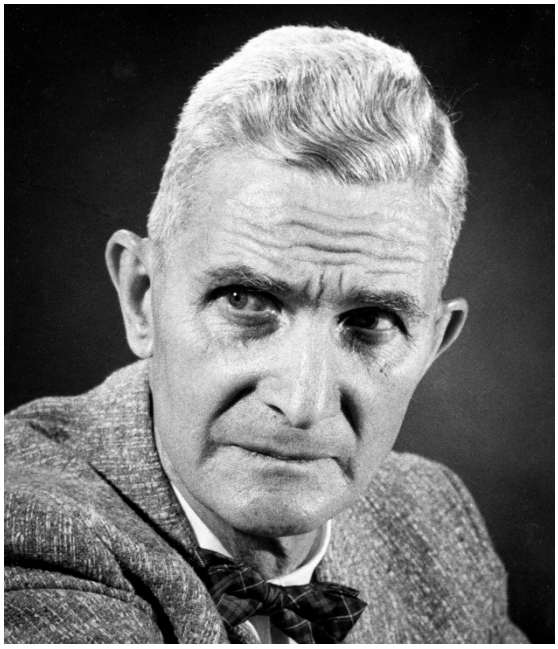

WILLIAM RALPH SMYTHE
(1893 – 1988)

INTERVIEWED BY
MARY TERRALL

February 13 and 15, 1978

ARCHIVES
CALIFORNIA INSTITUTE OF TECHNOLOGY
Pasadena, California

Subject area

Physics

Abstract

An interview in two sessions, February 1978, with William Ralph Smythe, professor of physics, emeritus, in the Division of Physics, Mathematics, and Astronomy. He recalls his youth in Colorado and Santa Fe, NM, and his father's career as a civil engineer. Undergraduate physics at Colorado College; six months' graduate work at Dartmouth. Enlists as U.S. enters WW I; sent to officers' training camp, Plattsburgh NY, and thence to France as artillery officer. Recollections of the war.

Returns to Dartmouth; moves to University of Chicago to complete PhD. Works with A. A. Michelson. Two-year instructorship at the University of the Philippines. Comes to Caltech as a research fellow, 1923. Isotope separation. His recollections of early physics dept. faculty and teaching his course in electricity and magnetism. Joins C. C. Lauritsen's Caltech rocket project; works

with Navy in Key West on the anti-submarine "Mousetrap" rocket. Invents yaw camera. Caltech in postwar era. His work on heavy-carbon separation.

Administrative information

Access

The interview is unrestricted.

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CALIFORNIA INSTITUTE OF TECHNOLOGY ARCHIVES

ORAL HISTORY PROJECT

INTERVIEW WITH WILLIAM RALPH SMYTHE

BY MARY TERRALL

PASADENA, CALIFORNIA

http://resolver.caltech.edu/CaltechOH:OH_Smythe_W

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CALIFORNIA INSTITUTE OF TECHNOLOGY ARCHIVES
ORAL HISTORY PROJECT

Interview with William Ralph Smythe **by Mary Terrall**

Pasadena, California

Session 1 **February 13, 1978**

Session 2 **February 15, 1978**

Begin Tape 1, Side 1

SMYTHE: A lot of this stuff I wrote up for my children. For instance, on World War I, I wrote a long history of all the things that happened, but I don't have any copy of it. I'll just remember a little bit of it now. I wrote it up while it was fresh in my mind.

TERRALL: Well, let's start with your family background.

SMYTHE: OK. I was born in 1893, July 5. That's the earliest event I can report on.

TERRALL: In Colorado?

SMYTHE: I was born in Cañon City, Colorado, down near the mouth of the Royal Gorge, I think in an adobe house. My father was a civil engineer.

TERRALL: When did your family come to Colorado?

SMYTHE: Well, before I was born. I don't know when.

TERRALL: Your father came as an engineer?

SMYTHE: Yes, he came there working as a civil engineer. He hadn't been out of school very long. Then the Depression of 1893 came along, and he moved back to South Dakota, where he had been born, and there he built a big standpipe and did lots of things.

But then he came back again to Cañon City, and he was Mayor of South Cañon and city engineer for North Cañon. It was divided then into two towns; it's united now into one.

TERRALL: How big were the towns?

SMYTHE: Oh, I can't say at that time, but I should say about ten, fifteen thousand. It's a very old place—it's older than some of the bigger cities there. One of very oldest settlements in Colorado.

TERRALL: Was that a mining town?

SMYTHE: Well, there was coal mining almost on the outskirts of town. In fact, there was a coal mine only a short distance from where I lived. But mining was in Cripple Creek. There were three ways to get to Cripple Creek from Cañon City. Cañon City was pretty close to Cripple Creek. Much later, I worked in the Portland mine in Cripple Creek one summer—one of the biggest gold mines in the camp. They took, I don't know, twenty-some million out of it. It still has lots of gold there, but the price of labor is so high they can't mine it.

TERRALL: Was that when you were in college, that you worked in the mine?

SMYTHE: It was the summer after I graduated from Colorado College when I went up there and worked in the gold mine—the same mine that Jack Dempsey worked in. He worked in it the year before—the heavyweight boxing champion. I worked on the eighteenth level. It was about 2,000 feet down. The top of the mine was over 10,000 feet in altitude. Cripple Creek, you see, is way up there, on the slope of Pikes Peak.

So, I worked in that mine. I worked as a mucker at first—that's shoveling—then as a trammer, running the cars. They had electric locomotives. Then I worked on the pocket, kept track of the cars that were dumped and dumped them.

TERRALL: You would shovel the stuff onto the cars and take it out of the mountain?

SMYTHE: Do you know anything about gold mining? The veins, or ore layers, ran from six to eight feet wide, and there are layers of ore with bedrock in between. [Drawing diagram.] Well, there's a section of ground. It's irregular and has these layers where there was telluride ore—gold telluride. I don't know what the valence of these things is, but anyhow it was gold telluride. And the way it's mined, usually, they have various shafts. I don't know how it started, but when I was there the shaft went down like this and then along this layer. Then the shaft comes down and dips into this [layer] and then they run shafts along here, and they start above. They mine from here up. They blast down and it comes down. They load the cars out of this, and they work up until they get to the next level. They blast it down and it falls down. They call it muck down here. They have chutes here, and little cars. Trains with electric locomotives come here and pull the ore out. Anyhow, they have these chutes, a series of funnels. There's the drift coming down, and they have built a wooden chute across here which has slabs that pull out so the ore can come through. That's what they call "tramming." Every once in a while, one of them gets stuck, hangs up; then you must be very, very careful. You quit your job and report, and there's a guy—who's sort of an aristocrat there, and they get killed every once in a while—who gets up into this chute and crawls up. This is all stuck above him. It's all broken, but it's stuck, and he tries to pick out the key rocks and put in a little flexible dynamite. You know, you can take dynamite and put it in your hands and it gets like putty. He puts it in the right places, puts a fuse on, and gets out, and then when that goes off it's supposed to drop this whole thing. It may stop dropping here, or it may be so far from it that it collapses the whole tunnel.

TERRALL: That's pretty dangerous.

SMYTHE: Then you have to get out. Well, I saw something happen awful close to dangerous once. The guy—what did they call him? They'd got a special name for him. Anyhow, the chute was all hung up. I was on the pocket at that time, but the chute was right close to the pocket. And this trouble-shooter was called in to where it was hung up, and he climbed up to take a look at it. Just as he was coming out of the chute, the thing dropped. It tore out all the timbering there, and everything collapsed. When he came

into the pocket, I was right close to him. He had the mouthpiece of his pipe in his mouth, but the bowl was knocked off. He didn't even know it—he was too excited. He had an awful close call that time. The thing dropped just when he was investigating it. I remember that happening, all right.

TERRALL: Well, let's go back.

SMYTHE: Well, Dad was a civil engineer and went back to Dakota, where he had lots of friends and connections and so forth. He came out to Colorado originally for Mother's health. Mother was tubercular, so they came out to Colorado, for the benefit of that. He went back there and stayed there for some years. When things got better, he came back out to the same town, Cañon City, and worked there. As I say, he was city engineer of North Cañon, and the mayor of South Cañon. Have you ever seen the Royal Gorge?

TERRALL: Yes.

SMYTHE: Did you ever notice the pipeline along the Royal Gorge on the far side from the railway? Well, he laid that out.

TERRALL: Down in the bottom, right?

SMYTHE: Down at the bottom. That was one of his jobs as city engineer, to lay that pipeline. He surveyed the pipeline. They couldn't use stakes or anything to indicate positions, so he had a slingshot and little bottles of white lead. He would get the plot located, and he'd shoot that all the way. He had a bad accident when the rock he was standing on, partway up the wall, broke loose once and his instrument went all the way into the river. He hung on, but it cost him $200, or something like that, to get his instrument fixed. He wasn't laid up—he was banged up a little bit, but not seriously.

TERRALL: That was long before the bridge was built.

SMYTHE: Oh no, there wasn't any bridge across the top at all.

TERRALL: But the railroad was there?

SMYTHE: The railroad was through. You know, they had a big war when that railroad went through. The Santa Fe and the D&RG [Denver and Rio Grande] both wanted that pass. They both built lines to it. If you live in Cañon City, you can see where the Santa Fe line ends. The D&RG beat them to it. They had men with rifles; it was really a battle. I've seen pictures of the arrangement of men with guns and so forth. But the D&RG won. So the Santa Fe went south through Raton Pass and became much more important than the Denver and Rio Grande.

Well, as I say, he became city engineer. I went to school, up to about the fifth grade, in Cañon City. Then we moved to Santa Fe, New Mexico. He and [C. C.] Corbet were partners. Corbet was from Cornell, just out of school. He was a very good engineer—Dad didn't have the education that Corbet had. They set up an office on the north side of the plaza. I think it was the north side; it was the side next to the mountains. They were the only engineers in northern New Mexico. They surveyed all over northern New Mexico. They would have a mining claim up on top of the Sangre de Cristo Mountains, and they'd have, for instance—I went on this one—they surveyed to get the contents of the White Rock Canyon, which runs from Los Alamos south to the Indian pueblo—what's the name of that pueblo, at the bottom, there? There's a pueblo right at the bottom of the canyon [Santo Domingo]. There are a whole lot of them above—San Ildefonso, Santa Clara—a whole lot of Indian pueblos up above. Anyhow, this canyon runs between where Los Alamos is now and down. Now there's a trail through it; in the old days, there was no trail.

On one trip, I'd gotten sick. I was out of school for six months with typhoid fever. My brother and I were extremely sick from that. We were laid up for about six weeks. I was unconscious for two or three weeks after I got back. Trouble is, it was way up in the Pecos Valley. We'd gone on a long hike. We'd gotten some contaminated milk up there, and it's a thirty-five-mile hike over the crest down to Santa Fe from there. We were all sick, the three of us, on the way back.

TERRALL: This was where your father had been surveying?

