. I cannot help to feel cheated that Feynman died so early. If he hadn't, he might possibly be walking right alongside of us now, and I could listen to his Brooklyn accent.

While talking about the group leaders, the name Klaus Fuchs falls. I inquire about him. "He was one of our most valuable group leaders" Hans comments. I want to know more and ask whether the damage done by Fuchs was important.

"He gave them everything, on a platter" he answers, very slightly animated. "He knew all the details, knew them better than I. He knew how to make the Plutonium, and he knew about the implosion. We calculated that the Russians could make a bomb in an absolute minimum of five years, starting in 1945. They tested their first bomb in 1949, after four years! But Fuchs had started giving them everything we had since 1942! He had an agent in Santa Fe that he met regularly. All the while he was a very important, and very effective group leader." I ask what became of him, and learn that he was the deputy director of the (now defunct) Nuclear Research Center Rossendorf near Dresden, in East Germany. "He never regretted what he did" Hans says, shaking his head, "and that, I resent." I ask why Fermi was not in Los Alamos during the time, and Hans answers that he was,

[7] R.P. Feynman, *Surely You're Joking Mr. Feynman* (New York, Norton, 1985)

during the end, but that he was needed more in Chicago (Fermi lectured at the University of Chicago) where they were building and testing the reactor that was supposed to breed the Plutonium. The pile was being built by the Dupont company, and Fermi was supervising their efforts. Hans tells of one event where the reactor was finally working satisfactorily, and Dupont decided to shut it down for a while. When they tried to activate it again, it wouldn't. The reaction just died every time they tried. So they called 'Mr. Farmer', which was Fermi's secret identity. (Of course we asked Hans what his secret identity was, but he said he had none, that only when he was travelling for the project he went by the name of 'John Doe'.) Fermi started to look at the problem. After a couple of days of intense testing and thinking, he came up with the answer: Among the fission products generated in the operation, it turned out that a Xenon isotope had formed, "with an immense neutron capture cross section", which would stop the chain reaction. Once they figured this out, they could restart the reactor. Hans maintains that without Fermi's intervention it would have taken them weeks to figure out what was wrong. Gerry asks whether Niels Bohr had any part in the effort. Hans smiles:

"Yes he did, an important part. It was in 1944, we were looking for an initiator that would start the implosion, to get all the Uranium, or Plutonium, in this case it was Plutonium, close together. We needed something that would work fast, and reliably. The problem was to get enough neutrons quickly, but there should be absolutely none before the initiation. We put two groups to work on the problem, supervised by three people, Critchfield, Fermi, and myself. Fermi was heading one group, Critchfield and I the other. Fermi came up with a design, and so did Critchfield and I, and we went into testing. It turned out that the Critchfield design worked really well, whereas Fermi's was not a hundred percent. Nevertheless it came to a vote, and Critchfield and I voted for our design, while Fermi voted for his. However, it wasn't very wise to contradict Fermi. So we asked Niels Bohr to look at the test data. After two weeks he came back and recommended our design, which settled the matter. So this was Bohr's contribution: you circumvent higher authority by going to an even higher authority!"

At dinner we had several discussions, of which I will pick out only one. Because it seemed appropriate at the moment, I asked Hans about Majorana, the famous Italian physicist who disappeared while still very young. He is presumed to have committed suicide. I ask him whether he met him.

"Indeed I did" he answers, "as did everybody. He was a very shy man. I couldn't communicate with him much, as he spoke neither German nor

English, so we could only communicate in my poor Italian."

"It was in Rome in 1931-32, all of the Italian physicists were there; Majorana, Segrè, who was Majorana's mentor, Amaldi, Fermi and Rasetti. Of them, Majorana was clearly the brightest." He briefly relates the story of how Heisenberg had constructed a theory of the neutron. Majorana read it, realized that it was wrong, and proceeded to construct the correct theory.

"Then," Hans continues, "there was the problem of getting everybody a position. The trouble was that there was one postdoc, who clearly was the worst of the bunch, who was the son of a very important politician. To win a position, however, everybody had to enter the 'concorso', and it was clear that Majorana would win. There were three openings that year, and in the end Majorana got the position without taking the concorso, Amaldi came in second, and somehow the politician's son got the third position." There is a brief silence, and Hans's face turns grave.

"I think Majorana committed suicide. He was a very silent person, very insecure, and he only confided to Segrè. When he got the position, he had to teach, and he was very uncomfortable with that. He didn't like to speak in front of an audience, he was so insecure."

During the discussion I found out that Hans and Fermi were speaking German to each other, just as Hans and Segrè. I also found out that Mrs. Peierls had a very loud voice. Many more things were discussed during the hike and at dinner, which I am now too tired to remember or to write down.

Sunday, Jan. 26th

Dinner at Hans's and Gerry's tonight, with two guests, Judith and David Goodstein. She is archivist and faculty associate at the department of history here at Caltech, and just published a book about Caltech's history [8]. He is professor of physics and vice provost, also here. They arrive at 7pm, just after the Super Bowl game has ended (the Redskins won against the Bills, 37-24). We have hors-d'oeuvres in the living room (which also is the dining room, but we sit around the couch table). The conversation is good-natured, Hans is the center of attention, naturally. The Goodsteins had both known Sir Rudolf and Lady Peierls, and stories about her abound. Gerry imitates her accent: "Zis how you clean pans, Bethe?" and Hans laughs loudly and cheerfully. Hans has a very 'German' laugh, it is really a loud: "Ha, Ha, Ha, Ha". He proceeds to tell the story of their important

[8] J.R. Goodstein, *Millikan's School* (New York, Norton, 1991)

dinner, at the house of Peierls in 1934 in Manchester.

Peierls and Hans were very young (Hans was 28, Peierls a year younger) and they had an important Italian physicist as a guest. Mrs. Peierls had cooked a duck, and apparently it turned out pretty tough, so Mrs. Peierls called Hans into the kitchen to help with the carving. The job turned out to require considerable strength, and all the while that Rudolf Peierls was entertaining the guest, Hans and Mrs. Peierls were finding themselves pulling at a duck's leg each, leaning against it to the point of rupture, as Hans and Mrs. Peierls were heard flying through the kitchen. Hans has a marvellous way of relaying this story, with a keen sense of comedy, and we're all laughing with tears in our eyes. Next in line is Hans's story about how his son got hired at Chase Manhattan Bank. In fact, as he recounts, what Henry was really good at, is Bridge. Gerry imitates Mrs. Peierls again: "Boy need only be good at one thing!" To our amusement Gerry maintains that Lady Peierls decided what would be the future of both the boys he then had (she was not interested in the fate of girls), and of many other professor's too.

Hans continues his story. In the New York Bridge Club his son made the acquaintance of a Chase Manhattan executive, who took a liking to him, and one day mentioned that his bank is looking for a young, bright person, and motivated Henry to present himself. So he did, and was interviewed by some people from the personnel department.

"In what branch did you obtain your Ph.D.?" he is asked, and to their astonishment answers that he does not have a Ph.D.

"Dear Sir," he is lectured, "we are turning away Economics Ph.D.s by the dozen, how do you expect to get hired for this position? What degree do you have anyway?

"None" Henry Bethe answers, and is asked to leave. He relays this to his friend at the Bridge Club, who arranges another interview, this time by the Bankers themselves. They ask different questions. They ask what he would do in specific situations, like what he would do if their Japanese branch would be losing money, and such. After an hour of interview, he is hired. This leads to an internal investigation of hiring practices, which leads to nothing. When they review his performance after one year, they relay his excellent performance to a higher executive of the bank[9]. He looks at the report and asks: "What degree does this Henry Bethe have?" The reporting person shuffles his feet nervously:

"None, Sir."

[9]I learned later that this 'higher executive' was none other than Nelson Rockefeller

"Well, then get him one!"
So they go to Henry Bethe and present him with a choice: "Do you want us to buy you a degree or do you actually want to work for one?" Choosing the latter option he obtained an M.B.A. at Columbia University, while working at Chase.

We go to sit at the table. The discussion is mainly politics, specifically the Democratic bid for the presidency, which we all agree can only be successful in 1996, possibly with Cuomo as candidate. Hans, while liking Cuomo seems to favour Lloyd Bentsen of Texas, as he believes that the Democrats "have to carry the South." We also discuss the disintegration of the Soviet Union. David Goodstein voices his fears that the world is now a more dangerous place, but Hans disagrees.

A snippet of interesting information surfaces. Hans was, as is well known, one of the chief advocates and negotiators of a treaty banning nuclear explosion testing (during the Khrushchev era). This treaty was near completion when all negotiations over it were unilaterally cut off by the Soviet Union. The incident that had apparently provoked it was an unauthorized spy mission by a U2 spy plane over the Soviet Union, unauthorized by the latter, of course. Recently, however, Hans talked to one of the negotiators, to whom he still has contact. He didn't reveal his name, but hinted at the fact that he is, or will be, the ambassador to Sweden. I suspect it is (Georgi) Arbatov, whom Hans had mentioned some days earlier, and to whom he had given the letter to Yeltsin[10]. In the course of the discussion with this official, Hans remarks that he was truly sorry about the U2 incident, and that that had prevented the signing of the treaty. "But no," the official exclaimed, "this was not the reason at all!" He then went on to describe a sudden shift in the power structures of the Soviet Union, completely undetected by Western observers, that forced Khrushchev to take their hard line. The U2 incident was a welcome excuse to not sign the treaty, and subsequent echoes of the hardliners' influence where the Cuban missile crisis (which, as is now revealed, was much more serious than believed at the time, since live nuclear missiles were actually stacked in Cuba), the building of the Berlin wall, and the ousting of Khrushchev himself.

Judith Goodstein has a new book project, and as it is a collection of Feynman's writings, a 'Feynman Reader' of sorts, she is asking for our opinion about several choices she made. We generally agree that her choices

[10]Instead it turned out to be Oleg Grinevsky, former security adviser to Khrushchev, and ambassador to Sweden from 1991-1997

are interesting. I propose to her to use excerpts of his 1968 Acta Physica Polonica article on his attempts at quantizing gravity and Yang-Mills theories, and his discovery of ghosts, as it is really a transcript of a recording that was made while he was giving a talk at a Polish summer school. I was pretty sure that she didn't know the article, and indeed nobody does, not even Hans. But it is the most 'Feynman' article I ever read; it is amusing and sobering and just about awe-inspiring. At the table, I paraphrase some of it and everybody loves it. Ending my little discourse, I feel a little saddened again. The table we are sitting at seats six. To my right is Hans, Gerry is opposite of me. David Goodstein sits opposite to Hans, whereas his wife Judith sort of heads the table, between her husband and Hans. The place on the opposing end of the table facing Mrs. Goodstein is empty, and this is precisely the place where Feynman would sit now, had he lived, as he was a good friend of all of those present, excluding me. I mention this and David Goodstein agrees, yes, he would probably sit there.

Mrs. Goodstein seizes the moment to ask Hans whether he could date a letter that he once sent to Feynman, and that she found in the archives. She describes the contents, namely Hans urging Feynman to write up what he had, to "publish now, before someone else does. It is time to write things down!" Hans smiles:

"This was good advice wasn't it?"

"So you do remember the letter?" Mrs. Goodstein asks. Hans has this expression on his face that I have come to associate with moments where he is extremely pleased with himself.

"Indeed I do" he answers, his eyes beaming out of slits, with a smile which I can only describe with the German word 'verschmitzt'[11].

"If I give you a copy of the letter could you date it then?"

"I can now, if you want!" he triumphs.

"I was on sabbatical leave from Cornell at Columbia University, it was 1948, the spring of 1948!"

Hans's memory is, as must trickle through these pages, absolutely phenomenal. Subsequently he reveals that he keeps a diary up to this day, ever since his Los Alamos days, after he found out from Robert Bacher (the head of the experimental division at Los Alamos) that he was keeping one, a very accurate one. Bacher's Los Alamos diary turned out to be invaluable, as the secretaries there strangely enough did not record the daily goings-on. It is, however, still classified. Someone asserts that most of what is in there

[11] Roughly: "mischievous, whimsical"

would probably be known by now. "Yes", Hans answers, "most of it, except the dates!"

The discussion turns to J.R. Oppenheimer. This is a dicey topic, as Gerry and Hans cannot agree, and decided some time ago that they would not discuss Oppenheimer anymore. Nevertheless, everybody wants to know their impressions. Gerry starts by saying that Oppenheimer is Hans's hero. I look over to Hans, and his face literally says, "Yes, he's my hero." Hans says that nobody but Oppenheimer could have led the Manhattan project, and that he did it absolutely brilliantly. Gerry, being a postwar physicist not involved in the project, only knows Oppenheimer from his time in Princeton, when Oppenheimer was the director of the Institute for Advanced Studies, and he a professor at the University. There, Oppenheimer must have been vicious, especially to younger people. Of an allotted 90 minutes in a talk, most speakers would not be able to hold 10, as Oppenheimer would inevitably interrupt. Hans interjects that he managed 30 minutes, which everybody in Princeton who knew Oppenheimer characterized as magical. Gerry however goes further (he had a self-admitted 7 minute session once). He maintains that Oppenheimer would first take out the speaker to lunch, ask him about his topic in detail, only to use it against the speaker later. After having made such a point, he would turn to the audience and sneer. This particular habit made Oppenheimer impossible in Gerry's eyes. Hans tries to defend Oppenheimer by citing the fact that he wasn't treated very well by the authorities. Gerry counters with his experiences with the 'House Committee on Unamerican Activities' (the McCarthy investigations). While Gerry was in Birmingham, McCarthy found out about his activities in the Communist party while a graduate student at Yale. They asked him to denounce his comrades (some of whom obviously had given away Gerry), which he refused. Instead, he gave the letter from HUAC to Professor Peierls, who placed it in a safe, and went on with his business. Gerry was denied a passport for the next seven years, which forced him to stay in Birmingham. (This turned out to be lucky in retrospect, because Birmingham was such a good place under Peierls.) Mentioning this, Gerry said that *that* didn't make him treat younger students badly, looking all the while at me. Hans, however, while acknowledging Oppenheimer's misbehaving, still maintains that the project was unthinkable without him. Yes, maybe Fermi could have led it, he concedes, but Fermi was out of the question because of his being Italian. Mrs. Goodstein asks Hans if he thinks that Los Alamos was Oppenheimer's finest hour. Hans is quite solemn:

"Yes, this was his finest hour."

She further asks Hans about a movie about Los Alamos, "Fat Man and Little Boy", starring Paul Newman as General Groves.

"That was a terrible movie" Hans answers, "it was wrong everywhere."

"They started with the premise that Groves forced us to do the project. This wasn't true at all. We had thought about it, and we wanted to do it, we had pretty much figured out what to do before Groves even came to the project."

Hans proceeds to tell the story of how the movie producers asked him to use his character in the movie. They sent him the lines attributed to him, and as there weren't many, he agreed. But when they sent him the contract, which forbade him ever to make any use of any material related to the events in the movie, or to make any other deals with other movie companies, or to write about it, he flatly refused to sign. They sent the contract back, having added a lot more lines to his character. He wrote back that he didn't feel portrayed accurately, that he wouldn't stand for the lines written, and that they should attribute them to some unknown character. That was the end of the Hans Bethe character in that movie. However, he says he immensely liked the series that was done for PBS. He liked the way they portrayed him, and especially he said that the actor playing Oppenheimer seemed more like Oppenheimer than Oppenheimer himself!

The last discussion of the evening centered around the former Soviet Union again, with everybody relaying some tidbit illustrating glasnost, and Gerry blaming the US government for not realizing what's at stake, and sending the wrong signals by shipping to Russia only surpluses that weren't needed, as well as juice that turned sour and bread that was stale.

I have to admit that during the dinner I very often felt the urge to interrupt, or at least let my opinion on this or that be known. The hardest thing however was *not* to relate some stories that I knew, and that I figured would fit perfectly, in ordinary circumstances. However, I also realized that Hans was center-stage here, not I, so I tried to hold back. I 'broke down' only at the end, telling three stories in a row, on the recent revelations about the Soviet moon program, the delicate matter of how a DEC computer's central mother board would exactly fit into a Soviet-made computer (while strict export limitations prohibited US computer parts to enter the Soviet Union), and of the friendly American visit to the Soviet Mission Control room in preparation for the Apollo-Soyuz mission, which ended in an éclat because the Americans simply did not believe that the equipment they were shown could guide rockets and satellites, and assumed that the Soviets

kept secrets. While all these stories were very well received, especially Hans exclaimed many times: "I didn't know that!", "This is fantastic!", I feel a bit bad about it now. Gerry walked me home, and in a joking manner alluded to my 'staging myself', though acknowledging that I did give Hans the opportunity to talk (Gerry likes to exaggerate). I assured him that I was well aware of who was center stage, and that I tried very hard. I did, really.

Second Week

Monday, Jan. 27th.

Nothing to report today. We had lunch at the Athenaeum at noon, the usual troika. From the conversation, nothing seems to stand out. I told some gossip from Stony Brook, and we compared sizes of quantum mechanics classes. My first year in Bonn had about a hundred students to start with, only to be narrowed down to about sixty towards the end. I told Hans that in some universities in Germany there could be over 500 students, which he found incredible. Gerry asked how big his class was. Hans thinks for a second, and then says, "Twelve." Of course, *his* class was taught by Arnold Sommerfeld. Gerry asks if he was the best in his class. Hans answers that this is a hard question to answer, meaning, I realized a bit later, that although it was he, he didn't want to say it. He only mentions (this was in Munich by the way) that as long as Rudolf Peierls was in the same class, this question could probably not be decided. But, he said, Peierls deserted them a year later. He continued his quantum mechanics at the University of Leipzig. Werner Heisenberg was lecturing there.

No dinner tonight, as Gerry and Hans were invited to dinner by Stanley Sheinbaum, who from what I could gather is a wheeler and dealer in the Democratic Party. So I took off to work out. Tomorrow Gerry wants me to give a talk to Hans about the paper we're currently writing. I just wrung some plots out of the Stony Brook computer for that purpose.

Tuesday, Jan. 28th.

I gave part of the talk before the lunch seminar, part of it after. I sort of tried to make it self-contained, without too many details, but I underestimated Hans. He just simply understood what I was doing, asked the usual pertinent questions ("well, yes", I would answer, "actually I hadn't thought about this, but it's a good question...") and was very nice to me about everything.

At six I went over to Hans and Gerry because they were watching the 'State of the Union' address by Bush. There was another guest watching, who would have dinner with us. It turned out to be none other than Bob Bacher, whom I've mentioned earlier a couple of times! He was the leader of the experimental division in Los Alamos. So I had dinner with the leaders of both the theoretical and the experimental division, at the same time! I had to remark to Hans later that this could only be beat by also having

Oppenheimer, but he of course is dead. Bacher is a very nice man, he looks a bit younger than Hans but is actually a year older. He lives in a retirement home with his wife, who is ill. Of course, during dinner we discussed mostly politics, which is why this report won't be very long, and while Gerry was away on the phone and Hans and Bacher talking to each other, I couldn't help thinking what a waste it is that these two brains will, some time in the future, just simply cease to exist, and all of their knowledge and experience that it took 86 years (up until now!) to accumulate, could then not be put to use anymore. The political discussions were mostly on Bush's announced measures for economic recovery, and military cut-backs.

Wednesday, Jan. 29th

High noon: lunch at the Athenaeum. A hot, slightly hazy day. While eating, we talk about books, plays, and literature. We talk about several books that Betty Brown once gave me to read, and which Gerry has all read, it turns out. One that Gerry liked very much is Jorge Amado's "Dona Flor and Her Two Husbands". We tell Hans the story, who finds it rather amusing, and then starts to recite two passages from (Kurt Weill's) "Drei Groschen Oper" in German, dealing with very much the same amorous subject matter as the book we told him about. Hans has no accent in German whatsoever. He very rarely speaks German, only when quoting, or to use a word that is best illustrated in German. Never for conversation. Hans wants to know what kinds of books I had to read for my German class in school, and how the exams where held. We very briefly discuss Döblin's "Berlin, Alexanderplatz", Fontane's"Effi Briest" (Hans didn't read that one, only heard of it) and Flaubert's "Madame Bovary". We also bring up Dürrenmatt (Hans mentioned him), and Gerry mentions "Die Physiker", which Hans immediately characterizes as "a bad play". Gerry claims that the character 'Möbius' in the play is in reality Konrad Bleuler, while I of course claim that this would be the character 'Beutler', and Hans agrees. Gerry mentions that Bleuler and Dürrenmatt were neighbors for quite some time.

We come to speak about the Physics Reports volume that was edited on the occasion of Hans's 80th birthday celebration[12], and held at Cornell University five years ago. As an epigraph, it has the following sentence:

"Das sind richtige Männer, die wacker die rauhen Berge

[12]Phys. Rep. **163** (1988) 3

besteigen[13]"

As there is no attribution, I had always wondered where this phrase came from. The origin is actually quite amusing. In fact, this was said by a little Swiss boy walking with his mother, after seeing Hans, Gerry and friends enter a mountain pass in the Swiss alps, all dressed for a long walk. This is very hard to imagine, but a true story nevertheless. The boy probably has no idea that, and in which way, he was immortalized.

Dinner at 6:30. Surprise of the day (besides the fact that CERN couldn't offer me a position) is that Hans got a phone call announcing that he won the "Einstein Peace Prize", an award worth $25,000: not bad. He seems to be quite happy about this, as he didn't expect it, and says that it is nice that his other work also gets recognized. More discussion about Bush's address yesterday follows, and this time we have it about education, about how bad it is in the States, and compare it to other systems. I compare with the German and French school systems, Gerry knows a lot about the English one, as he spent ten years in England. We all agree on the main points: more money for more schools and more teachers with a higher salary. We also agree that it'll take many many years. Gerry mentions as exceptions a Science School in the Bronx, which he claims has fostered more Nobel prize winners than all of Germany. While this claim is of course preposterous, I ask him who came from there. He can only name two, in fact, but they are quite illustrious: Steven Weinberg and Sheldon Glashow. Moreover, they were classmates, in the same grade!

We continue a discussion we had at lunch, about school. Hans is interested in how history is taught these days, this subject came up some days ago already. Especially he says that he wasn't taught about any other country than Germany, except for those that Germany had fought a war with. He remembers that they weren't taught anything about the United States, they knew that it was discovered once, and what it was called. I reply that we weren't taught about the history of the United States either up until the last two years, in which we covered mainly 20th century history. He then asks me how religion was taught. I told him that it was compulsory up until the year where I was in fact expelled from religion class, a story that he wants to hear. So I tell him about my belligerent last year in religion class, where I thought that it was my duty to tell everybody what fools they were, believing all this nonsense (I was fourteen). Hans is clearly pleased,

[13] "These are real men, who fearlessly climb these harsh mountains"

and laughs out loud when I tell the story where one 'faithful believer' tried to contradict me all the time in class, then reverted to asking the question that was supposed to deliver the final blow: "But how was this universe created then?", to which I, slightly heated from the discussion, yet still calmly, answered that I would gladly proceed to tell her just that, which I attempted, only to be thrown out of class a little while later because I was 'disrupting' it. As fantastic as it sounds, it's actually a true story. The teacher by the way didn't throw me out out of malice, I got along quite well with him, it was just because I was 'not what was needed'.

Hans likes all that, he tells us that he felt pretty much the same at pretty much the same age, but that he very rarely aired these convictions, but rather kept them to himself. Hans asks Gerry if he ever was as combative, and while I understood this question to relate to matters of religion, Gerry answers generally, by saying that he mellowed out at age 40-50. He goes on to tell about the fights he had with Aage Bohr and Ben Mottelson at Nordita, the Danish Research Institute founded by Niels Bohr, in Copenhagen. Gerry spent many years there upon invitation by Niels Bohr. Gerry feels that the nuclear physics division at Nordita is in serious decline, mostly due to the fact that, after Ben Mottelson and Aage Bohr (the son of Niels) had received the Nobel prize, everybody there just worked on extending their theory.