SMYTHE: Yes, but this was a pleasure trip. It did happen to go through the area where he had surveyed the railway up to that mine. He went up from the railway, straight up Santa Fe Canyon. We all got sick up there, and we decided we'd better get home. So we hiked, but every mile or so, one of us would pass out. The rest would wake him up and get him going again. When I finally got home, I passed out. I was out for two weeks. My brother was just about as bad. Wallace Fiske, the third man, was out too, but he recovered in about a week; for some reason it didn't hit him so hard. He became quite well known later, Wallace Fiske. They have a Fiske Planetarium at Boulder named after him. He became wealthy and gave, I think, $2 million to the University of Colorado. The planetarium is named after him. I visited it.

TERRALL: Was he an engineer too?

SMYTHE: No. His father was one of the pioneers in Santa Fe and was much older than his mother. They had a great big house with a big patio and a long front porch that faced the open area in front of the cathedral. Now it's all changed. They had two dogs, both thoroughbreds. One was a great big Saint Bernard and the other was a setter, Chap. Chap was always getting into fights. The big Saint Bernard was a very gentle dog, but he always had to go out and rescue the setter from the fights. It was more fun to see. He didn't want to fight, but he'd go out, and being big and husky, he would always rescue Chap. It was the funniest thing.

So we spent a lot of time at Fiske's. His father was one of the pioneers. He'd been in Santa Fe for many, many years—one of the pioneers in the town. They were very well off. All the boys went to Colorado University. One of them became a dentist, married a redheaded girl I knew, and spent his life in Santa Fe. I don't know where the rest of them went. Well, Wallace stayed in Santa Fe too, but he had a big house up north. I saw him right after World War II. I went to Los Alamos via Santa Fe. I got in there about seven o'clock in the morning and had to go out by plane about noon. I thought I'd call up his house. He wasn't up yet, and the maid who answered the phone was skeptical, but she finally agreed to go wake him. She awakened him. He rushed and dressed and we had a great rehash of old times.

TERRALL: How long did you live in Santa Fe?

SMYTHE: We lived in Santa Fe till 1911. In the summer of 1911, we moved up to Colorado Springs. The educational facilities in Santa Fe were pretty poor in those days. They had one high school. The total number of students in the high school was forty. There were about 7,000 Mexicans and 1,000 Americans [in Santa Fe]. Practically all the Americans knew each other; you could speak to people. The Mexicans all went to Catholic schools. If you didn't take off your hat when you met a padre on the street, you were just as like as not to get some Mexican to knock it off. It was pretty rigid in that respect.

TERRALL: When you moved to Colorado Springs, did you know you wanted to go into physics?

SMYTHE: I had no idea. I went one year to Colorado Springs High School, because obviously the training at Santa Fe High School was not good enough. So I went one year to Colorado Springs High School, which was a very well known and very difficult school. They really pushed you. I'd never had to work before or take books home. When I got up there, I really had to study, but that was a good thing, because when I went to Colorado College I was all ready for it. My parents decided that we'd better go to college, and they wanted a good college. There wasn't any good one in New Mexico. Now there are several respectable places, but there wasn't at that time. So we went up to Colorado College.

TERRALL: Did you study physics in college?

SMYTHE: When I went to college I didn't know what the dickens I wanted to do. I was interested both in engineering and science. So what I did was carry all the work required the first two years for both the liberal arts and engineering courses. Which meant I was awfully heavily loaded. In fact, I became interested in chemistry, and I had theoretically seven afternoons of laboratory. Actually, though, there was a lot of room, and they gave me a series of desks adjacent, about twenty-five feet long. I would have experiments

going on in the different chemistry courses at the same place there, all the time. Also I was an assistant in chemistry.

That was after I decided not to go into engineering. At first, I took both engineering and arts. Then I got interested in chemistry. I had no physics. As a matter of fact, I never had any physics in high school, either. But I had all this chemistry—physical chemistry, calculus, and all the mathematics—and so I decided I ought to have some physics. I didn't take it until my junior year in college. That was my first course in physics. Gee, I found it very interesting! Most of the other students had been working gradually up to it, and they were kind of bored by doing the same thing over, just a little bit more accurately than before. But to me it was all new, and my preparation was very complete. I had actually had physical chemistry before I had had physics. I had all the calculus and everything. To this day, I can't do any of these physics problems such as they have in high school without using calculus. I never thought of any other method of doing them.

So I moved into physics. I took all the chemistry courses they had in college. Physics I didn't major in until my senior year. I took my first course junior year, then my senior year I took a course in optics, under Professor [Roland R.] Tileston. He was a very effective teacher. He later became head of the department at Pomona College. I have here something he put out—a list of some of the students he's had. You find there Norris Bradbury, who came from Pomona and was the director, just after the war, of the Los Alamos National Laboratory.

Tileston left Colorado College and went to Pomona. He was very good at selling physics to people. I got extremely interested and decided to do postgraduate work in physics. Well, I was his first student. He was from Dartmouth, and he said if I would go into physics he would fix it so I could go ahead without any expenditure at all. He got me a teaching fellowship at Dartmouth College. So I went to Dartmouth College. That's very nice. It's up in the mountains, way up the Connecticut River—skiing and everything. I had never skied. Skiing was fairly primitive in those days. All you had was a ski with one strap across it to hold your foot. Well, you never got your leg broken in skiing. I broke skis but never hurt myself, because it just had this strap across it. Now

they have this elaborate thing where your skis are really attached to you. I broke skis trying to jump, but never hurt myself at all.

Well, it was nice up at Dartmouth. It was very cold in the winter; snow came on in the fall and stayed all winter. There was ice on the river—the Connecticut River froze over. We had to sweep a place to skate, because the snow built up on it. You had maple syrup, and one thing and another. Dartmouth is a nice place.

I'd been there about six months, from September [1917] until about March [1918], when the war started.[1] Anyhow, I decided I would like to get into the war. I went to the first officers' training camp, at Plattsburgh [New York]. That's not too far from Dartmouth. It's right on Lake Champlain, which divides New Hampshire from New York.

TERRALL: Did other people from Dartmouth go there too?

SMYTHE: I think there were some others who went, too. There were certainly students who went. I took my examinations for admission to Plattsburgh at Norwich military academy, which is about halfway between Dartmouth and Plattsburgh. They gave me a very good introduction, so I got admitted at once, and I went to Plattsburgh. The reason was that I wanted to see what the war was like. My grandfather had been in the Civil War, and I'd heard a lot about him. He had a tough time. He was wounded at Chancellorsville and reported dead. He was shot through both lungs—bullet went in here and came out here. Also had a bullet lodged against his spine, at Chancellorsville. He and my grandmother were engaged, and it was reported to my grandmother that he had been killed. The battlefield belonged to the Confederates, but his uncle and some of the other relatives, who were civilians, were allowed to come in and look for his body and bury him. They found him alive, and they got him out about two or three days after he'd been shot. Probably a good thing they didn't move him before then. They pulled a handkerchief through both lungs. I don't know how many hospitals he went to, but Mrs. McCabe, who is writing a Smythe genealogy, got copies of all his military records.

[1]World War I started in 1914, but the United States did not enter the war until April 1918.

TERRALL: This is your grandfather?

SMYTHE: Yes. That's only part of it. Applications for pension—she sent me all these documents. He was a corporal, but he was put back in the ranks because he used disrespectful language to a superior, as you'll notice there. Here's a picture of him and my grandmother—that's the picture that he carried. You can read on the back about that picture. Anyhow, they found him in a few days and took him to some place—well, I guess it says on the back what happened. He was paroled, finally, and they got married. He was never very strong—he was in pretty bad shape all his life. He did not live very long after the war. He lived long enough, however, to have two children. He died in 1875; he was hit in 1862. He lived thirteen years and died of pneumonia eventually. His lungs were never very good, you see. I didn't know him at all, but he had a cousin, Homer, who was also one of my grandmother's suitors. He was quite a bit younger than my grandmother. After he died, about five years after or so, she married Homer, and he was the grandfather I knew. They never had any children. He [Homer] served all the way through that war, three or four years, and all that happened to him was he had a finger shot off. I used to sit on his lap and play with the stump of his finger. We liked him; he was a nice fellow. He wouldn't kill anything—he wouldn't kill a chicken for Sunday dinner. My grandmother had to kill it. He'd go off hunting with a shotgun, but he never killed anything. I don't know why he did it—just to trek around, I guess. My grandmother had to kill the chicken for Sunday dinner. He just saw too much in the war, I guess.

TERRALL: So you were interested in going into the First World War right away, because you wanted to see what it was like?

SMYTHE: That was undoubtedly one of the things. I didn't think about it particularly, but I'm sure that was one of the things. Well, I thought it would be exciting, too. But that was one of the things, certainly—knowing what my grandfather had been through. Anyhow, I went to Plattsburgh, the first camp. I had a better technical background than most of the people there. So at the end of the first session, they separated people into different categories, and I was shipped out of Plattsburgh to Fort Monroe, Virginia, where

they had the coast artillery. They wanted people with mathematical backgrounds. They just shipped you there. So I found myself in Fort Monroe, Virginia. I went down to Fort Monroe and trained on the artillery and on the coastal defense guns. Then I got my commission as a second lieutenant—commissions were given mostly by age. The same day I got my commission, I got my orders overseas. What they did was, when the graduation came and they had the big ceremony and parade and so forth and everybody was lined up, they said, "All you who are ready to go to France tomorrow, step forward." Well, my folks were a long way off and I couldn't visit them—anyhow, I didn't think I could—so I stepped forward along with the others What they did was to give us orders to France, but they also gave us two weeks' vacation, or something like that.

Then we got to France; we were very early. The American Army hadn't been formed yet. There were three divisions over there I think. Three American divisions, all Regular Army. There was no draft or anything. The trouble with the Regular Army officers was that they were all West Pointers, and there weren't any second lieutenants. So they had to get second lieutenants from somewhere, and the only source apparently, in the artillery, was the Fort Monroe people.

TERRALL: Did you go directly to France?

SMYTHE: Well, we went to New York and got on a transport and then we went to France very indirectly. We weren't allowed on deck; everything was shut down. We weren't allowed to show our noses. Any uniformed people were not allowed to show their noses at all, passing down the Hudson River and so forth.

TERRALL: Why was that?

SMYTHE: They didn't want them to know what they were up to. They thought they might get torpedoed. Then we got to Halifax and we picked up the rest—I kept a diary of that time; let's see if I still have it here. I had forgotten all about that diary.

Begin Tape 1, Side 2

SMYTHE: It tells everything that happened, up until it became illegal. When we got into action, it was forbidden to keep diaries, because if captured it would give information to the enemy. That's all there is of it. It takes me as far as the end of artillery school in France, but it tells where we went.

TERRALL: I'd like to look at this, later on.

SMYTHE: Well, anyhow, it took us weeks to get to England—three weeks, I think. We went up somewhere around Iceland, I think it was—way up north. The first land we saw was the Mull of Kintyre, on the west coast of Scotland. British destroyers met us someplace up in the north region. It was very rough, I remember. The destroyer would disappear completely, in between the waves. It looked as if they were turned over. You would see the stacks way over, slanting this way. It was rough weather. I never did get seasick—never been seasick in my life, and I've been at least six months at sea. Since then, I've been around the world, to all sorts of places.