Hans is wondering what Edward Teller might think about all the nuclear disarmament going on in the world. Hans, a strong proponent for nuclear disarmament (his engagement in these matters having won him the Einstein Peace Prize) is "pleased as pie", as Gerry says, every morning reading the headlines announcing further and further cuts. Hans also maintains that Teller is a real nice guy, if you don't talk politics with him. As Hans is going to go to Stanford next week where he is going to meet his good friend Sydney Drell, another disarmament proponent, he will try to find out.

Leaving for the night I wish Hans a good night. He's sitting at the table reading the New York Times, looks up, and says: "See you later, alligator!"

Thursday, Jan. 30th

On the way to lunch Hans makes a few comments about the subject of my little talk on Tuesday, and I'm sort of pleased that he takes some interest in it. The day before, on the way back from lunch, I asked him explicitly what he thought about the idea of using the ρ meson mass instead of the quark condensate as the order parameter of the QCD phase transition. As

I cooked that idea up on the plane coming here I didn't feel too sure about it. But Hans said that that was quite all right, and that I had basically proven that it didn't really matter, hadn't I? That was indeed the point, and thus I'll publish it[14].

Very quickly at lunch we're back in the postwar era, with Gerry retelling how he went to Yale on the G.I. bill after serving in the Navy. He compares his $4 (weekly) room, and $1 lunches to our times, remarking that "not everybody has as expensive tastes as you", into my direction. I'm of course used to this kind of snide remarks, Gerry just loves to make them. Hans throws in an experience he had with Rose on Mt. Rainier in Seattle, "in 1937" as he recalls without a moment's hesitation.

"We were stopping at the 'Paradise Mountain Lodge', and for $1.50 you could eat whatever, and how much you wanted. And it was very good food. We had fish, and then some other dish, and then two desserts!" Gerry goes on about his first year at Yale, and how his mother had given him $100 to buy himself a suit when he went to Yale Graduate School. He instead spent $20 to buy a suit at the second hand shop, which was run by a person who bought the clothes from the students who had wealthy parents, a common picture, at least at Yale. Hans asks if the suit fit. "Roughly," Gerry answers. I ask what he did with the rest of the money. "Probably lent it to my leftist friends," is the reply. This leads into a discussion of McCarthyism, and I ask both Gerry and Hans who or what had finally silenced McCarthy.

Gerry describes the methods and motives of McCarthy and his two assistants, Cohn and Schein, the latter being, as Gerry points out, "a homosexual". I wasn't about to correct his substantivation of an adjective. Then Schein got drafted into the Army, and suddenly McCarthy focused his wrath on 'uncovering' communists in the Army. Everyday at 5:15 in the afternoon, 15 minutes before the newspapers had to finish the stories for the evening editions, he would stand on the steps of his senatorial mansion (or wherever he made his declarations) waving a pile of papers and saying: "I discovered 27 communists in the Defense Department". He even accused General (and former secretary of State) George C. Marshall, the highest ranking military. After this episode, and the counter attack of the military, McCarthy had sort of lost his credibility.

Gerry recounts how he left the country in the beginning of 1950, more because he wanted to escape his advisor Gregory Breit, than because of

[14]See Phys. Rev. **D 46** (1992) 478

the uncertain political times (McCarthy had just started his witch hunt). He wrote to universities in England, and from Blackett got the response that they had no jobs, from Max Born that he (Born) was too old to take on assistants, and only Peierls answered "Come on over!" From another physicist at Yale Gerry was told that in Birmingham he should also look for a certain 'Klaus Fuchs' who was a good friend of Peierls. At the dinner reception at the Peierls' house Gerry promptly asked Peierls where he could find a physicist by the name of 'Klaus', the last name having escaped him. According to Gerry's testimony Peierls "turned green", then answered that he just visited him in prison, as he was arrested days ago. Gerry, meeting Peierls for the first time, thought it better to change subject, as the last one somehow had lost its appropriateness for polite dinner conversation. As it turned out, Fuchs was indeed arrested a few days earlier (Gerry arrived February 4th, 1950) for espionage. Hans observes that this was especially hard for Peierls, as he was probably the only close friend of Fuchs (in response to my inquiry, Hans confirms that Fuchs was a loner), and somehow ended up watching out over him. Peierls admitted that he felt personally betrayed by Fuchs. He spent 12 years in prison, teaching physics there, and relativity to his cell mate. A prison guard, or was it the director, Hans isn't sure anymore, once asked Fuchs how this was possible. He answered "But you are much smarter than my cell mate, I could teach *you* in no time!" After the twelve years, he went to East Germany, and became deputy director of the Nuclear Research Institute in Rossendorf, the biggest one in East Germany. Gerry visited the Institute some years ago, and had lunch with Fuchs. I do not know the year in which Fuchs died[15], but Gerry remarks that he always had low blood pressure.

Further information about Mrs. Peierls surfaces. She is Russian, 'Eugenia' by first name, 'Genia' with a soft g, to friends (that solves the mystery about the terrible accent that Gerry always uses when imitating Mrs. Peierls). Gerry describes the extremely nosy and prying nature of Genia Peierls, how she was cornering everybody until she had extracted the most private and intimate secrets, then proceeded to offer her advice. Her advice, Gerry concedes, was almost always sound, and opened up avenues the advisees often hadn't even thought about. He offers the example of his son, who was 'ordered' by Mrs. Peierls to go into the hotel business after she had analyzed his personality. He is now running several large hotels, one of them, I was told, in Santenay, France. Gerry asks Hans whether the inqui-

[15] January 28, 1988

sition staged by Mrs. Peierls had annoyed him.

"No," he answers, "I rather enjoyed that. It was her loud voice that sometimes annoyed me." Gerry asks about how Rose felt, and we learn that she couldn't stand her. After all Genia Peierls had the habit of telling the professor's wives that they should stay at home and care for their great husbands. (This was also observed by Judith Goodstein some days ago, who also was offered this unsolicited 'advice'). Hans and Gerry agree however that Genia Peierls was the most exceptional woman they ever met. Peierls had met her on a conference in Moscow, and married her very soon after.

Gerry recounts how Genia decided to marry Rudolf. The latter could sleep in any situation. Once they travelled to Kiev by train, and Rudolf Peierls, being fairly short, crawls into one of the overhead luggage nets, and falls asleep. The hyperactive Genia sees this and decides on the spot: "This very stable man. This is man for me!" They didn't spend a lot of time in Russia. But apparently Peierls was very good at languages: the Peierls conversed in Russian with each other.

Someone passes our table and greets Hans enthusiastically. Gerry immediately proceeds to tell that Hans got the Einstein Peace Prize, all the while Hans is trying unsuccessfully to prevent that by waving his hands.

"They didn't tell me on the phone to keep it secret" Hans pleads, "but maybe we should wait until they had a chance to make it public." Gerry reluctantly agrees. I ask Hans whether he knew that he would be up for the prize and he denies it, says instead that it came as a complete surprise.

We come to talk about the Nobel prize, and I recount how Einstein was nominated five times, and got turned down four times, mainly due to the influence of H.A. Lorentz, who claimed that Einstein shouldn't get all the fame for special relativity, and later arguing that general relativity was too speculative. They finally gave it to him for the photoelectric effect of 1905 (I heard this version of events from Max Dresden[16]). Hans is surprised. Then Gerry starts to tell the story about how Hans heard about his Nobel prize, in 1967. Gerry always does that, starting stories for Hans. Hans interrupts pretty quickly, saying that he tells it all wrong.

"That night," he begins, "Rose slept in another room. At six in the morning the telephone rings, and they tell me that I won the prize."

"Even you were too excited then to go back to sleep, weren't you?" Gerry jokes.

"No, no, but the telephone didn't stop ringing! The radio, television,

[16]Professor of physics at Stony Brook

newspapers called. This went on until eight. Then finally Rose woke up and asked what this was all about, why the telephone kept ringing. At that moment it rang again and she picked it up. It was the (Cornell University) physics department, and they suggested that they should give a press conference."

"You might as well," Rose answered, "the day is shot anyway!" This, as Hans remarks, was one of her famous one-liners.

Wolfgang Pauli's remark about Peierls (told by Hans): "Peierls thinks so fast, when I finally start to understand what he is telling me, he is already explaining to me why it is wrong."

Dinner. We have roast beef, as this is one of Hans's favorite. We talk a lot about history, especially the French Revolution, the Napoleonic wars, and the war of 1812, between the United States and England. The subject came up when we tried to date "Pride and Prejudice" by Jane Austen, which Gerry is currently reading. Hans supposed "beginning of 19th century, Napoleonic wars". It turned out to be published in 1813. Can't beat the guy. He remarks how the Austen family was always poor, despite being quite influential, and two of Jane's brothers being admirals. Hans loves to talk about history, so during the conversation I try to wring out of my brain what I can possibly find.

During dessert, I ask Hans whether he knew Einstein. He says he met him, but didn't work with him. He also says that he appeared to be a very sweet old man. They met in Princeton, on account of some peace initiative. I ask him whether he ever wanted to work with him, and he answers that he was no expert in Einstein's field, and also didn't want to. At the time, Einstein was involved with his Unified Field Theory, which, as he tells me, was not a quantum theory, but was supposed to yield the quantum as a result. This, Hans deadpans, was the problem with this theory. We discuss the rise and fall of Einstein, from the wonder year 1905, when anything he touched would 'turn to gold', over to 1917 the year of general relativity, up until 1926, when with Bose-Einstein statistics he still was in the thick of things, at age 47. That, however, was the end of it: one more influential paper much later with Podolsky and Rosen, then assistants like (Peter) Bergmann, (Valentin) Bargmann, and Strauch, the latter pretty much unknown today. But, as Hans insists, he was a great man when he was young, and a sweet man when he was old.

Getting up from the table Hans says he has to make a phone call to Seattle. Gerry, nosy as ever tries to find out who he wants to call. After some prodding, Hans reveals the name of the person: "Pete Rose, not the

one from Baseball." As he goes to the phone, he closes the door behind him. Gerry, writing a letter to Peierls to inquire about his health, says:

"He's cooking up something again, he never is that secretive. I practically had to pull this name out of him!" I wish Gerry a good night but he's already engrossed in his letter again.

Friday, Jan. 31st

Lunch is with all the group today as every Friday, minus Hans for the reason mentioned last Friday. It seems I never really had an interesting Friday lunch at the Athenaeum, compared to those with Hans and Gerry. After lunch Steve Koonin comes into my office and says he wants to talk to me "about next year". We settle on Monday 2pm. Gerry already divulged to me that he's going to offer me a job.

I do not remember how, but at dinner we're in the middle of talking about history, and school, again. It seems to be one of Hans's favorite subjects. I get to tell the tale of my final (oral) exam in history for the Baccalaureate at the European School in Brussels, one of my favorite stories. The rest of the conversation is centered around Germany. First Hans asks me if German students are politically interested. I tell him that they are very much so, that almost everybody takes a side. I realize now that this might be slightly exaggerated, that it probably just seemed so to me because my friends where very involved in politics. I say that I was less involved, but that I voted in the Student Parliament elections every year. Since I had told Hans which parties could regularly be found at campuses all over Germany, he naturally wanted to know who I voted for. From there on we very quickly went on to the German political parties, and the rise and fall of the Social Democratic one. We talk about Helmut Schmidt, and Hans explicitly inquires about Oskar Lafontaine. Later the integration of East Germans is our topic, one which Hans always seems to turn back to. Also we discuss the "Volksdeutsche" (ethnic Germans in Eastern Europe) and their plight. Hans asks if all these people living in the Banat (the German enclave in Romania where my father grew up) would like to return to Germany. I venture the guess that their living conditions are probably very bad, but that they consider the region their land, which they had cultivated, and paid for with their lives, and thus would be rather unwilling to leave[17].

[17]In fact, almost all Germans left before 1945

Hans mentions a visit to Italy, with his wife in 1951. He describes how everybody was very nice to them, but very poor. He also mentions visiting the best-preserved Doric temple in Agrigento. Gerry asks if he also visited the place where he got arrested. A very thinly disguised invitation to tell a story. We're over dessert already: Mrs. Smith Cherry Pie.

"San Leonardo," Hans says slightly contemplatively.

"But we weren't arrested, we were under house arrest. It was 1933, the fascists."

"A friend of mine and I were vacationing in Tirol, and we were invited by his mother, who lived across the border in Meran. We wanted to walk over the border, so we consulted this guide, the 'Baedeker', which mentioned several passes that were open. We chose the 'Timmel' pass, which we walked. It was an incredibly boring walk, until we came into Italy, when it was quite nice. A little later we met some border guards, who informed us that we could not take this pass. I spoke only a little Italian, and the guard spoke no German, so he took us to the border station. That was approximately 6 km away, and we were two young, tall, guys and well trained, and the officer had quite some difficulties following us. Then we arrived in this little town, and they directed us to a room where a "Maresciallo" was waiting, who wasn't really a 'Feldmarschall' but a Sergeant, but he had a beautiful uniform. At the beginning we had to stand, and it didn't seem as if he understood my Italian. Then he asked what our professions were. I answered 'libro docente'. 'Bring chairs', the Maresciallo immediately ordered, and started to understand my Italian. We described our situation, and he insisted that it was forbidden to cross the 'Timmel' pass. However, he said that he would call the border station at the 'Brenner'. Until then, he asked us to stay in town, and we took a hotel. The next morning we presented ourselves at the little border station. The Maresciallo had contacted the Brenner station and they had decided that we had to go there and have our passports stamped. The only bus from the little town to the Brenner, however, had already left in the morning. So my friend ordered a taxi from Meran."

"That is far, that must have been quite expensive" Gerry asks.

"Well," Hans responds, "he was already quite well to do then."
Upon Gerry's further inquiry Hans reveals that his friend worked at a bank.

"Earlier the Maresciallo had told us that two soldiers would accompany us. When I told him that a taxi was coming to pick us up he exclaimed: 'In that case I will come myself!' "

"When we arrived at the Brenner station they locked us in a little

room, then asked us to come out. They told us gravely that it was an offense to cross the Timmel pass, but that they would not fine us for that, and let us go free. We were walking up and down the platform waiting for the Maresciallo, but he was busy drinking wine with his colleagues! Finally we left the Brenner, dropped the drunken Maresciallo at his little village, and drove on to Meran."

Saturday, Feb. 1st

Got up at 7am this morning. At 8am I had breakfast with Hans and Gerry, as we planned to go up to 'White City', a hiking destination at the foot of the mountains here. This is an interesting hike that Gerry and I had already done two weeks ago. In fact, I found it quite strenuous then, and I was wondering how Hans would take it (so was Gerry, as he told me later). 'White City' is the upper station of a trolley that used to go up the mountain, from its foot at Lake Avenue. It ceased to operate in 1938, and today 'White City' is mainly ruins. Yet, one has a beautiful view down to Pasadena, the Jet Propulsion Lab, and downtown L.A. further back. The trail is rather narrow, such that we had to walk one behind the other. This unfortunately prevented us from communicating much, also Hans was concentrating on the sometimes treacherous trail. As he suffers from "Menier's syndrome", his sense of balance is somewhat reduced. Yet, he managed the ascent and the subsequent descent admirably, and this convinced him that he'll live to be 90, and see the results of the SNO neutrino experiment, after all. At the top, we ate our sandwiches quietly, while Gerry took a little nap. I was lying on my back contemplating the sky, which was partly cloudy and provided for partial shade during the ascent.

On the way down we stopped and had some water seated under the pylons of high-voltage power lines. The silly debate going on in the general public over the effects of electromagnetic fields on people prompted Hans to tell me a story, while Gerry was napping again. There was a public meeting of the city council of the city of Santa Barbara not long ago, for reasons of introducing the new candidates for the upcoming election for city council members. One of the candidates was the wife of Jim Langer, who is the director of the Institute of Theoretical Physics of the University of Santa Barbara, and a friend of both Hans and Gerry. He is in fact a former student of Gerry's, and I met him when I was down there last year to give a talk. The frightening moment occurred when someone from the audience asked the candidates if they would oppose or agree to an ordinance banning

electromagnetic radiation. This is not a joke, as this question was seriously posed, and in fact the first three candidates all agreed that, yes, they would support such a city ordinance, to ban this terrible electromagnetic radiation. After this display of expertise Langer took the microphone and declared that although he was not a candidate, his wife was, and he wanted to point out, in his qualities as director of the Institute of Theoretical Physics, that they would have to ban the sun if they wanted to follow through on such an ordinance. The city council kindly invited Langer to give them a briefing when the vote on the ordinance would come up. Scary stuff.

We made it down the mountain at 3pm. We had a short discussion about the legalization of drugs, and whether such an act would better or worsen the situation. We were all pretty much undecided; however, we agreed that a legal distribution net could take away much of the violence associated with the drug war. As the drugs would be used whether legal or not, this would seem like an improvement. After all, alcohol is legal too.

Dinner at 7pm. Gerry asks Hans about the Emperor Franz Josef, as Hans had given him Gibbon's "Rise and Fall of the Roman Empire" to read. Interestingly, this sparks the only physics anecdote of the evening. Hans tells us of the fun that Viktor (Vikki) Weisskopf and Enrico Fermi had comparing their 'impressions' of Franz Josef. To Weisskopf, Franz Josef was "der Kaiser der sich um das Wohl seiner Völker kümmert". For Fermi, he was "il odioso Francesco Guiseppe". Or so they were told at school. Having branched into history, however, Hans is unstoppable. He goes back to Maria Theresa, going through all her children, with a detour over the Kings and Emperors of France after Louis XIV, the revolutions of 1848, to the assassinations of the heirs to the Austrian-Hungarian throne, the last one in Sarajevo, 1914. He knows all the details: Franz Josef born in 1830, enthroned in 1848, emperor for 68 years (or so, I don't remember as well as Hans.) This is how he claims he knew Franz Josef's year of birth:

"I know that from a stamp that commemorates his birthday."

"You collect stamps?", I ask.

"Yes!" he answers.

"Me too!". I say.

"Very good!" he finishes. A very typical exchange.

It is quite amazing. He knows the kings of Venice, the one put in by Napoleon in Sweden (Maréchal Bernadotte, if you must ask) in fact he lists all those that Napoleon put in as Kings, the one the Austrians put in in Mexico, etc. etc. I cannot possibly list here all the things Hans told us this evening. (Also, since these are generally known, this would be quite

repetitive.)

There is a brief discussion about aid to Russia during dessert. Hans mentions a group called "Direct Relief" that he seems interested in (in any case he has talked to one of the organizers of this relief effort). This group currently ships medical supplies into Russia. The way I see it, though Hans didn't imply it at all, he is, or will be, helping them financially. We talk about the Ruble again. He says that there is no way of rescuing the Ruble. They need a second currency. (Hence his letter to Yeltsin.) Hans speaks favorably about Yeltsin (just having read one of his recent speeches.) He speaks favorably of Bush only with respect to arms control (and, after Gerry's inquiry, his behavior in the Gulf War), but he despises his domestic policy, as "doing more harm than good".

Sunday, Feb. 2nd

We have lunch at 12:30, and are planning to go to the Huntington Library and Gardens later. Hans received a letter asking him to write an article for "Global Viewpoint", a group that has an agreement with most of the major newspapers in the world to have their articles published. It says that he would have a readership of about thirty million people. They then go on to enumerate some of the recent contributors. Every major head of state seems to be there. The topic they would like Hans to comment on is the so-called 'Baruch plan' of 1946, which, it seems, is in the process of being revived. The letter states that among others, Edward Teller, and a Russian whose name I don't remember, have already embraced the plan. This is startling to Hans. Indeed, the Baruch plan was a singular attempt at limiting the use of nuclear weapons, by giving the monopoly of possession to the United Nations. According to this plan, no nation was allowed to build, or possess, nuclear weapons, and every nation found to do so would be punished, "severely and continely". Hans mentions that this was the first and last time he ever saw the word 'continely' used, and so have I, and Gerry. We decide to look it up sometime.

The plan originated not from Baruch, but in fact from Robert Oppenheimer. It was adopted by then-secretary of State Dean Acheson. However, it seemed to Acheson that this would never pass the Senate like this, and Hans adds that "he was most probably right". So the idea came up to convince Bernard Baruch to present it to the Senate, which was a clever idea, as there probably was nobody more conservative than Baruch. Also, he was hard to argue with since, as Hans says, "he was even more hard

of hearing than I", and he would, during an unpleasant discussion, just turn off his hearing aid. Somehow they got Baruch to present the plan to the Senate, and so it bears his name. This plan now seems to have been revived, and it also seems to make a lot of sense, the only problem being China, who probably would refuse to comply. Hans says that he will agree to write the article, but that he will first request from 'Global Viewpoint' an article or some information showing that Edward Teller advocates this plan. This indeed sounds incredible as Teller is (or was) one of the extreme hard-liners, a hawk, anti-communist, nuclear supremacy advocate, and one of the staunchest proponents of the SDI. He and Hans are not talking, when politics is concerned.

We leave for the Huntington Library later, which is a complex featuring a Library with old manuscripts, an Art Museum, and a beautiful botanical garden and park, just a couple of minutes away. While walking in the cactus garden we encounter Stephen Hawking (who visits Caltech as regularly as does Hans), riding in his electrical wheelchair, somehow slumped into one corner of it, head crooked to the left, an electronic communication device with a screen in front of his eyes. He was accompanied by a woman. Even Hans and Gerry didn't dare to talk to him. Hans enjoyed the garden immensely, in fact he's been there several times and knows what is where, and studies some plants carefully.

At dinner Hans mentions that he talked to Rose, his wife, and that she was pleased about his getting involved with the Baruch plan. Gerry mentions that she was never pleased by Hans's participation in the Hydrogen-bomb effort. Hans mumbles something, then says that he has "atoned since then". But naturally, the subject is now the H-bomb. I feel a certain reticence on Hans's side to talk about it (which I may have been imagining) and so I ask about the Soviet effort instead. I ask where they at all got the idea that a Hydrogen Bomb would work.

"This," Hans says gravely, "Fuchs told them. He didn't know any details then, just that it would work."

"He may have told them about the Lithium Hydride" Gerry asks. Hans answers somewhat distanced:

"This I don't know."

But he goes on to talk about Sakharov. He says that Sakharov was their mastermind, and that he presented the group with three designs, the nature of the second one he never revealed. The first one already had Lithium Hydride, and the third one worked. They had a preliminary test, not of the bomb itself, in 1953, and a successful test of the bomb, if I remember

correctly, in 1955. Hans credits Sakharov of revealing that the first successful test came that late, as American intelligence claimed that the 1953 test had been successful in order to speed up the American armament effort. Hans had predicted earlier that it would take the Soviets three years to build the bomb, after the first successful American test showed the Soviets that it could be done, and he was right. Hans also recounts a story told by Sakharov, that at the dinner celebrating the successful Soviet H-bomb test, Sakharov gave a speech saying that they should be happy that they accomplished the goal, but that they should hope that this weapon would never be used. A Soviet general rebuked him. Giving a speech himself, the general said that, on the contrary, this weapon should be used, to wipe out the capitalists. Gerry asks whether the Soviets were capable at this time of launching such a bomb on an intercontinental missile. "Indeed they were," Hans responds, "they were ahead of the Americans in rocket technology". He then recounts, very calmly, the events that took place at a particular test of such a rocket. The military staff was present, including the general who had advocated the use of the bomb, and as the countdown receded to ignition, nothing happened. "Like the engineer in this story," Hans reports slightly smirking (I will tell the story he alludes to later), "this general goes up to the rocket to check the exhaust. At this point, the rocket ignites. He was fried to a crisp!"

"That was like a sign from god!" Gerry jokes.

"Yes!" Hans answers, now beaming.

We go on to discuss Soviet and American rocket technology. This being more my domain, I do most of the talking. We compare Sergei Korolev to Wernher von Braun, and the 'American Germans' to the 'Soviet Germans'. Hans points out the accomplishments of the American team, especially the Minuteman, I point out that the Soviets would very probably have been the first on the Moon, if Korolev hadn't died so soon (I hazard a guess at 1962-63)[18]. After that, I point out, they basically tried to scale up Korolev's design, up to the gigantic N-1, which never flew, but exploded in three successive tests. America, on the other hand, had von Braun, who was very much alive and turning on the heat down in Alabama. Hans likes that.