We got to England. Then, as you'll find in there, it tells everything that happened, in much more detail than I remember. I was surprised, when reading that, at some of the things I'd forgotten.

I went to artillery school in France then. We learned the French guns, the French methods.

TERRALL: What did you need your mathematical training for?

SMYTHE: A darn good thing we had it. In the first place, they sent us to artillery from Plattsburgh because of our mathematical background. It was not a simple thing, especially on the heavy guns. You have to make an awful lot of corrections, and they didn't have any computers in those days. You shoot one of these great big guns and the Earth is going at a certain speed underneath it, like this. When it gets up to here, the Earth is moving faster than *it* does, and it comes down in a different place even if you shoot straight up. When you are shooting east, north, or south—it makes a difference

which way you shoot. You make corrections in any direction, correction in range and everything. That's just one of the things; there are a whole lot of other things besides that. You have to correct for different heights. It's a very complicated business, as far as one of these big guns goes.

TERRALL: What range did they have?

SMYTHE: Well, we were trained to [fire] any of the heavy guns. Most of the guns I was on, at the front, had less range than a 75-cm-bore field piece. But we were trained on the big guns.

TERRALL: What was their range?

SMYTHE: The Germans had the biggest one—the one they fired into Paris. Incidentally, they were shooting into Paris when I was there. I guess our best was about twenty miles, something like that.

So we were sent to artillery school in France. When I got there, we had a hundred in that school; we had to learn French methods. We decided the French methods were better than the British methods. I went through the regular course that all the artillery officers got. The fellows who did best in that—I think I ranked second in the hundred there—were sent into what they called the *orienteur's* course. The *orienteur* is the person that does a lot of stuff that the fellow who aims the gun doesn't know how to do. So I took the *orienteur* course. I was second in that, too, so instead of sending me to a battery, they sent me to staff. There was a colonel, Colonel Wilson—incidentally, there were three Colonel Wilsons on that staff. This Colonel Wilson was devising a slide-rule arrangement about 6 by 10 inches in area. You would put in a slide for each gun and then you could calculate these things that took hours in a matter of minutes. The data in the range tables were put on the scales and so forth. So I was assigned to him, and I made the drawings for this and did a lot of the calculations for it. I found a whole lot of shortcuts. He didn't know as much math as I did, so I could see lots of shortcuts for him. I didn't like it at all, doing this. I could hear the sound of the guns firing all the time, and I felt I was sort of stuck on that job. So I went to the chief of staff and told him I was fed

up with it. He said, "OK, OK, you get through with this job, then you come around." In the Second World War, that chief of staff was a major general—the fellow who was my boss there. He said, "OK, OK, you finish this slide rule and he'll take it back to the United States to get it manufactured, and I'll give you your choice of wherever you want to go." So that's what happened. When we finally got this thing finished, Colonel Wilson departed for the United States. Two things happened. I had—someplace, probably in wrestling—got an incipient hernia and didn't know it. At the artillery school, we had to pass physical exams, and the doctor there said he thought I ought to get it fixed when I got through with this staff job. So I did. I went into the hospital.

TERRALL: Where was that?

SMYTHE: Mailly le Camp. It was south of Soissons. Mailly, they called it. It was an easy operation. I was supposed to stay in the camp hospital for a week. But just at that time, the Germans broke through up north, at Soissons. There was absolutely nothing between us and the Germans—no troops at all. They weren't interested in our direction, they were going towards Château-Thierry and Belleau, that area. They didn't turn in our direction at all. But we got kicked out, and we joined a whole bunch of refugees. There were women pushing wheelbarrows and driving cows, babies that were lost—it was a very pitiful sort of thing. All these refugees from the area between us and the Germans, we got into that gang. We had an ambulance. The crowd was going south, down towards Bar-le-Duc. We went with them—there wasn't anything else to do. The doctor said, "Well, you're not ready for duty yet, you've got to be careful, so we'll give you a furlough down at Nice." I went down to Nice, on the French Riviera. There were a lot of Allied people down there. They just loved to have somebody to look after. They certainly kept us busy down there. Very nice people, some of them.

Then I went back up to headquarters. Meantime the Battle of Belleau Wood and Château-Thierry and so forth had taken place, and the Germans had been repulsed. I went back to the same place I'd been, and the same chief of staff was back. He said, "Well now, Colonel Wilson has gone back to the States, and now you say you want to go somewhere," and he named where all the different units of heavy artillery were. By far

the most interesting one was the one at Verdun, with the French 10th Colonial Division. They really were at an interesting place. He said, "They need an *orienteur* officer, their *orienteur* officer has gone to the hospital." I was a qualified *orienteur* officer—my father being a surveyor, I just ate that stuff up. I was very effective at it, because I had been familiar with it all my life. So I went up there as an *orienteur* officer.

TERRALL: Why was Verdun the most interesting?

SMYTHE: All the rest of them were places I'd never heard of, but I'd heard a lot about Verdun. That was the most bitter battle of World War I, I think. There were about 600,000 French and 500,000 Germans killed there, in an area about ten miles square. I'd heard a lot about that place. We were assigned to the French colonial division that had been in the big battle. That was where our battalion was.

It was an isolated battalion, the only Americans in the whole sector. It was an old Regular Army outfit. Everybody above lieutenants were Regular Army mostly. No, I take that back: There were a couple of captains who had come up through the Reserve. I went there as *orienteur* officer. I remember I had a busy time. They'd lost their first man, killed about a week before I got there. Each person had a different story about how it happened. It was lucky they didn't lose fifty men. They were given a mission—this doesn't have anything to do with me, this is just hearsay. The French had discovered something the Germans had in the woods, and they wanted to destroy it. The American battery, with its 8-inch howitzers, was just the thing to use for that particular kind of target. They went out, right out in the open, set themselves up, and went to work on this target. They took just the amount of ammunition they needed and everything. I guess they must have hit a sore spot. They got it all done. They were all finished with their work. They had used up all their ammunition and were starting to clean up. They were scattered about, picking up the equipment—ammunition trucks and the guns and one thing and another—and getting the limbers fixed,[2] when about four German batteries opened up on them. They really would have lost a lot of men had they been bunched, but they were all scattered. They had only one man killed. No one else was hurt by that

[2] A limber is a pair of wheels that supports the rear part of the gun carriage when it is moved.

bombardment. Everybody had his own version of what happened, because each fellow was in a different place and everything seemed different to him. That was just a week before I arrived. We were back of Le Mort Homme; that was one of the famous spots in the Battle of Verdun. They knew the Germans were about to pull off an offensive somewhere, and they thought it might be right there. They [the Germans] might want to try to cut off Verdun. The batteries were up in a certain position, and we decided that we'd have to fall back. We couldn't hold them, we knew. But the two batteries would be there, and they would fire until the Germans crossed a certain ridge up in front. Then one of the batteries would go back. As *orienteur* officer, I had to set the aiming posts for all the positions. We had to run telephone lines back so that they could pull back and start firing immediately when they got to the next position. They would fire, and if the Germans crossed another certain spot, the other battery would jump in back of us. That way we could keep up the fire without losing out. Anyhow, the offensive didn't hit there, it hit about ten miles to the west. When that happened, they moved us up into the point of the Verdun salient. The guns were at a place called Fleury-devant-Douaumont. In the Battle of Verdun, that changed hands, I think, twenty-some times in two weeks. In fact, it was the most desperately fought area in the Battle of Verdun. Every shell hole was full of shoes with bones sticking out, and ribs, and skulls occasionally. Most of the bones were more or less pulverized, except for the shoes. They survived with the bones sticking out. Some German, some French. It was kind of cloudy weather most of the time. Whenever the sun came out, it smelled. Our guns were right in Fleury. We were exposed on the ridge above Fleury, but we had deep prewar dugouts. They were full of rats and had water in the bottom of them, but they had duckboards over the water, and the rats weren't very vicious because they had cadavers they could feed on and they didn't need to eat us. But they splashed in the water and ran over you at night.

We were well defended against gas. When the *orienteur* officer came back, my job changed and I became gas officer and summary-court officer—I had a whole bunch of jobs. I had five jobs, but I don't remember now what they all were. All of them were supposed to be captains, and I was a second lieutenant, but because of my training I had a better background than most of them.

One of the first things that happened up there was kind of funny. They had a first lieutenant in command of one battery, a second lieutenant in command of the other, and a captain in command of the battalion. It was supposed to be a major and two captains. The staff back behind didn't like that, so they sent up a National Guard captain to take over the second lieutenant's battery. Well, we hadn't ever fired from this position—we could fire in three directions—because we didn't want them to know we were there. But this darn fool captain decided that he wanted to show off. He was a coast artilleryman from someplace in Maine. I was still *orienteur* officer at that time, so I set all the aiming posts and the lookouts. Since I had plenty of time, I did everything several ways just for practice, so I was absolutely sure everything was all right. What happened was, this captain invited the major and a lot of people up to see the shooting and its results. They picked a point to observe from and didn't see any bursts at all. The captain of the battery was perfectly furious. He came back with the major to my dugout, since I'd set all the aiming posts and everything. He said he couldn't see any of the bursts—something was wrong with the set position of the aiming posts. So I asked him what he was shooting at, and he showed me what he was shooting at. And I said, "Where were you standing when you observed?" He said, "We were standing right here, right on the ridge, right above the battery." I said, "Can't you see this hill in between? What you were looking at was this second line, the thing you were shooting at was behind that hill." He couldn't read a contour map. He was a National Guard captain. Well, that was the finish of him. They sent him back that day, counting boxcars or something. They just completely kicked him out. The major of the battalion was quite disgusted with him and put the second lieutenant back in command. That's what happened that time.

TERRALL: Were the Germans using gas at that time?

SMYTHE: Oh yes. We got gassed about three times a week. I was very careful about that. I was responsible for gas protection, so I checked on all the gas masks and also we had a system. You could tell gas shells; they made a kind of a *pop*. Fortunately it was in the fall—damp, rather cold weather, and the mustard gas wouldn't vaporize immediately. You could always tell when they were firing. On the slopes above the batteries, you

could hear the *pops* when they hit. So we'd get a whole bunch of battery men out at daylight, as soon as you could see, with bags of thiosulphate, or "hypo," and shovels. They would work up the slopes. As the liquid mustard gas is heavy, it evaporates and flows downhill. They'd work up the slopes, throwing hypo, which neutralizes mustard gas, on the gas-shell holes and then throwing dirt over it so they couldn't see anything unusual about it. I don't think we ever had a gas casualty. We also fixed up our dugouts well. We had a double frame. A frame here, slanting like this, and then a hollow with the duckboards on it, hypo down under the duckboards, and room enough for a stretcher, and then another one the same way here, with oilcloth sealed around at the bottom, which held it tight against the frame with tension. That's the way we fixed up our dugout, so you could bring somebody in and drop the curtain behind them, then open up the other curtain and bring them the rest of the way in without letting in any gas. I don't think we ever had a gas casualty, but we had some people with flu or something. We'd watch these people, and if they were a little bit unusual, we'd send them back, just on the chance that they might have been gassed, but they weren't.

Incidentally, the flu hit us up there. It was at a time when we were firing twenty-four hours a day. We just couldn't carry on our assignments. We had one gun working in one battery and three guns in the other. A guy would pass out and they'd lay him out in a line, and they'd look along the line to see if anybody had his eyes open. Then *he'd* get up and start loading a while, and that's the way it went. But as far as I know, we didn't lose a single person from flu. It was very strange. The battalion doctor got it. He thought he was going to die. I had to go through his little trunk and remove all bottles of cognac and such that he had in there. He wasn't married, and apparently his mother was very particular about such things, and he didn't want his possessions sent back with anything like that in his trunk. So I had to do that. Incidentally, he was the same doctor that had operated on me down in Mailly for that hernia. It was just pure accident that he landed in the same place I did. He came back to us before the Armistice;he was all right. As far as I know, everybody came out of it all right. But these evacuated people kept coming back, so that about a month before the Armistice they were arriving at the rate of five or six a week. A lot of them had gone AWOL to come back. They didn't want to go to a draft outfit or a National Guard outfit. They were professional soldiers.

When I got back to Fort Monroe after the war, I went to the headquarters of the regiment and saw the battle standards going clear back to the War of 1812. We were the only ones in the Argonne from our regiment. I saw the silver band that they put on along with the other silver bands for different actions. As I say, we didn't have any gas casualties.

We didn't fire gas; we didn't have any gas shells. There was a French battery in back of us that fired almost exclusively gas. They were not very big guns, but they made an awful noise. It seemed loud because they were just behind us and the muzzles were towards us, I suppose. They fired gas. The worst gas attack I ever saw was accidental. The Germans dropped a 320, I think—that's a 13-inch shell—right in their stack of gas shells. It just tore them open, and this great cloud of stuff came out. I was down in the dugout when it exploded and I came out and looked down the hill to see if it might have hit our battery. Well, it wasn't our battery. It was the French battery in back of us. This great cloud of gas, with a twenty-five-mile-an-hour wind taking it off. The French were running around trying to find their gas masks. We had a rigid rule that you had to keep your mask on your person—you weren't allowed to hang it up anywhere. But the French didn't, and they were running around like this trying to find their gas masks. But the wind was sufficient to dissipate it very fast. I expect they had some casualties all right, but we didn't know. You didn't know much about what happened even to people right next to you. I was up on the ridge, looking down at them. They were in back of our batteries; they were both down below me. Our line from the PC down to there was always getting shot out.

TERRALL: Was this still with the colonial division?

SMYTHE: Yes. In the French Colonial Division, we were the only American outfit. We were assigned to the Colonial Regiment for practice. This French 10th Colonial Division—it had been in the big Battle of Verdun. They were very familiar with it. Then when the American Army came over, that was funny; they took over this French division, as part of the American Army, but they stayed right in the same place. We stayed right there when the American offensive started up through the Argonne. We took the city of

Saint-Mihiel—that was on the other side. Saint-Mihiel was southeast of us and the Argonne was northwest of us. Our batteries were pointed north, and we turned around to shoot southeast into the German lines at Saint-Mihiel. They never shot at us from that direction. The shells all came from the hills north of us. We didn't get shot at at all, after the American attack started. The Germans were shooting entirely at the Americans, and we were shooting at them [the Germans], trying to locate their batteries and put them out of the business of shooting at Americans. I still don't know whether we did or not.

Then we went into the Argonne Forest with the 3rd Division, and moved up north next to the river. Here are some of the old maps we used. These are fairly familiar places, some of them. We finished up here, near Dun-sur-Meuse, sitting there waiting for a bridge to be built across the river. [Referring to map.] This is the Meuse River, winding around here. We were up in the forest. We were up very close to the river, shooting at the Germans on the hills over here. The Germans blocked all the railroad lines and everything that went up to Saint-Mihiel. We were up in here, so when the Saint-Mihiel offensive came, we fired back down onto these lines in here. Here's Fleury-devant-Douaumont. There was a village here, and this is the ridge. We were on this ridge, but our guns were at Fleury. There wasn't a trace of that village at all. As I say, this was taken and retaken, and this whole slope was covered with bones. There wasn't a single trace of vegetation of any kind; it had been killed by the gas. That's where I used to sit, in the turret in Fort Douaumont, and direct the firing. Here's another town where we were another time—Septsarges. There's a church there, and our guns were off on this side, towards the river, and this is where our PC was. It had a beautiful church, but just the altar was left—the rest of it was all gone.

We had our PC on the second floor of the city hall, and the machine gun battalion's PC was on the bottom floor, and our kitchen was in the altar of this church. Everything else in the village was flat. Just these two buildings had any shelter at all. We had many arguments here, when we were bombed by airplanes, as to whether we'd better be on the second floor, with nothing between you and the bombs, or whether to be on the ground floor, where if the bomb hit up here, everything would fall on top of you. We never did decide that question. The bombs fell very close to us. They frightened us, but nobody ever got hit. We didn't get shell-fire there, we just got bombs. We had quite

a lot wounded, but very few people killed. Of course we didn't know, when we sent the wounded off, whether they died or not, so some of them probably did. But we had very few killed outright. We were very pleased, about the time of the Armistice Day, by all these guys coming back, because we didn't know whether they were dead or alive. There were a lot of them. We had already received official communications that if these men turned up, we were to arrest them for desertion. They'd left the hospital without permission and were deserters. We paid no attention whatever to any of this stuff. We kept them. We were shorthanded, for one thing, and for another thing we didn't consider them deserters when they were trying to get back to their own outfit. We didn't obey any of those orders. We didn't pay much attention to what came from far in the rear anyhow. They didn't know anything about what was going on. They didn't behave intelligently at all.

As I say, the Armistice found us up there sitting, waiting to go across the river. They wouldn't let us on the pontoons. We went across, but that was to take German guns. The infantry rushed back word to us that the guns were undamaged, and would we please come up quick and turn them around and fire them at the Germans. When we got up there, we found that things like firing pins and so forth had been removed. They could have been repaired in short time in a machine shop. We had diagrams of most of the German guns, and we could probably have repaired them in a fairly short time. But it was hopeless. The Germans were on the run then. This was around November 1st. November 11th was the Armistice. So there was no hope of doing anything. But we did have a chance to look at the places we'd been shooting. The only time we ever did have a chance. They'd picked up the dead as far as the Germans were concerned, but one of the boys counted twenty dead horses where these guns were, and I suspect that our fire just about wiped out that battery when it was moving back. We certainly killed their horses. This is why the guns were abandoned, I think. We must have killed some men, too, but we didn't find out about that. They'd pick them up pretty fast, except for the ones that were in the bushes. We'd find dead in the bushes, shrubbery, and so forth. One place we were in, we found four Americans dead, a second lieutenant and three privates. The bodies were in the bushes where we put a gun. They had been overlooked because they weren't visible. That was why they were in the bushes, so they wouldn't be visible,

but somebody had spotted them. Anyhow, they all got killed—by machine gun, I suppose. I don't think we had very many killed. Probably some of those we sent back died, but not very many.

TERRALL: After the Armistice, did you go back to Fort Monroe?

SMYTHE: No. When the Armistice came, as I say, we were sitting up there waiting to go across the Meuse. Immediately, lights went on. We hadn't seen lights at night for all the time we had been there. All the trucks used their headlights. We'd never had any lights before. The first thing that happened was that about 150 absolutely green replacements arrived. We were way down; we were supposed to have 375, and I think we had 250, but we could operate just as well, because we were all experts, we'd been at it a long time. They were just absolutely green guys. Gee, everybody was sore about that. At the same time, I got orders six weeks old to come back to the port of embarkation—I don't remember whether it was Fort Monroe, or New York, or someplace—and pick up a company of artillery and bring it back to France. I'd been promoted by that time to captain. I had started off as a second lieutenant.

Begin Tape 2, Side 1

SMYTHE: There was this nice infantry captain [on the ship from France to the U.S.] from San Francisco who lost an arm. The ship was a 600-foot ship—*Northern Pacific,* I think, was the name of it. It was supposed to compete with railways between San Francisco and Los Angeles. It was a big fast 600-foot ship, but they never put escorts on because it was so fast. It was considered safer to send it without escorts. They didn't sent it in convoy; it would travel alone. It was a hospital ship anyhow—had big red crosses on it. Well, as I say, it was so long that it would get up on top of a wave. It would go up like this, tilt up, maybe over like this, and then it would overbalance and come down. The propellers would stick out and would race and shake the whole ship; it would roll one way or the other. Nothing was stable. A plate of soup just was hopeless—you couldn't do anything, it would dump itself out completely. But for food they had, of course, these little square things clamped down so your dishes wouldn't slide very far.

I had this infantry captain, Robinson, from San Francisco, next to me. He had lost his right arm, and he just couldn't feed himself, so I cut up his stuff for him and so forth, and he could do that with his left arm. I was pretty well acquainted with him. Every day we sat next to each other, and I saw that he got something to eat. He wasn't sick and neither was I, but, boy, there were a lot sick. And these poor doggone wounded downstairs—I think that the ship could take 3,000 wounded and it had only about 2,000 or 1,500, so there was lots of space, but there were only, I think, ten doctors. These were all supposed to be convalescences and with this rolling around they were tearing open wounds all the time, and these doctors would fix them. The doctors were all sick and they just had a miserable time. They were losing their food and then going back to work, and they were working practically twenty-four hours a day when we got into that, because you just couldn't take care of all these fellows. It really was a mess down below. So I spent my time going around talking to these guys down below and trying to cheer them up. That was really quite a storm. Never been in one since like it. I've seen worse ones, but not from a ship,

So we got back to this country, and then I went to Fort Monroe according to my orders. All the troops that I was supposed to take over were already out of the Army. They had already been disbanded and sent home, so there was nothing for me to do. Well, I got back soon enough after the Armistice so that they hadn't yet cancelled the order giving returning soldiers two weeks' leave, or something like that, with pay and transportation at very nominal cost, so I went out to New Mexico and saw my dad. My mother died—after I went overseas in September, and she got only one letter, that was the one I wrote—and so my father was alone. I went to see him at Raton, where he was in charge of the highway construction over the pass—surprised him completely! Then I went back to Fort Monroe and had a long argument with a colonel, a nice old guy, who pointed out to me all of the advantages of military life in the coast artillery and so on. But I couldn't see it. I wanted to get back to Dartmouth where I'd left, and so I did.

When I got up there, gee, they were glad to see me! What happened was, their student body was way down, but all these guys had just been released from training camps, you see, and come back to school. There were no instructors. They didn't have instructors, and when I turned up it was a godsend to them. They just practically hugged

and kissed me, they were so glad to see me, and so I stayed with them for six months before I went to [the University of] Chicago.

TERRALL: You were a teaching fellow then? Were you also doing graduate work there?

SMYTHE: I was also taking graduate courses, yes. I got credit for some of them in Chicago when I got there, so I got through at Chicago in less than the three years that's usually required for a doctor's degree.

TERRALL: How did you decide to go to Chicago?