Hans and Gerry relate their experience with the change in attitude that was being felt all through America in the late fifties, initiated by the 'Sputnik Shock' and Eisenhower's reaction to it. Suddenly, everyone wanted to hire scientists. Gerry tells how suddenly it was no problem for him to get

[18]14 January 1966

a passport to accept an invitation by Niels Bohr to go to Copenhagen, and Hans relates how he got an offer by the Chrysler Corporation to head their rocket development division, which he turned down. Instead, he says, he worked for "Avco", which seems to have been a conglomerate of companies, the exact nature of which Hans didn't reveal[19]. He does reveal however that he was working for them on "the re-entry of war heads". He says that the atmosphere was very pleasant at Avco, as long as the old chairman, Arthur Kantrowitz, was there. After he was replaced, Hans didn't like it there anymore and quit. Incidentally, I just remember that when Hans mentioned the mysterious Pete Rose that he had to call, he answered, upon Gerry's insisting prying, that Rose was "an applied physicist that he met at Avco", a name that didn't mean anything to me then.

From discussing the importance of the 'Sputnik shock', which led Eisenhower to emphasize science, research, technology and engineering, we draw analogies to the situation of today, the 'Japan-shock', (or should we call it the 'Toyota- shock'?) and discuss methods of dealing with it. Hans is convinced that the American People can stand up to the challenge, if they are made aware of the dangers, and if a program is set in place. I ask Hans if he thinks that Bush is aware of the situation, and of the steps that have to be taken.

Later, during dessert, we discuss a little bit of physics, something that Gerry brought up during lunch, and that we had figured out in the meantime. He tells Hans that there were 'many ways to show this', but that he'll show one of them to Hans the next day. This sparks another story, and Gerry initiates it by saying that this was precisely what Ernest Lawrence had told Hans in Berkeley, when Hans was inquiring about the solution to a certain problem. (This was in 1936-37, as Hans mentions upon my inquiry.) Hans interrupts, to tell the story how it really was. Hans had written a paper[20] with a postdoc of his on the problems encountered in the physics of synchrotrons, namely that in order to focus the beam, the field strength had to get smaller towards the edges, whereas in order to counteract the effects of relativity, the field had to grow from the inside to the outside. From this he derived a "maximum energy for synchrotrons", which turned out to be 20 MeV.

"Ha," exclaims Gerry, "another mistake. First he claims we would see all those neutrinos from the Sun, and then he derives a maximum syn-

[19] Avco Everett Research Laboratory, in Everett, Massachusetts
[20] H.A. Bethe and M.E. Rose, Phys. Rev. **52** (1937) 1254

chrotron energy!" Hans continues undisturbed how he got angry letters by Lawrence in Berkeley, claiming that this wasn't right. He suggested that Hans should talk to Robert Wilson, who then was but a graduate student. (Later, he would head the 'nuclear experiment' division at Los Alamos.) As this didn't lead to an answer (namely the bound would still be firm) Hans talked to Lawrence himself. So Hans asked him how he intended to show that there was no such bound on the energy.

"There are many ways to skin this cat!" Lawrence exclaimed, but Hans asked him to show him only one of them. In the end he failed. The problem was solved eight years later by McMillan, Lawrence's assistant, who showed how you can use amplitude modulation to circumvent the bound. He got the Nobel prize for this clever trick, and today's synchrotrons are still using it. Hans mentions briefly that 'the people at the Berkeley lab' where quite reactionary, and hard to deal with, especially Lawrence and Alvarez. Now this is not so anymore, however Lawrence Berkeley Laboratory is not one of the world's top labs anymore.

The story that Hans alluded to when he talked about the general who was "fried to a crisp" was told yesterday, when we were in the middle of discussing Maria Theresa, and her children, and the French Revolution. Maria Theresa had a lot of kids, many of them girls (Hans would know the exact number, and the names). All the girls were called Maria-something. One of the 'somethings' was 'Antoinette'. "She came to a sticky end" Gerry quipped, and then proceeded to tell the story of the two noble men and the engineer, who are scheduled for execution by the Guillotine. The first noble man goes and puts his head under. The blade falls, but a snag holds it up just before cutting the head. According to the prevalent law, the noble man is released. The second noble man is forced on the instrument, and the same thing happens, upon which he also goes free. Now it is the engineer's turn, but instead of presenting his neck to the blade, he presents his throat. Looking upwards, he points at the instrument and exclaims: "Ah, there is the problem!"

Third Week

Monday, Feb. 3rd

Hans finally got Yeltsin's letter. He wanted to show it to me, but didn't get around to yet. From what he told me and Gerry (who already saw the letter) Yeltsin seems to consider Hans's proposal. At lunch, more anecdotes about Mrs. Peierls. I suppose that there is an endless supply of them. Once, Hans let his son Henry, then still very young, in the care of Mrs. Peierls for two weeks. A couple of days after he picked him up, Mrs. Peierls comes to dinner to the Bethes. They open the door, and this was when Henry Bethe spoke the first word he ever pronounced. He saw Mrs. Peierls and went: "Nooo!"

For part of the lunch Gerry and I talked about our longer manuscript[21]. He's afraid that I won't finish it, I'm afraid that he sends it off as it is. I promised him that I'll get the job done, and he promised me that he won't send it off without my permission. "Of course," he adds, "that doesn't mean that you will be sober when you give me the permission. I have a lovely bottle of Chianti at home; it'll make you sign anything!"

After dinner Steve Koonin talked to me in his office and offered me the Prize fellowship. I accepted. Dinner is at 7pm. Gerry made two chickens. I tell Gerry and Hans how I am improving my record over two miles of running (currently at 18:04, I'll break 18:00 tomorrow, my goal is 15:00), and Hans tells us how Freeman Dyson's wife has taken up running the marathon, and is actually performing well in her age group (of fifty to fifty-nine, she being at the lower end.) This is how it goes at these dinners: free association.

Hans asks Gerry what made him join the communist party at Yale. Gerry complains that Hans always asks these difficult questions. He first goes into explaining how, when he was in the Navy, he shared everything with everybody there: Blacks, Jews etc., but when he came to New Haven he found instead ghettos and discrimination. Somehow, though, I get the feeling that that wasn't all that did it, but he doesn't tell more. He goes on talking about the 'Wallace movement', and about the FBI's infiltration of that movement, of tapped phones and people following him. Finally, he and a good friend (and physicist) of his are expelled from the Party for alleged 'left wing deviationism'. Gerry leaves the country early enough towards Birmingham, but his passport is revoked. We talk about the communist

[21] Phys. Rep. **234** (1993) 1

witch hunt going on at the time at other universities. Gerry mentions Harvard, and how the faculty there stuck to Prof. Furry, who had a communist past. Indeed, in one year all faculty donated 2% of their salary to pay the legal fees incurred by Furry. Another time, Furry was supposed to talk on television. Because they were afraid that he would expose himself, they asked Ramsey to talk instead. So he did, and sure enough McCarthy was watching the show. Afterwards, McCarthy invited Ramsey to dinner, and asked him how much money he was making at the university. After Ramsey told him, McCarthy answered: "I'll triple your salary if you come to work for me as my P.R. man!" Needless to say, Ramsey refused.

At dessert (we have pie) I ask Hans whether he knows Ramanujan's representation of π. He says that he didn't know that one, but that he knows a story about Ramanujan. Indeed, Ramanujan, who was a self-taught mathematician who 'dreamed up' formulae without proof, which often enough, however, turned out to be correct, was known to find a number-theoretic peculiarity with every number. Once, the mathematician G.H. Hardy (who brought Ramanujan to England) visited him while he was recovering in a London hospital. He mentioned to him that he had come over in a taxi, with the number 1729. "Surely, you will find nothing peculiar about the number 1729!

"But on the contrary," Ramanujan answered immediately, "this is a very interesting number. It happens to be the first number that can be represented by two different sums of cubes!" Naturally I asked Hans if he knew what these two sets of numbers were. "Of course I know!" he answered. "You just have to know your cubes." How could I have doubted. Unfortunately I couldn't find it fast enough, so he told me. *You* will have to figure it out for yourself, though!

As we were talking about numbers, and tricks with numbers, we automatically came to talk about Feynman. According to Hans, Feynman was a wizard with numbers, by anybody's standards. He tells the story of one of Feynman's semi-official visits to Brazil, when he went into a bar where a numbers artist challenged people out of the public. It was made for Feynman. He won hands down. As the last challenge, the number artist said: "Cube roots!" And he proposed the number... 1729! That of course was easy money for Feynman. They both sat down to calculate, but Feynman had the first three digits after the 12 in a matter of seconds. While the magician was checking this answer, Feynman found three more...

Gerry asks Hans if Feynman was happy. "Very," Hans answers, "most of the time". We talk about Feynman's wives; his first wife died in Albu-

querque of tuberculosis while he was working on the bomb in Los Alamos. She was extremely bored in the hospital, so they wrote each other many letters. At one time, they decided to write each other in code. This proved to be very unsettling to the authorities, as all letters going out of Los Alamos were routinely censored, and the letters thus kept coming back to Feynman. He finally decided he would include the key to the code with the letter, so that the censors could read it too. Still, this proved to be too much for them. The second wife, it seems, pursued Feynman for three years until he finally 'gave in'. Hans says that the woman wasn't much good. The third one, a British woman, however, everybody seems to hold in high esteem.

Another story: at Los Alamos, there were of course very strict security measures. However, Feynman discovered a hole in a fence surrounding a toolshed, from which he could leave the center without checking out. Three times in a row he did just that, entering without having checked out, until a confused guard finally questioned him about it. I suppose Feynman loved to confuse people. Hans also tells the story about Feynman cracking the five safes of de Hoffmann, a story that appears in his 'Surely You're Joking...' book. He tells it very comically, but since it already appears in print, I won't repeat it, as I didn't discover anything new in the story. I don't remember if de Hoffmann's name was mentioned in Feynman's book though. Hans says that de Hoffmann died several years ago of AIDS, acquired through a blood transfusion. I ask Hans if what Feynman did was real or if he was just using tricks. "Everybody uses tricks!" Hans replies, this of course not being an answer. Gerry throws in that Hans isn't above using tricks himself. He maintains that Hans's motto is: "Never enter a competition without an unfair advantage." Hans grins broadly. I am very sure that Hans is great with numbers too, but I'll ask for a demonstration another time.

At lunch, Gerry or Hans told a story where Hans was invited to a dinner by a colleague. After being introduced, the wife of the colleague asks Hans: "Oh, so you are the one who writes the Physical Review?" Says Hans remembering that: "These were the olden days!"

Tuesday, Feb. 4th

Tuesdays at noon is the Journal Club at Kellogg, and Gerry made sandwiches for Hans and me. He spoke for half an hour on deep inelastic scattering; a graduate student had the other half on J/ψ.

At dinner Hans asks me what was going on in the J/ψ talk. As the girl spoke very softly, I suppose he didn't catch all of it. I explain to him the

main points, and he is satisfied. Funny enough, we spend most of the dinner reciting German childrens' poems. Hans knows a lot of them by heart, so does Gerry. In fact it turns out that I am the one who knows the least! We discuss the tales of Grimm, and recite Wilhelm Busch's "Max und Moritz", and the often frightening tales of "Der Struwwelpeter". It is unique to hear Hans recite:

> Paulinchen war allein zu Haus,
> Die Eltern waren beide aus.

or

> Und Minz und Maunz, die Katzen,
> Erheben ihre Tatzen,
> Sie drohen mit den Pfoten,
> "Die Mutter hat's verboten!"

etc.