SMYTHE: Oh, well, I'd decided on that long before. At Colorado College, I had taken a senior course in physics, in optics. They had very good equipment. I don't know how they happened to have it, but they had remarkably good equipment, and I just had a wonderful time with these optical experiments, devising a lot of variations and things. And [Albert A.] Michelson was the world authority in optics and so I decided I wanted to study under Michelson, so I went to Chicago. He was the head of the department there. He was the first American Nobel Prize winner in physics. I guess the first one in science, the first Nobel Prize winner in science.

TERRALL: So you wanted to go into optics?

SMYTHE: I was interested in light—optics and so forth. Actually, when I got there, I discovered he didn't take any men directly, but his chief lieutenant, Professor [Henry Gordon] Gale, did. He took some men that wanted to do optics. He had been a colonel, I think, in the war. Anyhow, he had a decoration of some kind. Incidentally, they offered us decorations to distribute in our battalion, but we didn't have any reasonable way to assign them, so we quit trying to and just thanked them and didn't take any. It would have wrecked morale if we had tried to distribute those things. In an artillery outfit, everybody has a job to do, but there weren't any spectacular maneuvers such as the infantry might get into. Anyhow, this Gale had a something-or-other. I don't know what the thing was—he had a little button. He was either a lieutenant colonel or colonel. And

we had to organize the first American Legion Post at the University of Chicago. I remember helping on that. So that was the end of the first year.

I went to Chicago and worked under Michelson, and got out a thesis [1921]. I got all of my work done in about two and a quarter years. You're supposed to have three years' residence, but they allowed me graduate residence for some of the time I'd been at Dartmouth, so actually I got through in a very short time. So I didn't actually lose very much time by being in the war. I lost maybe a year, but probably not more than a year's time. And I didn't have to pay tuition or anything, because I was a war veteran.

TERRALL: So you did your work with Michelson or with Gale?

SMYTHE: I worked under Gale directly, but I was in Michelson's department, and I probably saw more of Michelson than any other student, because I made drawings for some of his papers and did a few experiments. He had the argument with Lord Rayleigh in Cambridge, England, as to the nature of the source of the colors that you saw when light is reflected from the back of a beetle, for instance. I don't remember which side was which—one said it was a diffraction, like a diffraction grating, and the other one said it was fluorescence. If you examined the light that came out, you could tell which it was, so I remember I had these bugs, and I had to take pictures of the reflected light from these bugs and turn them over to Michelson. I don't remember what side he was on, and I don't remember what the answer was, but anyhow he decided that Rayleigh was right. And then I did other jobs for him. I knew him better, I suppose, than any student there at that time. He didn't object when I went into his lab, but most of the students would get kicked out if they went into his lab, because he didn't want anybody monkeying around with his setups. So I got to know Michelson.

TERRALL: Was he helpful to you? Was he easy to work with?

SMYTHE: Oh, he was very particular. He had been to West Point, and he was sort of military. You didn't salute him, but you had the military atmosphere around him. It didn't bother me at all, because I'd been in the Army. It might have bothered somebody

who hadn't; it didn't bother me at all. I got along fine with him. I probably had more contact with him than any other student at Chicago at that time.

TERRALL: Did you know [Robert Andrews] Millikan while you were there?

SMYTHE: Oh, yes, I took every course Millikan gave while I was there, as well as all the courses Michelson gave. I have notes here someplace. Oh, yes, here are the notes. Yes, I have all my notes from Chicago. Here's another one—here's another one from Millikan. I suppose they don't mean much to you, but I kept them for sentimental reasons. Here's another one from Michelson. Here's another one from Michelson. And here's another one from Michelson. I've got some more of them here, but those are the most interesting. I have all of Millikan's and all of Michelson's courses. I did very well on that stuff. I was very much interested in it, and I did very well on it. These pictures are pictures of experiments that were done, you see—setups and experiments and so forth. [I was also involved in] the velocity-of-light experiment much later, after I came to Tech, up on Mount Wilson. He [Michelson] needed three observers and something happened to one of his observers—I don't know what. Anyhow, he knew from Millikan that I was here, so he sent down word and asked if I would come up. So I went up and assisted on his velocity-of-light experiments up there. There's a monument up there on the pedestal that we worked on to commemorate where we took the light that went over to Mount Baldy and came back.

TERRALL: How did you happen to then take a job in the Philippines?

SMYTHE: I stayed at the Gamma Alpha house in Chicago. That's a graduate scientific fraternity, and we had biologists, physicists, and chemists—all sorts of people. Some of them later became very famous, won Nobel Prizes and so forth, and one of the old-time Gamma Alpha men had been at the University of the Philippines. Anyhow, he came back to Chicago, and he stayed at the Gamma Alpha house, because that's where he used to be and there was room, so he stayed there. And they [the Philippines] wanted somebody badly there in physics, and so he talked to various people and I was one of them. He told me all about his experiences in the Philippines and everything, and I

thought that sounded very interesting, so I decided to take that job. I was already engaged to be married, so that was our wedding trip. I was married in Salem, Massachusetts, went to San Francisco, and took an Army transport to the Philippines. We didn't rank very high, because I was a civilian. If I'd kept my commission in the Reserve, I would have had much better quarters, but they had a rule at that time that if you left the continental United States you had to resign your Reserve commission. So I wasn't eligible, but the minute I got to the Philippines they immediately wanted me to sign up in the Reserve, because they had a Reserve in the Philippines. I don't understand that. But anyhow, we went on this Army transport. It was a slow, old boat. It took us, I think, ten days to Hawaii and a week to Guam, and we went by all the islands where ships could get wrecked and inspected them. That was one of this Army transport's regular jobs—it went out once a month—to go by all these reefs and things where a ship might be wrecked. They just weren't inhabited. It was also so that they could look it over with telescopes and see if anybody needed to be rescued.

TERRALL: Were there many civilians on the Army transport ship?

SMYTHE: There were not too many. There were maybe a dozen or so. Not very many, mostly Army. If I'd kept my commission, I'd have had good top-quality accommodations. As it was, I was quartered with the men and Helen went with the women's dormitory on board. But that was interesting—it was just an interesting trip. It got monotonous. After a while, after you've been at sea for four weeks, you get— But in a way it was more interesting than a regular ship would have been. We went to different places. As I say, we went to Guam. At Guam, they hadn't seen anybody outside their own little groups since the last transport lit there, and they just had a wonderful time. We had a heck of a time getting into the harbor. At that time, there were coral reefs everywhere, and you had to wiggle around and sound to get in, and we got hung up a little on one spot, but not enough to bother us, because we were just creeping along. So we got in, and they had a big dance and I don't know what all. And we brought them fresh stuff—cabbage and so forth. Most of it had spoiled by the time we

got there, but some of it didn't—fresh meat and one thing and another. They probably got fed up with eating fish. And as I say, we went by other islands.

But the thing that was really outstanding about that trip was entering the Philippines. We went through San Bernardino Strait. We crossed the deepest part of the Pacific there—I don't know, six miles deep or something—just a little off the San Bernardino Strait. It looks as if you're going into a rocky wall. You could see these mountains and cliffs. You can't see any opening or any houses or anything, just cliffs, and you're steering right straight towards it. And then you get a little closer, and if you're standing up on the ship, you notice that the cliffs on this side and on that side don't line up. And there's a volcano on this side. And when you get there, why, there's a strait that opens up here—that's the San Bernardino Strait, between these. It's very spectacular. The water, as soon as you get into the strait, is very calm and phosphorescent. You can follow the trail of your screws a hundred yards or so at night, and you see all these flashes of phosphorescence in the water, due to various animals and organisms that flash. And you see the little huts on stilts along the shore, and you see the volcano there, with a red glare on the clouds up above the crater. It wasn't actually erupting at that time, but it was active. It's a very spectacular way to enter the Philippines, all right. Ships that usually go to Hong Kong come in from Manila Bay, and that's nothing unusual at all.

TERRALL: How did your wife feel about going to the Philippines?

SMYTHE: Oh, she was crazy to go. She'd never been around very much, confined mostly to New England—although she was actually, I think, born in Chicago, but her folks, when she was a baby, moved to Salem, Massachusetts. She'd been up to Maine. She had a job in the summer as a swimming instructor up in Maine, so she did camp up in Maine, but she hadn't traveled much. She was delighted to go to the Philippines.

TERRALL: Had you met her when you were in Dartmouth?

SMYTHE: Yes. I had a cousin who was at Boston University. I had a cousin, Dorothy, whom I knew better than all of the other cousins. I knew Cousin Dorothy very well, and

they were having a house party out at—where the house party was, now, I don't remember. It seems to me it was in Salem. Anyhow, they had a house party with a men's fraternity. What was that fraternity? I'll think of it in a minute. Anyhow, there was a sorority they belonged to. They were having a party, and Dorothy wanted me to go to the party. So I went to the party along with Dorothy, and I met all of these girlfriends of hers, and Helen was one of them. That was—let's see, that was before I went to France. And the result was— This is the funniest thing: I got to France, and I got letters from every girl I met at that party. I was about the only one they knew who was in France. So I got the largest stack of letters you ever saw. I couldn't remember some of them, who they were, but Dorothy was still there and so they got my address from her. They wanted to write to someone in France, so I got an awful stack of letters from these girls. Some of them I remembered and some of them I didn't.

Well, then we went to the Philippines. As I said, I took this job because I talked to this man that came from the Philippines and they needed somebody badly, and I thought it would be wonderful to go out there, because we might be able to see China and one thing and another. So I took the job, and we got out there, and immediately Helen got a job teaching at the Normal School. They were just as delighted as they could be to get someone to teach English who spoke English, because if you pass it through several generations of Filipino teachers it gets to be a rather queer language. She was qualified in every respect. As soon as they discovered she was qualified, and they didn't have to pay all the transportation expenses to the United States or anything, why, they gave her a job and she enjoyed it very much. She liked her students and they liked her. She still has a picture the students presented her of the class with all the signatures on the back and one thing and another. She had a wonderful time with the students.