Hans mentions an article he read in the newspaper about an archaeological discovery, namely that they found traces of *Homo erectus* in Tbilisi (in Georgia) that are 1.7 million years old. This, he says, is quite astonishing as *Homo erectus* supposedly originated in Africa, about two million years ago. That the species travelled so far was up to now unknown. Since neither I or Gerry are experts in this kind of history, we let Hans tell us a bit about it, and so he does, about which species was where, the relation to other species, he gives us a time table of events; as always he is a walking encyclopedia. We venture into theories of the extinction of the dinosaurs, and Hans offers his explanation of the extinction of the saber-tooth tiger, which he says was a contemporary of early Man. He says that they were such excellent hunters that they basically killed off the species, which were their main food. I ask him if this is established wisdom, and he says yes. I find that strange as I would expect that the species would, in such a case, survive by feeding on themselves, which apparently however they did not do. Strange story.

This leads us to the problems of our world, which potentially could lead to the extinction of the species 'Man', which in my view is inevitable should that species turn out to be "a bad idea", as all of nature's bad ideas disappear sooner or later. Hans doesn't think that mankind is a case of a

'bad idea', however we discuss the trends of growing world population, and lessening rain forest area. We try to figure out how much area of rainforest is needed to offset the CO_2 emission of a car engine, but fail, not having enough data. Hans believes that both problems (of world population and rain forest) are solvable. I believe that the rain forest problem is solvable in the near term, and that the other problem will linger until very close to disaster.

Hans still wants to get some packing done, so he retires (Gerry is still busy doing Hans's laundry). I wish Hans a good trip, but he says that we'll still have lunch together tomorrow before he leaves. So be it.

Wednesday, Feb. 5th

Last lunch with Hans before he leaves for ten days. He'll be back for five days after that. Not a very chatty lunch. I guess that Hans is in 'travel mood'. Gerry mentions that Felix Boehm of Caltech will have open heart surgery the day after tomorrow. In such circumstances Hans says: "Gosh!". After weighing the pros and cons of exercise, and whether to choose surgery or not, Hans says: "Sometimes it's a pity that I don't believe in God, because now I don't have anybody to thank for that I don't have to worry about such things!" The rest of the lunch is physics, interrupted by periods of silence. Hans wants to know why chiral symmetry is broken on the lattice. Our answer is of the sort: "What do you mean, why?"

Hans wants to get going quickly, no time for any farewell. I already wished him a good trip yesterday. He just shrugs off any attempts: "Ah, I'll be back in ten days."

I have dinner with Gerry alone at 6:30. We are eating spaghetti and leftovers from last night's dinner. I mentioned to Gerry earlier that day that Steve Koonin had told me that I was awarded the Prize Fellowship, which I had accepted, and for celebration he opened the bottle of Chianti that the Goodsteins had brought for dinner, a few days ago. It turned out to be excellent. Gerry talked mostly about my future, and related things. He told one story about Gregory Breit, his advisor at Yale. When he was in Minnesota, Eugene Wigner joined him there, and they decided that they should form a Nuclear Physics Institute. As they were at this point the only members, Breit proposed that they should choose a president. Wigner argued that they wouldn't need a president.

"O.K.," said Breit, "so *you* be the president!" Wigner reiterated that they didn't need a president.

"All right," said Breit, "then I'll be the president!" and as he was saying it punched Wigner in the face such that he collapsed on the floor. I couldn't believe this when I heard it, but recalled some of Gerry's earlier stories where Breit demonstrated physical violence against his students. Oddly enough, they wrote their most famous paper together after that incident. This story was told to Gerry by Wigner himself after the latter was somewhat tipsy following the Ph.D. celebration of one of his (last) students.

After dinner, Gerry and I went to South Pasadena to watch the movie 'High Heels", by Sergio Almodovar at the "Rialto".

Saturday, Feb. 15th

Gerry and Hans came back in the afternoon. Gerry surprised me in the office around 6pm, and collected me for dinner. We also called Tetsuo Hatsuda who was visiting for a seminar, from Seattle, and went to a little Thai restaurant on Colorado Avenue where Gerry and I were greeted with 'How are you?" and "How is your son?" Gerry and I had been there before, and so had Gerry and Titus.

Hans was in a good mood, which may have been attributable to his getting something to eat (after the dismal lunch on the plane, as I was told). As is perhaps inevitable, I soon was in the middle of telling stories from my trip to Thailand in 1982, and we never really got away from that subject, as Hans wanted to know more and more about the Akha hill tribe. As I had spent a couple of nights then with the tribe, he didn't let up. He also was emphasizing how dangerous the North of Thailand is, something that I wasn't quite aware of at the time. When I mention the kind of stilted huts the Akha (and their visitors) slept in, Hans is reminded of very similar huts that he saw when he visited Cambodia, in 1969. This was before the Khmer Rouge took over, and Hans muses at how peaceful the country was then, and how unthinkable were the atrocities committed by the Pol Pot regime, murdering about one sixth of the population. We agree that it probably was one of the worst genocides in the history of mankind. We talk about Angkor Wat, the 1100 AD Hindu temple that sits on the border between Cambodia and Thailand, and Hans bets that it should be possible to visit it in about two years.

Tetsuo didn't say much all evening, he probably was feeling much like I felt when I first met Hans. After dinner Gerry asks Hans if he is sated, and Hans answers "Mäh, Mäh!" alluding to the line "Ich bin so satt,

ich mag kein Blatt, Mäh, Mäh", from a fairy tale of the Brothers Grimm that Gerry and Hans are quoting off and on.

Sunday, Feb. 16th

So many stories, so little time! Tonight we had dinner with Vendula and Petr Vogel. She is a (math) teacher and Academic Dean at Westridge School for Girls in Pasadena, knows a lot of the names and stories, and the latter abounded. I can only try to pick out the cherries. He is a nuclear physicist at the Kellogg Lab, and they seem to know Gerry from far back, easily twenty years. But first, our morning hike.

At breakfast, Gerry surprised me by asking me what the r-process was. He flatly admitted that he only learned about it at the conference that he was at with Hans just now. I, however, I must concede with no trace of humility whatsoever, that I knew about the r-process, and I will add with even more candor that I only learned about it such that, in the event someone would ask me about it out of the blue, that I could just answer off-hand. Indeed, I ran across a Physics Reports article[22] about it a few months ago when I was at the University of Regensburg, and read it. It is nuclear astrophysics, so it was completely irrelevant for my work, but it was kind of interesting. And secretly, I hoped that someone would one day try to "catch" me ignorant of it. This sounds like a silly game, but if you do this often enough, it pays. I sort of looked around and said: "Well, yes." and explained. Gerry tried to catch me again with the s-process:

"What does the 's' stand for?"

"Slow" I answered calmly. Gerry was mightily impressed.

"Why is it slow?" He wanted details. I remembered them while I was speaking. Later in the evening the same topic came up again, because Gerry likes to joke about my lack of knowledge about nuclear physics, telling Petr Vogel he should teach me some when I'm at Caltech in the fall. To which I just remarked that at least *I* knew about the r-process! Gerry conceded, and I told the story of how I read about the r-process while in Regensburg, just because the article was there (which was true), and Hans liked that a lot, agreed that "this is the right way." The moral is: sometime these little games I play pay off with dividend!

Last week we had the worst storm in Pasadena for the last fifty years, so the media said. Indeed, and I was right in the middle of it. It did not

[22] "The r-process and nucleochronology", Phys. Rep. **208** (1991) 267

stop raining for a considerable amount of time (like, four days), and the California highways are just not built for this kind of beating, to which they respond with flooding. This is however only a temporary impairment, but when we went to the foot of the mountains to walk a specific trail this morning, we got a glimpse at the expanse of the damage. The entrance to the trail was blocked by a fence; in the valley beneath us we could see and hear a white river in a bed that probably sees a few drops of water only once a year, and the trail, well we could see the rest of it on the side of the mountain, it was simply washed away in gigantic mud slides that came down from the mountain. No hiking on that trail. So we decided to drive to another area where we could walk on an asphalted road. During this brief trip, we got to talk about David Hilbert, professor of mathematics at the University of Göttingen for a long time. Sure enough, Hans had some stories about him. Indeed, the way we broached this subject was on the heels of a discussion where we realized that at each phase of our career, while being a student or later, there would always be someone who was just better, and smarter. But also how these people somehow got left behind at the next phase. Gerry claims that for him it was because he worked hard. Hans countered that he also knew people who were smart, and worked hard, and still they never amounted to anything. He suspected that those just simply lacked imagination. This is where he quoted Hilbert. The way he rendered the quote, it was clear that every word was authentic Hilbert, transmitted to him, as I learned later, by his father-in-law Paul Ewald, who happened to be "physico-technical assistant" to Hilbert at one point in his career. Hilbert was talking about an ex-student of his, and the exact quote is this:

> "Also der Schmidt, für die Mathematik hat er nicht genug Phantasie gehabt. Jetzt ist er Dichter geworden. Dafür hat es gerade gereicht."[23]

He related to us one other quote of Hilbert during the short ride, and that was in the middle of the 1930's, when the mathematics department had been all but completely wiped clean of the Jewish faculty, and replaced by Nazi followers. Hilbert, not being Jewish and therefore untouchable, was asked by a Nazi if it was true that the level of mathematics in Göttingen had gone down. "Das würde ich so nicht sagen" answered Hilbert (Hans was quoting Hilbert in German), "die Mathematik ist nicht heruntergekommen

[23] "So this Schmidt fellow, in the end he did not have enough imagination for mathematics. Now he is a poet. For that he had just enough."

hier, sie existiert einfach nicht mehr!"[24]

There was no interesting discussion during the hike, which took only about two and a half hours (it started to drizzle slightly). I remember some talk about physics, and attempts to locate downtown L.A. from our vantage point. Indeed, due to the previous rain the atmosphere was pretty clean despite the low-hanging clouds, and L.A. appeared to be very close. Hans and Gerry claimed that the structures that we could see in the distance were Glendale, and I, because I had memorized the vista on earlier hikes, maintained that it was L.A. After the first discussion I actually gave in to the combined pressure of Hans and Gerry, after I asked Hans whether he was sure that this was Glendale. This might seem like a trivial point all in all, but then the reader doesn't realize how points like this are of tremendous importance to at least the three of us. Everybody wants to be right, nobody wants to be wrong, no matter what the object of discussion. The discussion about this never got heated. I gave in after Hans and Gerry both claimed there were sure. On the way back it was clear they were wrong. I first convinced Gerry, and he happily swung to my side, as he could show how Hans was wrong again. Grudgingly, Hans admitted defeat. We may have very erudite discussions most of the time, but we behave like children if it is about who's right and who's wrong.

On the way home in the car, suddenly Hans says: "Good!" I am somewhat startled, and Gerry immediately asks what was the matter.

"I looked out the window to the names of the cross-streets" Hans replies.

"I saw one which said 'Atchison', and I wondered if the next one wouldn't be called 'Topeka'. And indeed, it was." Gerry smiles, I'm completely at a loss. How do you deduce that the name of the next cross-street will be 'Topeka', if you just read 'Atchison', not being familiar with the neighbourhood of course? Well, the answer is in one of the first transcontinental railway lines, which was the Atchison-Topeka-Santa Fe Line, as they lectured to me subsequently.

"The interesting thing about this line is that it never connected to Santa Fe!" Hans adds. I suppose that, if you have lived that long, and never forgot a single fact, you come across information like that.

For dinner, Gerry had made his goose, once more. For hors d'oeuvres we sat around the couch table with a Californian Chardonnay, that I bought

[24] "No, I wouldn't say that mathematics has declined here. It simply doesn't exist anymore."