We went around all over. We went up through the head-hunting country, took a hike through the head-hunting country—she and I and one of her women friends. Perfectly safe for an American, but very perilous for a lowland Filipino to go through that country, because the lowland Filipinos were always trying to conquer the head hunters, and they never succeeded, but there was bitter enmity there, and it's not safe for lowland Filipinos to go through that country. But Americans are all right, so we went through and I think we spent, I don't know, two or three weeks en route. About every twenty-five

miles there would be a rest house with a Filipino cook and somebody to look after travelers. There were then no roads, but there was a trail, and you always had the same thing—chicken. Chicken was the only meat available, but it was all right. I didn't get tired of it. You had to get down there—this was in the proper season; it wasn't the rainy season—but you pretty nearly had to get in before two o'clock in the afternoon or it would begin to rain, so you started early, in spite of the fact that it wasn't the rainy season. This was up 8,000 feet in the Philippine mountains—very, very dense vegetation, quite different from anything you saw here. You couldn't make progress off to the side of the trail unless you had a machete to cut your way through the brush and things. And also there were various kinds of snakes and one thing and another, so you had to be careful about cobras and other kinds. We didn't see any of them on the trail close enough—well, I guess we saw a few, but they were as scared of us as we were of them, so nothing happened. But we went back all through the Igorot areas—saw these houses on stilts. They don't hunt heads, theoretically, anymore, but actually once in a while they got sore at somebody and cut his head off. But they didn't object to Americans at all. We didn't actually go to the center of any villages. The trail we went on skirted above or below them, usually. They eat dogs. Dog is the most delicious repast for them. I've got pictures of them with their dogs, carrying dogs—they'll eat them, eventually. They have rice terraces. Sometimes the wall of the terrace on which the rice is is higher than the area that's supported, and some of those hills—I should have brought that book down; I've got pictures of all this—some of those hills are terraced from top to bottom. There's so much rain there, the rice terraces fill up during the rainy season, and then they stay there and the rice grows up, and then by the time it's dry the rice is harvested and so forth. And there are areas there where the rice terraces go from the bottom to the top of the slopes. Really remarkable, these Igorots. They're entirely different from the lowland Filipinos. They're different stock, and they don't get along at all with the lowland Filipinos. They're pagans, and the lowland Filipinos are Catholic. They're the ones who survived—if you weren't Catholic, you wouldn't have survived. There's enmity between them.

I saw another type, which very few people ever see, and that's the Negritos. The reason I saw them was that two doctors, Dr. [E. W.] Goodpasture and Dr. [A. W.]

Sellards, from Harvard Medical School, roomed at the same place we did. I got pretty well acquainted with them. They were at the Philippine General Hospital, and one of the native doctors—Filipino—lived out in the Negrito country. So they said they'd like to see the Negritos, so he said he'd arrange it for them. So he did, and we went to this little village—regular Filipino village—and we met this old man and his dog who this fellow had referred to us; he said he'd take us to see the Negritos. So we went up into the hills there. That grass is about as high as this bookcase, with a path about this wide; you could touch both sides of it. You can't see a doggone thing, and the sun beating down, and oh, it was hot. There was no breeze or anything, of course, down in that grass. We went for miles through that grass, and then we came out in an open area, where the trees came down near to us. Preceding us was a dog, way out in front. Then came a man, 100 feet or so behind the dog, and then the three of us were about 100 feet behind the man, because Negritos are very timid. Alone, we would have gone through that place and seen nobody. But they knew the dog, and they knew this old man, and so when we came out, the dog had arrived, the man had arrived, and there were a couple of Negritos talking to him, and then pretty soon they began to come out of the trees, and before us stood about twenty-five of these primitive Negritos. I don't know what language they speak—I think they have no language of their own, but they speak poorly the language of those who surround them. They shoot bows and arrows. On the end of some arrows, they have little notched things, like fingers. When they shoot them, they capture birds without damaging them. They put on a shooting match—I have pictures of them. So we talked with them, and they did a sort of a dance for us. I forget what it was—anyhow, they all line up side by side and swing around. It was very interesting. Most residents of Manila have never seen the Negritos. They're very rare now. They were pretty nearly wiped out by the regular Filipinos with guns and things. They have no guns, only spears and arrows, and they're completely naked. That was very interesting. They wouldn't allow Helen to go with us, but I did get a shot at seeing the Negritos. Oh, we met one Negrito and his wife and little boy carrying some kind of a melon. It was a great big thing that stinks terribly but tastes good. I can't remember the name of it. This Negrito was bringing it in to trade it for something—he and his wife and little boy. We had to

squeeze into the grass to get by. He was very alarmed at first, but it was all right afterwards. I guess he was kind of surprised. They're not used to white people.

TERRALL: What were the students like at the university?

SMYTHE: Oh, the students were much like the students anywhere. They had trouble with English, some of them. Here's a catalog. They had three Filipino instructors in the physics department and two Americans, and they needed a third. I was the third, and I gave a graduate course. Both these other Americans had left this country long before, and they weren't up-to-date on the modern physics at all, so I gave a graduate course for these three assistants. They took it, and they all came to this country and got PhDs later—one of them went to Harvard, and one went to Yale, and I forget where the other one went. Anyhow, they were pretty bright boys. One was in astronomy and one was in physics and I'm not sure if the other one was in physical chemistry. When they got their degrees from the eastern schools, they stopped by Caltech on their way home. They hadn't changed much. The best student I had was a girl, Virginia Lumanlan. She was very small, perfectly beautiful, awfully smart, and way out in front of everybody else. She went to the medical school.

TERRALL: In the Philippines?

SMYTHE: Yes. The university has all these departments—medical school, engineering school and everything. When the three instructors came by to see me, I asked them what happened to her. She got her MD all right. She spoke with a very, very slight accent. I have a strong suspicion that she was raised by a missionary, because that name, Virginia, is not a Filipino name. Her last name, Lumanlan, is a Filipino name, but the Virginia is not, and she spoke better English than most of the Filipinos.

TERRALL: Were you planning to stay there?

SMYTHE: Oh, no, no.

TERRALL: You just wanted to go for two years?

SMYTHE: Millikan was very disgusted with my going out there. He says, "You'll ruin yourself. You'll spend two years out there and you're stuck." But I had some ideas for research, and while I was out there I kept working on it. I had all of the plans, and I had plenty of time to get all worked out what I wanted to do with the proposition. I sent it to the National Research Council and got a National Research Fellowship anywhere. I hadn't decided where to go or anything, but they accepted it as a pretty complete statement of a project. When I got back to this country, I had two places designated, Harvard and Caltech. I stopped at Harvard and saw what the facilities were there. I could have gone on there, but Millikan, whom I gave as a reference, I guess wrote me and told me the place to come was Caltech and cited all Caltech's advantages. The facility offered at Harvard was an old room in an old building. This would have been all right, I expect, but from what he said, it sounded more glamorous out here, so I came out here instead.

TERRALL: What was the project you were working on?

SMYTHE: Methods of separation of isotopes. Separating isotopes was a difficult business. They are atoms that are chemically identical—for instance, iodine or bromine or chlorine or sodium or potassium—but have different masses. And this was the method of separating isotopes in large enough quantities so that you could measure some of their properties separately. The different isotopes of an element give different band spectra, depending on their mass. If a beam of charged atoms of an element is deflected by a magnetic field, the different isotopes have different deflections. What I did was to devise a magnetic lens so that you could take the charged-atom output from a great big area and focus each isotope at a different point, and so collect enough to experiment with. Some of that stuff is here.

Begin Tape 2, Side 2

SMYTHE: Both of these [papers], as you can see if you read them, were purely guesswork as to what the isotope ratios were. You'll see that usually the first part tells the different theories as to what they had. They had hypothetical isotopes and all sorts of things, but these were all very definite. They not only told what the isotopes were but the amount present.

TERRALL: But you didn't finish this work until much later, then.

SMYTHE: Oh, yes. You don't build an apparatus like that right off. It took a long period of construction—several years—to get that stuff built. And then here was another method. There was a great mix-up about oxygen. Oxygen is the basis for the atomic weight table, you know—oxygen 16. And there were discrepancies in atomic weights measured by different people. And then somebody discovered—taking a spectrum of oxygen and other things—a very faint line right close to the oxygen line and then exposed it long enough— Well, there was a big argument about whether that was real or some instrumental defect. And we set up an apparatus here. I was interested in isotopes then, and so about four of us got together and set up an apparatus to settle the matter. And sure enough, we found it was there. There were papers appearing, and some said it was absent and some said it existed and some said it didn't. And so I devised this method that involved no magnetic fields at all, just alternating electric fields. This actually determined the ratio for the sample I had—which came from lead peroxide—with very high precision. That enabled them to figure out what the real atomic weight was. You see, if that isotope ratio isn't constant, it would account for the variations in the measurements by different people. This is still the best average ratio, because I, just by pure luck, had a sample that was apparently about average. But now they have found that the ratio varies. They can date the age of minerals that have been deposited a million years ago by the isotope ratio, which was different in those days, and also meteorites and such have different ratios. But this was the first accurate determination of that ratio. Also it was the first time it had been done without using a magnetic field. There is always a certain uncertainty in a magnetic field, but with the high frequency, you could

measure it with a very great precision and regulate it so that they took identical paths in the apparatus, making it a very accurate method. I was skeptical; this was so widely different from the accepted value. I didn't claim as high an accuracy as I could have, because it actually turned out to be very precise. Other people have measured it, but there was a tremendous deviation in the results. You didn't know whom to believe. Well, those were experimental. This [indicating reprints] is the sort of theoretical stuff. I've done about as much theoretical as experimental.

TERRALL: When you first came to Caltech, were you working by yourself on this apparatus?

SMYTHE: Yes. Wait a minute—sometimes yes and sometimes no. Theoretical papers were all by myself, but this one, "On the Isotope Ratio in Oxygen,"[3] I had a fellow, [Josef] Mattauch, who was a research fellow here and he wanted something to do. He was here only for a year or so, and so Millikan said he could work with me. So I had him working with me. The design of the apparatus and everything was mine, but he worked on it. It was a pretty complicated apparatus, all told. It wouldn't be complicated to do it now, because you have nice oscillators now, but in those days they didn't have such nice oscillators as we have now. Let's see, maybe there are some pictures of that in here. I don't know. [Looking through papers.] Oh, here's a picture of the apparatus for the separation of quantities of rubidium and potassium. I don't know where that appeared. I think it was in a newspaper or something.

[3] *Phys. Rev.*, 45:5, 299-303 (1934).

WILLIAM RALPH SMYTHE

SESSION 2

February 15, 1978

Begin Tape 3, Side 1

SMYTHE: One thing I forgot to tell you about World War I. I had the job with this man designing a slide rule for calculating [the positions of the big guns].

TERRALL: Yes.

SMYTHE: Well, one day I got an order to report out to a certain company at Haussimont, no explanations at all, detaching me from this job and putting me out there. I couldn't imagine what in the world I was going out there for. The first thing that happened when I got there was that the company commander said, "You will go to the post exchange and buy a carton of cigarettes to sell to your men." They had just one person taking care of it, who sold only cartons to officers and could not sell individual packages to the privates. The YMCA was supposed to buy cartons from him to sell packages to the privates at cost, but they didn't; they sold them at a big profit. The Army had no control over the YMCA at all; in fact it was known universally as the "damned Y." So that's the first job I had when I got out there. He said, "You will go and get a carton of cigarettes, and then you can sell them at cost to your men, because the Y won't do it." Oh, gee, they hated the Y. Another thing that griped them was the Y wouldn't eat with the enlisted men. They insisted they must eat with the officers. The officers had no control over them, so we just kicked them out, didn't have anything to do with them. Gee, how the men hated the Y.

Well, as I say, I went out there. But then I discovered what I'd been sent for. The Americans were firing the first big gun they'd ever fired in France. It was a great big gun on a railway carriage—I don't know, with a range of eighteen or twenty miles, something like that. When you fire a gun like that, you have a lot of calculating to do, as I told you—the rotation of the Earth and so forth. We didn't have mechanical calculators then. Well, it turned out that they wanted somebody who was expert on this gun, because there

were going to be generals there—a big ceremony, French generals, American generals, and so on. I was supposed to be the expert, since I worked out the range tables, and that's what I was sent out there for—to make all the calculations for firing the gun. They had about, oh, I guess, a hundred men moving the gun. It was on a curved railway track. So I made the calculations for the firing, and I was the lieutenant in charge of that first gun that fired. And then immediately after this was over, I was ordered right back to the job I'd been on before. That was the first big gun fired by the Americans in France.

Now, let's see, where are we?

TERRALL: Well, you told me about getting the National Research Fellowship and coming to Caltech.

SMYTHE: Oh, yes, and you wanted to know something about [Lee A.] DuBridge [Caltech president 1946-1969]. Well I thought you might be interested in this. I knew DuBridge a long time before he came here. I have here the catalogs all the way back, and if you look in this catalog you will notice how I came to know him so early. [Reading.] "The Division of Physics, Mathematics, and Electrical Engineering." Here I am, research fellow, and here's Lee DuBridge.

TERRALL: Oh, yes.

SMYTHE: He was here for two years, and I knew him then. This was in 1926, before he went to MIT. So I knew him pretty well before he ever came to Caltech as president.

Now, here's the first class I taught. [Looking through old class lists.] I was a research fellow, but I taught this class because it was a new book with a lot of new material in it, and you'll see some of the people who are listed in this. Here's Carl Anderson, Arnold Beckman, Charlie Lauritsen in this class. That was the first class I taught. They were the first men I had. A lot of the rest of these were later on.

[Referring to the list of Caltech professors in the division] Harry Bateman was one of the most unusual men we ever had. He was professor in physics, aeronautics, and mathematics. He was about equally able in all of them. He was a very fragile sort of person. He'd been a scholar at Cambridge before he came here, and it seems to me he

was chess champion of Cambridge. He was a great fellow, and if you wanted to know anything—got stuck anywhere and wanted to know about it—you always asked Bateman. Then probably in your mailbox the next day you would find a little note, written in a very microscopic hand, about this big, giving you the solutions to the problems that were sticking you. I probably have some of those somewhere here, I don't know. But he was a great asset here. He lived with his wife about where the zoology building is. It wasn't Tech campus then, it was a residence. He was in fragile health, but he was a genius, no question about it. Harry Bateman.

[Richard Chace] Tolman I knew quite well, also. Tolman was a tremendous worker, but he was always under stress when he worked. During the Second World War, he went to Washington, and he was in charge of some big section there, and he wore himself out. When he came back here, he was in terrible shape. He was a man who couldn't put his problems away at night. We were all appalled after the war when he came back, to look at him. And he lived—well, it's on campus now, but the house has been torn out—he lived just up the street a little ways.

Epstein, Paul Sophus Epstein. He knew Russian very well, and he'd been all over Europe. I guess he was a pretty fast guy when he was younger, but he had calmed down a lot by the time he got here. And he was another person that knew an awful lot about everything. He got shingles, an acute virus disease that gets on your skin so that you can't touch anything. He was in terrible shape. It took him a long time to die. It was very, very painful. But he could read any European language, as I remember. He's the one who told me that there was a Russian edition of this book. This is the book I got out.[4] He saw references to the translation, and he showed me the references to it in the Russian literature. But they published just as many as they needed, and I've never been able to get a copy. Several people here who went to Russia tried to get a copy but could not. So I was never able to get a copy of the Russian translation. Incidentally, I've got the statistics on that book here. I got $35,000 in royalties. It sold 26,000 copies—7,000 are foreign and 18,000 American, and it's still selling, although that last edition is not too recent.

[4] Smythe, William R., *Static and Dynamic Electricity* (New York: McGraw-Hill, 1939).

TERRALL: 1968.

SMYTHE: Yes, but it's still selling. I'm getting about $600 a year out of it still, because there isn't any other book that has a lot of this material in it. So that was quite a success. I made all of the drawings for it myself. There are some tricky ones—this is one of the tricky ones—and I couldn't get anybody else to do them. That's an eddy-current drawing. There's no treatment of eddy currents like this in any other book, and that's one of the reasons it sells, I think. Eddy currents are pretty much neglected, but they're very important in some cases. In fact, I had a fellow in here just the other day whom I'd never seen, who gives a course using this book as a text. He came from the Illinois Institute of Technology. I had never heard of him before, but he came in and said he'd been using this book for years. He didn't like the third edition as well as he did the second edition, because it leaves out some of the stuff in the second edition which I didn't think was very important.

Well, now, Fritz Zwicky. Well, he was a character! He came here from Switzerland, an expert skier. Before I talk about him, I have to say something else. In the early days, PhD students came up and they just took the regular courses, and the guy with a good memory could get through. But when they came up to the PhD exam, which had to be an oral three-hour examination, they were asked things they actually hadn't got in class but which used that material. There were some horrible failures. Then Millikan decided they had to do something about this, and so what they did was institute these candidacy courses in mechanics, optics, and electricity and magnetism. I had the E&M [electricity and magnetism], Zwicky had the mechanics at that time, and [Ira S.] Bowen had the optics.

TERRALL: That was Millikan's idea?

SMYTHE: Yes. They had these disgraceful examinations where the people would flunk completely, although their grades were all right. They had been given closed-book examinations, and all they'd have to do was to remember what they'd seen.

TERRALL: Was that the first course that you taught?

SMYTHE: No, the first course I taught was that one I showed you there. That was a course in a new subject, a lot of new material that had never been published before. I think I have that ancient text. There was a book that came out with all that stuff in it. At that time it was hot stuff. I taught that course. That's the first course I taught.

TERRALL: Was that a graduate course?

SMYTHE: Yes, that was a graduate course. I had to work hard, because I hadn't had most of the stuff myself. So I had to dig it all out and get it thoroughly in hand before I taught it. I learned as much as anybody else did in that course.

Well, Zwicky gave examinations, which were almost impossible for the students to do—you could do a little of them. And the better seniors tried to take this course to get it off their chests before they got into graduate school, because it was one of the candidacy courses, and they were quite sore about the fact that he gave them stuff that none of the seniors could do. And so they arranged this thing; they got a lot of the graduates that had had the course to do something for them so when Zwicky gave the next examination—it was upstairs in West Bridge—one of the seniors went in there and copied the questions down. Then he went back, and in each room there were two or three graduate students and each group concentrated on one question, and then this one fellow copied all the solutions so they were all in one handwriting, and handed it in. And Zwicky, of course, didn't know any of his students—he didn't get their names or anything—so when he came to correct his exams he had this marvelous paper, in fact perfect, and he got really excited about this genius he had in class. And so for the rest of the term, every little while he'd see somebody and didn't remember their face and he'd ask, "Is this your name?" I forget, they'd concocted some absurd name for this guy; it was hard to pronounce. So he'd ask them about it. That went on, and the class had an awful time keeping their faces straight. Then finally, when the grade sheets came, this guy's name didn't appear on the grade sheet, and Zwicky was perfectly furious. When Zwicky was furious, he was absolutely unrestricted—he did everything, and he talked in such a broken way when he got excited that it was difficult to understand him. So he went over to the registrar's office, and oh, was he peeved when he went over there! He

said, “Hey, see, you left my best student off this list,” and so forth. The registrar’s office didn’t know anything about this. They had never heard of this guy, and it was quite a while before he calmed down and discovered what had actually happened—that this was a purely fictitious student. They got all the papers—blanks—from the registrar’s office and filled them out, you see, beforehand. They also sent them in my course and Ike Bowen’s course, the other candidacy courses, but both of us knew the students inside of a couple of weeks, and so we just threw the cards out when they didn’t turn up and forgot about them. I knew what was going on because one of my former students was one of the ones who was helping the undergrads on this exam.

Zwicky was quite a character. He was a very good skier and he liked Greco-Roman wrestling. I told you this, too, I think, about the wrestling—well, that was Zwicky.

C. C. Lauritsen, of course, was a genius all right. He took my course, and about halfway through the candidacy exam the lights all went out so he couldn’t do any more work, so he only did about a couple of hours’ work, but he got a pretty good exam anyhow.

And his son, Tommy Lauritsen, was a good student, too. Especially he was an expert in research. C. C. Lauritsen was the one who founded the rocket project here. He went to England [1941] and saw what they were doing with rockets and decided that we ought to have them here. So he came back, and they had a rocket project in the east but they used a different kind of— I’ve got all the dope on the rocket project in here. They used this type of rocket with a lot of little sticks in, because in America they didn’t know how to make big sticks. And when Charlie Lauritsen went to England, he saw these great big sticks like this, extruded. These burn much slower. And so he designed these rockets—this is a sample one—with these long single sticks in, and they had much more range than the old rockets had; they burn longer. And the Navy really took over, and we made all their rockets. But anyhow, they were spending $100,000 a month for rockets when the war ended. Anyhow, C. C. Lauritsen was entirely responsible for this. He’s the one that set it up and Willy [William A.] Fowler was his main lieutenant. Willy Fowler was in direct command and Charlie was back of it all. And they started this big rocket

base up at Inyokern. The laboratory up there is called the A. A. Michelson Laboratory, because he was considered by many to be the greatest scientist the Navy ever had.

Another thing I wanted to show you: It was Michelson's daughter [Dorothy Michelson Livingston] who sent me this. The Navy put it out. It's an exact copy of Michelson's—there he is, as a midshipman—of Michelson's notebook and his first velocity-of-light experiment at the Naval Academy. It's made to look just like the original. Even the lines and everything are exactly the same and the pictures he pasted in. The Navy thinks a lot of him. He was one of their most famous men. I sent all this information to his daughter because I'd been his assistant and knew a lot about him that she didn't know, so she sent me that copy. This is from Dorothy Michelson Livingston. I don't know if she's still alive or not. At the dedication of the library, she and his two other daughters sat on the platform, I remember. But I don't think I met them. She wanted me to come back when they were naming a building for him at Chicago and were having a big celebration. It was after I'd corresponded with her, and she sent me an invitation and said, "I'd certainly like it if you came to visit." But I couldn't go.

[Reading from the list of names.] [J. Robert] Oppenheimer. I didn't know Oppenheimer awfully well. I knew him all right, but not terribly well. He went from here and became head of Los Alamos for a while. His brother was a genius as a teacher, Frank Oppenheimer, but he and some three or four other students had had a little group studying Communism up at Berkeley, so he was barred as a Communist from all activities and fired from several jobs on that account. I think he went to Minnesota and was fired because they thought he was a Communist. He wasn't. It was just that the kids were interested—they all got over it. I had a fellow, too, who was in that group—his name was Bruce Dayton. He was barred from everything. He wanted to go to Europe—he had a scholarship or fellowship or something offered to him—and the United States wouldn't give him a passport, because he was in that same little group of five or six people up there who were interested in Communism at Berkeley. He and Oppenheimer's brother, Frank, and a group of others—it really hampered them later. They weren't Communists, but they had this little group studying Communism. But this Oppenheimer [J. Robert], whom I didn't know very well, had a terrible time. He was persecuted—one of the reasons being that he didn't want to build the atom bomb.

TERRALL: Well, that was much later, though.