("Get a light fruity white wine, I don't know how to shop for wine", Gerry had asked me). Somehow Mrs. Vogel seemed to praise the American husbands over the European ones (the Vogels are of Czechoslovakian origin) which I, maybe slightly rudely, contradicted. ("This is absolutely wrong.") I realized that she was maybe a bit disconcerted by that, so I didn't say anything for some time, but rather listened, to let her recover, then made polite comments about her tales about the new developments in Prague, which they visited recently (they still have many relatives there). Hans was very interested in stories about Prague and Czechoslovakia, and bombarded Petr Vogel with questions. I was 'sommelier' like always, so I didn't get much out of it. At dinner, the conversation turned to gossip about famous and not so famous physicists that had crossed the paths of those gathered. It is completely impossible to remember more than a few. The circumstances of Richard Feynman's death were elucidated (the Vogels were friends with the Feynmans) and Mrs. Vogel told how Gwyneth Feynman didn't invite anyone from Caltech to the official viewing of the film that the PBS station had made about Feynman, and his death. The reasons seemed to be that Gwyneth Feynman thought that Caltech didn't really acknowledge the eminent stature of her husband, and also that she just didn't get along with the other faculty wives. Then Murray Gell-Mann was the object of our attention. "He seemed to continuously struggle against the overpowering image of Richard," Mrs. Vogel claimed. "He liked to maintain that the V-A theory was really his idea" at which we all just snicker. Gell-Mann of course is the one who invented quarks, and a large part of QCD. I relate the story of how Gell-Mann claimed that he gave Feynman a problem to work on, after the latter had asked him for one. "Quantize gravity!" he is supposed to have said. After running into serious difficulties, Feynman goes back to Gell-Mann and tells him that it's not working. "So, I propose something easier. Quantize Yang-Mills!" Feynman encountered basically the same difficulties, and decided they were generic. Indeed, he had discovered the so-called 'ghosts'. He never wrote it up, though. The only record is the famous Acta Physica Polonica transcript of a talk he gave. I already mentioned this article earlier. I was told this story by Max Dresden; he insisted that this was Gell-Mann's view of history. Mrs. Vogel tells of other troubles of Gell-Mann. He seems to be an art collector, and once bought illegally exported art objects of Peru, for over $100,000. The police found out, and he was forced to return the objects, without refund. He avoided being criminally charged, and he even avoided to be mentioned in the L.A. newspapers. I asked who owned the LA Times. "The Chandlers"

I was told. "They were good friends of the Gell-Manns. They live just a couple of blocks from here."

A 1964 conference is mentioned that both Hans and Petr Vogel attended (without them knowing each other). Petr Vogel claims that Feynman didn't go because he didn't want to shake hands with Pontecorvo. Hans doesn't believe that, that this would be very unlike Feynman. Vogel hints at a dark past of Pontecorvo, that he assumes is common knowledge (and probably is, but just not mine)[25] and that he later was at the Rossendorf Institute in Dresden, with Klaus Fuchs. (I begin to see). Hans says: "I did not mind Pontecorvo. I did mind Klaus Fuchs."

As we already went over Feynman's death, we go over some more physicist's demises. Petr Vogel mentions one physicist who died "like a man, skiing, in Dubna". There seemingly are very many opportunities for trail skiing, as Dubna is essentially flat. He died of a heart attack. I mention Heinz Pagels, who died while on a hike with other physicists. The Vogels know the story very well, as they arrived a few days after the incident. Somehow Pagels lost grip on the trail, or the trail crumbled under him, and he just fell, over 100 feet. When the rescue helicopter came it was already dark, and they had to wait until morning. By this time Heinz Pagels was dead. Another physicist's death is mentioned, this one while rock climbing. It is already very late while I write this, and I don't recall his name.

The Russian physicist Efimov is next on the list. I've known his name for a long time, as I took (Werner) Sandhas's course on scattering theory in Bonn and learned about few-body problems. There is a "Efimov effect". Efimov, the story goes, is in the United States trying to get a job. Vogel mentioned that he was at Caltech for six months, but that he didn't really do anything. The same seemed to have happened elsewhere. Gerry says that he didn't do much in the last fifteen years. Mrs. Vogel mentions that he last tried to get a job in a supermarket, but that he was turned down because of his accent. I can scarcely believe it.

Some more Hilbert stories. Hans says that some of them are written down, others were related to him by his father-in-law Ewald (as already mentioned), and some by Courant, who was Hilbert's collaborator. The Vogels know a mathematician by the name of Erica Toth, she worked with Hilbert. According to them, she dressed terribly. They claim that Hilbert once arrived at the Institute with an iron, such that Toth would iron her

[25]Bruno Pontecorvo was an Italian nuclear physicist who fled to the Soviet Union in October 1950, 10 months after the arrest of Klaus Fuchs. He died in Dubna in 1993.

clothes[26]. I ask if this was typical of Hilbert. Hans answers that the iron was most certainly an idea of Grete, Hilbert's wife, and that Hilbert was terribly absent minded. Once, Hilbert was to have a discussion with a German cabinet minister. He was sitting in the waiting room, when he suddenly would burst out to the corridor, open the window, and call out to his wife: "Grete, what is it that I wanted to discuss with the minister?" Another time, Hilbert was giving a big party. When everybody was there, it turned out that only Hilbert himself was missing. After a brief search they found him asleep in his bed. He had started to change for the party; but after undressing obviously forgot about the party, and simply had gone to bed.

This astounding fact was revealed by Mrs. Vogel: Gerry had a native American grandmother, and that this is the reason he wasn't getting any grey hair! Gerry didn't care to comment, other than that this had already been revealed in a book that was published in France, and which told the biographies of eight famous men that the biographer had known. I will have to ask Gerry again what her name was[27]. As the seven other people were all well-known Frenchmen, the question of the day at the time of publication was: "Mais qui est ce 'Gerry Brown'?"[28]

Monday, Feb. 17th

Back at lunch, 12 sharp at the Athenaeum. As reliably we are in the midst of Napoleon's offensive against Moscow, in a matter of minutes. Hans presents us with the mysteries of the Fires of Moscow, more precisely the mystery of who laid them. Indeed, Napoleon was in Moscow, but the Russian Admiral Kuznetsov wouldn't give battle, but retreated. Napoleon had counted on getting supplies in the city, but found nothing. With the fires in the city and the citizens fighting in guerilla tactics, Napoleon had to retreat. This Hans compares to the retreat of Wellington into Portugal, and the unsuccessful retreat of the Austrians, as the Napoleonic supply lines were never broken. We also dwell into Hitler's defeat so close to Moscow that he could see it. Hans suggests that "for your education" I read Shirer's "Rise and Fall of the Third Reich", which he found to be very accurate. Next he discusses the cutting-off of the British supply lines by the German submarines in 1942, and how the German submarine fleet was defeated.

[26]Note: I could not find any mention of a mathematician Erica Toth. The only female assistant to Hilbert I could find was Emmy Noether.
[27]Dominque Saudinos, "Leurs leçons de vie" (Mercure de France, Gallimard, 1990)
[28]But who is this 'Gerry Brown'?

Indeed, due to the need of having a tube protruding over the water to supply oxygen, the submarines could be detected by radar. This was, as he says, later overcome with the invention of nuclear submarines. I ask Hans who invented those, and he tells how right after Fermi had shown how the nuclear reaction would work, Westinghouse and General Electric started working on a reactor. It turned out however that these reactors were much more expensive to build than the conventional ones. A navy captain finally had the idea to use them for submarines. He pushed the development, and became an admiral later. (Hans knew the name: Hyman Rickover.) For the rest of the lunch I'm afraid I was playing the entertainer, with stories about Apollo 13, other accidents in space, material left by the Apollo astronauts on the moon, footprints on the lunar surface, the Martian atmosphere, and my preferred subject: Titan, one of Saturn's moons. What can I say, I'm a space buff.

For dinner we have "The Remains of Goose" from the previous night. Hans begins to tell me about something that he just learned, namely that you cannot have turbulence in two-dimensional systems in the absence of viscosity, simply because of angular momentum conservation: smaller 'rings' cannot be shed by larger ones because that would, at constant energy, raise the angular momentum. He is investigating the effects of convection in supernovae, and he was always told that convection would not lead to mixing (which he needs). However, these models of convection were two-dimensional, and thus without turbulence. A real three-dimensional convection system would exhibit turbulence, and lead to significant mixing.

After a short lull in conversation Hans announces that Governor Paul Tsongas of Massachusetts had won his heart again (as a Presidential contender), because he was quoted in a newspaper that he supported nuclear energy. We all agree though that all Tsongas can do is lead the way for Cuomo in 96, as no Democrat will win in 92. I ask Hans about Cuomo's stand on nuclear energy, and Hans responds: "Not good." Cuomo seems to be generally in favor, but vetoed the Shoreham plant after it was ready to go on line, a six billion dollar instrument. I quote the concerns about emergency evacuation, and he responds that those were entirely manufactured. After all, he said, all you need is to be five miles away, and out of the prevailing wind direction. This cannot prove to be difficult.

While Gerry is on the phone several times, I ask Hans about his famous 'linear chain' paper, which was published in 1931, as he remembers.

"It had its 60th birthday last year!" Indeed, it was unknown to him that the now so famous 'Bethe ansatz' was taken from this paper. When

Feynman told Hans shortly before his death that he was getting interested in the Bethe ansatz, Hans answered genuinely surprised: "What is that?" Hans wants me to tell him what this Bethe ansatz is all about, but I can only tell him that it is some sort of solution to some two-dimensional conformal field theories, I really know next to nothing about it. I tell him that I should maybe read the paper, as I never did. He answers that he hasn't looked at it for pretty much sixty years himself.

I ask him about number games, and he says that in order to sleep he likes to take a number and find out whether it can be decomposed into the sum of squares. For instance, he goes on, there is a mathematical theorem that states that every prime number of the sort $4n-1$ can be decomposed in such a way (he says that he forgot the proof). Given this, one can manufacture a number, and try to find its decomposition into a sum of squares. He does that to fall asleep! I think it would keep me awake all night.

Tuesday, Feb. 18th

As always on Tuesdays, no lunch but rather 'Journal Club' and later, at 2pm, group meeting. I give a little talk on quark number susceptibility during the latter.

At dinner, (roast beef, since it's the next to last dinner for us, and Hans likes it so much) the first subject is the business concerning the visa for Ismail Zahed's new wife, who was denied entry to the US. Gerry called D. Allan Bromley, the President's Advisor for Science and Technology (they know each other from Yale, where Gerry got his Ph.D.) and was assured by him that he cleared the matter up, and that Ismail's wife will be allowed in. Gerry boasts that if that initiative hits a bureaucratic snag, Bromley can always call George Bush, as they also are 'chums' from Yale. I guess they call that the 'old boys network'. Gerry is pleased that this matter is finally cleared up. Next on the list is the primary that was held today in New Hampshire. Hans is worried about Buchanan having obtained 40% of the vote, as this might drive Bush further to the right in order to fend off Buchanan. Tsongas, our collective favorite, won on the Democratic side, though we still believe that he has no chance against Bush.

After Ismail called Gerry to get the latest information, I tell how Ismail was prepared to work on explosion theory for the Algerian government in exchange for his military service. (Since then he received a Green Card and the Algerian government has dispensed his age group from military service.) Hans mentions that there isn't much to do anymore in that field,

and that most things are known. Gerry remarks that Hans is the world expert on shock waves and explosions. This gets us to talk about the first test of the bomb. Gerry asks Hans if it was Fermi or Feynman who against regulations stepped outside the trench after the explosion, to measure the strength of the shock wave by dropping little pieces of paper and seeing how far they would be carried by the shock. Hans acknowledges that this was indeed Fermi. Feynman is supposed to also have dodged regulations by looking directly into the flash (though with dark glasses, which everybody was wearing). Hans cannot confirm that, as he said he didn't look at Feynman then. Hans turned out to be at the observing trench roughly 20 km away from the explosion, which took place in New Mexico at "Jornada del Muerte" (literally: "The Journey of Death"), about 100 km away from Los Alamos. Fermi was at the closest trench, at 6 km. Next to Hans was a journalist from the New York Times, who was specially selected (as the test of course was Top Secret) and who was supposed to publish an article about the test after the Hiroshima dropping. Roughly a minute after the flash, the shock wave arrived at the trench with Hans and the reporter. When he felt the shock (which was quite substantial, as the yield turned out to be about 20 kilotons) the journalist asked: "What was *that*?" Hans patiently explained it to him. Gerry asks if the 6km trench was safe, and Hans answers that is was pretty safe, although they didn't know precisely what the yield would be. In fact, there was a betting pool about the yield, and Hans predicted 8 kilotons.

"You were wrong by a factor of 2.5!" Gerry shouts, delighted.

"Well," Hans answers, "I bet the theoretical prediction" (who would have doubted that).

"I obtained the numbers for the neutron multiplication from Bob Serber of the neutron group, and he is a very reliable physicist. He had an assistant, a mediocre physicist, who bet 24 kilotons. Who should I have believed?"

"The pool was finally won by I.I. Rabi, who knew next to nothing about the subject. Fortunately the reporter from the NY Times bet 50 kilotons."

I ask about who was at the test. From the government there were General Groves and two deputies, as well as the head of the nuclear weapons development department James Conant, and Richard Tolman, scientific advisor to Groves. Then there were of course all the division leaders, and most other important people from the project. Secrecy was a big concern, which is why they had it so close to Los Alamos. Nevertheless, the chief of secu-

rity sighed: "How am I supposed to keep this secret, next time they'll ask me to keep the Mississippi river secret!" Indeed, the test was held in the middle of the night. It was supposed to take place at 3 a.m., however this was cancelled because of rain, as this would have deposited the radioactive material on the ground. The detonation, then, was just before sunrise. The darkness was supposed to help to follow visually the development of the shock wave, which followed immediately after the flash. The flash itself was described by Oppenheimer as "brighter than a thousand suns". By a mechanism that I wasn't able to figure out, the shock front is luminous, ("just like the shock front of a supernova, which we can observe", Hans explained) and was filmed by a high speed camera. The mushroom cloud that emerged glowed in a deep violet first, due to the Cherenkov radiation emitted from the electrons, which were travelling faster than the speed of light in the medium of sand and fission material. Later, the cloud turned grey, as the electrons had slowed down. Then the shock wave hits. As to the secrecy, the Los Alamos community had placed themselves strategically to observe the flash from a hundred kilometers away, and had no problem detecting it. The next morning, there was a story in the 'Albuquerque Journal', from a man who was driving home that night, and claimed that he saw the sun rise twice. I ask Hans about the size of the bomb and he spreads his arms:

"About like this, roughly 5 feet wide. They called it 'Fat Man' ". Hans mentions that you can now visit the test site, and see a moderately-sized crater, the bottom of which is covered with green glass, the residue of the molten sand. I want more details and ask Hans about the temperature in the middle of the bomb during the explosion.

"This is classified" he announces calmly, "but I can tell you the temperature of the air right outside the bomb, which is available. This is about one million degrees." Cautiously I coax him:

"It is classified, but you know it?"

"Of course," he answers.

"So I suppose that the temperature in the middle of the bomb is higher?" I ask, feeling mildly like a spy. Gerry throws in:

"That is probably classified too!" but Hans signifies no, and says that it is indeed higher. I enquire about how the bomb was attached to the ground. Hans explains that it was attached to a hundred-foot-tall tower, to make the analysis of the shock evolution easier. He describes how Robert Wilson (later with Hans at Cornell) was one of the last ones to check the wiring and the electric connections of the bomb on top of the tower. I ask about Wilson's heart rate at the time. Hans says that it wasn't measured,

but that it was very probably considerably elevated. He also says that the tower was pulverized. I ask Hans if everybody was convinced that it worked.

"Most of us were convinced. But there was this little uncertainty about the initiator. After all, Critchfield and I had designed the thing, and ours was in there instead of Fermi's" (I told this story earlier). The initiator is mainly a source of neutrons that is activated at exactly the same moment as the two shells of fissionable material are blasted together by a conventional detonator. They used an 8 tons detonator (quite a lot, but they wanted to be sure). This was why some of the entries in the pool about the yield were just this number: 8 tons. Those were the pessimists who didn't believe that it would actually ignite. The initiator in mainly Polonium, and a little Beryllium. I'm not sure if Hans knew that this was declassified, because when I asked him about the initiator, he first hesitated a bit. But I knew about the Polonium and told him, he then acknowledged it, and mentioned the Beryllium. Whether the Beryllium is declassified, I don't know. I ask if there were other tests, and he says that there were none, that next was the Hiroshima bomb, which in fact was a very different design, where a gun would shoot half of the fission material with high velocity on the other half, all this taking place in a tube, which was dropped from a plane. The 'shot' was timed such that ignition would take place at a specified altitude.

I ask Hans about a good book which describes the test, and he mentions "The Making of the Bomb" by Richard Rhodes, which Hans says is highly accurate. I mention "Heller als Tausend Sonnen", and Hans remarks that this is a miserable book. In the following, we make fun of the author Robert Jungk.

"He was already a little crazy when he wrote the book, but he got steadily crazier after that!" Hans laughs.

"His book is completely unreliable, you cannot even obtain the truth by believing the opposite of what he says!"

During dessert, we talk about Shakespeare's Hamlet. If anyone is interested in how we made *that* transition, here it is: After all, we talked about Polonium, and Laertes' father is, well, Polonius. This is not a joke. Hans compliments me about how well I know Hamlet, and we discuss the Tieck translation. We also argue about whether Polonius was an OK fellow. Gerry maintains that he was just a meddling old fool. I offer that he was treacherous. Anybody could tell we were over dessert, a chocolate pie.

Wednesday, Feb. 19th

No lunch today (Gerry and Hans had an unspecified appointment), so it was on to our last dinner. In the meantime I had bought Rhodes book about the bomb, and brought it to dinner as it had many nice pictures in it, also of Hans and his wife. Looking at those, especially the one of his wife Rose, he exclaims: "How young we were!" There is a photo of General Groves and Oppenheimer at the remains of the firing tower, and Hans mentions that the photo must have been taken weeks after the test, because of the radiation. He also tells how he and Weisskopf drove to the edge of the crater a few days after the test in a jeep. Weisskopf had a Geiger counter, and suddenly went pale when he saw the reading, which indicated 240 rem, as that dose would have led to radiation sickness, and death, in a matter of days, Weisskopf was scared. It turned out, however, that the counter was incorrectly hooked up, and that the correct reading was 250 *minus* what the instrument showed. Considering that these two men are still alive today, with healthy children, it is amazing how people can be scared by exposure to a few *milli*rem. In Rhodes' book, there also was a picture of George Kwiatkowski, riding a horse. He was a chemist, originally from the Ukraine. Hans mentions how, when Kwiatkowski didn't understand something, he would turn to him and ask: "Could you please explain this to a poor chemist?" Hans and Gerry argue about "Who built the bomb" when it comes down to it, "who did most of the work". Gerry says: "I always thought that it was Bacher who really did it." Hans agrees: "Bacher and Kwiatkowski, they did the most."

Earlier, I had read the reference about Hans' initiator, which described it in some detail, and indeed mentioned the Polonium and the Beryllium, and how it was mixed. It also mentioned a classified aspect of it, namely the shape of the Polonium-Beryllium mixture, which supposedly was rough like a golf ball, in order to create turbulence in the explosion. When I asked Hans about this feature, he just didn't answer at all.

During dinner, we talked about other things, like how much bigger you chances were to excel in academics if your parents are academics. Hans started to enumerate all the Ph.D.'s in his family, father, grandfathers, cousins etc, but lost count. Also Gerry's father was a University professor, though in first generation. I told a story about Pauli and Heisenberg that I learned from Max Dresden, which amused Hans. Towards the end of their career, Pauli and Heisenberg announce that they have a new unified field theory that explains just about everything. Rumors are flying that they were able to calculate the fine structure constant from first principles. They are to give a joint seminar at Pupin Hall of Columbia University, which is

not officially announced, but everybody who is anybody in physics learns about it and tries to attend. Young Max Dresden is there, with standing room only. At the conclusion of the talk, Julian Schwinger raises his hand and comments that their (spin-3/2) theory is blatantly unrenormalizable. After a few more critical comments, the audience is silent, and Niels Bohr, sitting in the front row, slowly gets up. He turns his back to the speakers, faces the audience and exclaims: "It is amazing that these two have ever gotten anything right!".

I ask Hans if it was true that Pauli had palsy, and for that reason was always nodding his head during seminars, as if he agreed with the speaker. Hans vehemently shakes his head. "No, that is completely wrong!" he says, and pulls back his chair a bit.

"He was rocking his whole upper body back and forth! And he always did it, even when he was young! In Copenhagen, where many of the stories about Pauli originated, they made up something about him." And, smiling broadly, he recites:

> Wenn der Pauli mächtig denkt,
> er seinen Oberkörper schwenkt.
> Wenn er mit einer Frage kämpft,
> dann ist die Schwingung ungedämpft![29]

He tells another Pauli joke that circulated at the time. For introduction, it must be said that Pauli was not very well-liked in seminars, as he always contradicted the speakers. So it is said that when Pauli died, he was received by the angels, who told him that, because he had spent his life searching for the answers to the most difficult problems, and had contributed a lot to the advancement of science, he was allowed to go and see God, and ask him one single question. So he does, and after meeting God, Pauli asks him how to derive the fine structure constant. "Ah," says God, "that's easy!" He goes to the blackboard and starts filling it with equations. After two minutes he filled the board, and presents Pauli with the answer. Pauli looks at the proof, looks at God, and says: "Wrong!"

Maybe because it is the last dinner, the conversation isn't what it usually is. At some point Hans gives me his keys to the apartment, as I will move

[29] When Pauli's deep in thought
His upper body rocks.
When fighting with a question,
The oscillation's undamped.

in after his departure. He retires early. As I will have breakfast with Hans and Gerry the next morning, this was quite all right.

Thursday, Feb. 20th

We have breakfast at 8:30. Gerry and Hans talk about physics, as they always seem to do during breakfast. The current problem is the r-process induced by convection and shock waves in the post-supernova environment.

Gerry asks Hans about Oskar Klein, and whether he knew him, and Hans answers yes, that he was the one who introduced him at the Nobel Symposium, and that he was a very nice man. But he adds that he did not know (Theodor) Kaluza, as Klein's name is almost always mentioned along with Kaluza's. After breakfast Hans reads the New York Times, as he has been doing for innumerable years. We briefly go down to the patio of the apartment building for some pictures, Hans and Gerry, and then Hans and I. "If it has to be done" says Hans, he doesn't seem to like to be photographed. "For posterity" says Gerry, and Hans answers that he already has his picture in Rhodes' book. Maybe he is just a bit vain, and doesn't like to be photographed at this age. The van that will take Hans and Gerry to the airport has arrived. We briefly shake hands, Hans says that he hopes that we will see each other again, and so do I, hopefully next year. Then I go back to the apartment, alone.

Epilogue[30]

I have always considered myself extremely lucky that I got to know Hans, this extraordinary man, on such a personal level. We continued these winter meetings at the Kellogg Radiation Laboratory for another eight years, and our relationship grew ever closer. We talked about everything in the world, I was able to teach him some evolutionary biology, and he listened to my work in quantum physics.

I never was able to duplicate this feat of writing down all our conversations, but I do have notes from some later years. I also recorded our last few days together in the Spring of 2000, because we all realized that it was possible that it would be our last meeting. Traveling was becoming more and more of a burden for Hans. Unfortunately, these notes were in a bag that was stolen from my office along with my laptop. Everything else that was stolen I was ultimately able to replace, but the loss of these last notes

[30] March 4th, 2006

still pains me. But I do recall the last time I saw Hans, back in the same office where I first met him. He was about to leave, and I greeted him at the door. He picked up the cane that he had been using for the last few years, and remarked: "I am more able with my cane", a pun that I had made a few years earlier, and that amused him enough that he repeated it once a year. He was never fond of sentimental farewells, so for our goodbyes he only said two words to me, words that I have been trying to live by ever since. He shook my hand, stronger than the first time we shook, looked me into the eyes, and said: "Carry on."

Acknowledgments

I don't think I have ever properly thanked Gerry Brown for giving me the opportunity to become friends with Hans, and for inviting me to contribute these notes to the memorial volume. I also want to thank his wife Betty for her friendship in the last twenty years, and particularly Rose Bethe, for the kindness she demonstrated to both me and Taylor year after year. She took the time to tell me personally that Hans had read these notes shortly before his passing, enjoyed them very much, and encouraged their publication. Finally, I would like to dedicate this diary to my father Nikolaus Adami, who passed away the same year as Hans. He was the one who urged me to keep a diary after I told him that I was going to meet a legend and spend a month with him. "Great men keep diaries", he encouraged me. He read them with great pride.