SMYTHE: That was much later, yes.

TERRALL: You didn't know him too well when he was here?

SMYTHE: Oh, yes, I knew him all right, but not too well. He was not interested in the same fields I was. I didn't know him anything like as well as I knew Lauritsen.

I knew Earnest Watson very well in Chicago before he came here. He came out here with Millikan. He never got his degree at Chicago. He came out and, so did Bowen. I knew both of them in Chicago. I knew Bowen best. We went on hikes everywhere together. We climbed Baldy together, and we went up Mount Whitney together, and we went all over on hikes before he was married. After he was married, I didn't see him so much. He was director of the Mount Wilson Observatory and was sort of an experimental genius.

TERRALL: So you were working with [Charles] Lauritsen on the rocket project?

SMYTHE: Yes, when that rocket project started, the Lauritsens, Bowen, Fowler, and I, and several others were in it. That was the nucleus of the project, which had 3,000 or 4,000 people working in it when the war ended. I spent a summer in Key West working for the Navy on this project. They ordered all small boats that couldn't fire the Hedgehog—which had a big recoil, so nothing smaller than a destroyer could fire them—to use rockets. In training the people, we had a little rocket, much smaller than this, which followed the same path and had just a shotgun shell in it, and that exploded when it hit the submarine, so the submarine could report whether they had been hit or not. They were training with that. These little things were relatively inexpensive. They called these "Mousetraps," because when this thing is cocked up here this way, you can't see it from this point of view, but if you look at it sideways, it looks just like a mousetrap. It was big business during the war. They spent millions on it.

I was in Key West supervising Mousetrap installations and also helping train the crews. As a civilian, I could do lots of things the military could not. Some idiot down

there marked the installation instructions confidential, so the people who were doing the installations couldn't look at the diagrams, because they were non-coms. I got a whole lot of the stuff that hadn't been marked confidential and shipped it there and distributed it. Before the intelligence officer there discovered it, they'd learned their jobs from these instructions, and so we got through all right. It was the only thing that worked at night there in Key West. You'd see the flicker against the sky of the welding torches—it was blacked out completely except for that. They had a general order from Washington to do anything necessary to expedite this rocket-arming of the small boats, so they worked all night. If you were off to the side and looked towards Key West, you'd see these flickers of blue light in the sky, as they welded them on to the decks of these sub chasers.

Sometimes I stayed in the bachelor officers' quarters; sometimes I stayed in the hotel. It just depended on what was available. We had no fresh water in Key West, except for drinking, then. All baths you took were in salt water. Once a week, a tanker with fresh water came in, and that was the supply of water for Key West. It rained a lot, and most of the people who lived there collected rainwater. We had some good storms there. They were sinking the ships carrying oil. Tankers would pick up oil in Texas and go by Key West, you see, coming out into the Atlantic. There were temperature layers in the water, so if you sent a sound signal, it would hit a layer and bounce off, so it was perfect for submarines; they'd sink one or two ships a week off Key West. And whenever there was a ship sunk, everybody in Key West would rush out—all the boats, everything. The sub chasers, these fellows who were training with the Mousetraps, everything would go out there and try to get these subs, but they never got one. It was just impossible. With the sound gear you had, you'd send out signals and get reflections, you see, and you'd hit one of these layers and bounce off it, and the sub would be sitting down below and you could never get it. So they never got one. But every day, practically, when I was living in the bachelor officers' quarters inside the base, I'd see a bunch of these bedraggled sailors coming by. They'd been fished out of water when their ship was torpedoed. One big ship they brought in, the *Pennsylvania Sun,* a great big tanker. You could drive a boat right through the ship; up near the bow, about 30 feet back of the bow, there was a hole right through it. But it had been perfectly calm water, and they'd been able to tow it out. And later on I saw this ship after it had been patched.

I was at New Orleans. I made a trip inspecting all of the anti-submarine bases in the country, and I started on the New Orleans group. I was taking the ferry there, out to the island where the Navy had their stuff, at the mouth of the Mississippi, when I saw this ship coming down, and when it got close enough I could see the name of it. It was pretty well blacked out. I could see the big welded places on it. It was this tanker that had come into Key West that time. I talked to the sailors. Being a civilian, I could have close contact not only with the officers but with the privates and non-coms, so I saw all sides of it. I talked to the sailors who had the job of taking the corpses off this ship. Most of the people got out, but the people up in front where it was hit didn't. And they described the corpses in great detail; they looked just like fried pork. It was a very unpleasant job, getting those bodies out.

Earnest Watson I knew at Chicago and came out here with him. Ira Bowen I also knew at Chicago. We worked in adjacent rooms there. He was the one who closed the gap between the ultraviolet and X-ray regions. He had been working with Millikan, and that was done in the same room here [the Norman Bridge Laboratory of Physics], right next to this, where the head office is here. You could hear him every day, every Saturday, Sunday—he worked every day of the week. Everybody here worked every day of the week then. Research men worked seven days a week. This place was just as busy on Sunday as it was any other day. Well, none of them were married then. Now that they're married, they have to pay some attention to their wives, and so they don't. This place is perfectly dead on Saturday and Sunday.

TERRALL: But when you came here, you were already married.

SMYTHE: Yes.

TERRALL: Did you work on weekends?

SMYTHE: Oh, I didn't come down here on Sundays much. But once in a while I'd come down. I came down on Saturdays. Yes, I was married. But I wasn't trying desperately to finish up a thesis or anything like that. I very rarely came down on Sunday; in fact, I never came down on Sunday. But on Saturday mornings anyhow, I usually was here,

because I had fellows working for me who were working in different rooms around here doing theses and I liked to be around.

Well, Ira Bowen closed this gap between the ultraviolet and the X-ray regions. He identified all the unknown lines in stellar spectra. They had a lot of hypothetical elements—coronium, nebulium and so forth. The astronomers looked at the spectra. They recognized the common lines of elements that we had, but they got lots of spectra that they couldn't recognize at all. They didn't know what they were, but they thought they were different chemical elements, so they named them. There was nebulium—that's a spectrum that appeared in nebula, that never appeared on Earth, and coronium, a spectrum that appeared in the sun's corona which they'd never seen on Earth, and things like that. And Bowen, when he was working with this spectrograph here, recognized some of the lines he was getting as being members of the same series they'd observed, and so he solved the problem of coronium, nebulium, and so forth. They were common elements like oxygen, but in a state in which the atoms had been stripped off to the extent that the spectrum was utterly different from any they could get here. And the basic lines of the spectrum, the head of the spectrum where the series started, were in the ultraviolet, where the atmosphere absorbed them, so they weren't observed. He got all these lines—he and Millikan—on this spectrograph, which is in the main office there. He knew the theory, so he took those lines and drew what the rest of the spectrum would be and hit all of these nebulium and coronium lines. They were stripped atoms. That was one of the things he did. He did an awful lot of research. He had six papers good enough for a PhD thesis. When they finally got around to giving him a PhD, the problem was what should he use for his PhD thesis. I don't remember what he used, but he was a genius in some ways.

He had a pretty tough time, though. He married the sister of Millikan's secretary [Inga Howard], Mary Jane Howard, who became Mary Bowen, and she went both blind and deaf, completely, and never had any children. It was awful hard on him. He died fairly recently [February 6, 1973]. I didn't see much of him lately. I knew him extremely well when he first came, but after he got married and after this business came, he became director of the observatory [1946] and I didn't see him very much. He didn't have any office here in Bridge anymore.

Begin Tape 3, Side 2

SMYTHE: [Talking about Jesse W. M. DuMond.] Here's one of his projects. That's the second edition of Millikan's book [*The Electron*], and Jesse DuMond edited it. He was a good research man, but he tended towards very elaborate equipment. He built some equipment, which was tremendously intricate and very successful. On the rocket project, he didn't do so well. They invited him to contribute, but everything he designed was too complicated; they wouldn't build it. On the rocket project, he didn't get very far. Lauritsen didn't like any of his stuff. When you're building things by the thousands and expecting sailors to work them, why, you've got to have them fairly simple.

He was divorced and remarried. The reason was they had a family—his first wife, Irene DuMond, I knew fairly well. She was French; he spoke some French. I guess he met her in France. She was taking the children back to see her folks in France; they had several girls and a boy. And the boy, on the steamer going across, got something or other and died, and Jesse blamed it on his wife. So they separated and then he married a girl he'd known when he was young at school, also French, and Irene went back to France and got married again, too. I don't know what happened to her in the Second World War or what happened to her folks.

DuMond had brilliant ideas that came to him for research. They were always complicated. Bowen's stuff—he'd build something extraordinarily simple that would accomplish some big result. But Jesse always had complicated equipment, but he could handle it all right, and he turned out some very good stuff. But he was a temperamental sort of person. I don't think he ever did any kind of exercise, never played anything—any game or anything. But his first wife was very popular, especially among the faculty wives. For instance, Helen was very fond of her, and all of the rest of them were fond of her. She was a very attractive person. And so when he got divorced because he blamed her for the death of this boy, the women on the faculty were absolutely horrified, and they were perfectly furious. And I don't think they ever associated with his second wife much. She was sort of isolated. I know Helen was perfectly furious, and I understood that most of them were; they just sort of ostracized Jesse and his family. She had no children, the second wife. But Irene DuMond was a very nice person and extremely popular. I liked the second one all right. I had just a speaking acquaintance with her,

that's all, once in a while—I never saw her at home. None of the faculty women would have anything to do with her. Very strange situation. It wasn't anybody's fault. Irene DuMond didn't kill the boy. It was just a misfortune that something happened to him when he was out there. His [DuMond's] daughter married a physicist who became very famous, Wolfgang Panofsky. He's up at Stanford now, I guess. He's an extraordinarily brilliant chap; he's done a lot of outstanding work at the linear accelerator at Stanford. He and Jesse were on good terms, it was just the women around here that got down on him—Jesse DuMond. He died very recently [December 4, 1976]. He hadn't been in good health for a long time. About the time he died, there was something wrong with him, I don't know, mentally.

Now, there's visitors—Einstein, Bohr, and [Paul] Ehrenfest. Well, I had just a speaking acquaintance with Einstein. We spoke, but that was all. I never had a long conversation with him or anything. Bohr I had even less contact with, but I had a lot of contact with Ehrenfest. I believe he committed suicide [1933].

TERRALL: Did you keep in touch with him after he left Caltech?

SMYTHE: No, no, I didn't know him that well, but I knew him pretty well at Caltech. He was quite a guy. This is a picture taken up in the physics lecture hall, you see [201 East Bridge]. I don't know why [he committed suicide]. I suspect it was some technical reason, that he thought he was weakening or something. I just don't know. Oh, yes, I know one thing about it. I was asked once to go on a trip with him and some other people to San Francisco, and for some reason I couldn't go. But after they got back, I asked them how it was, and they told me all about it. I remember one thing they mentioned was when they got up on the hill to see the lights of San Francisco, Ehrenfest felt very sad for some reason, because of all the lights. He made some remark about lights. So I think he was a rather temperamental person. But I didn't really know him. I know he committed suicide later, when he went to Europe. But he stirred things up around here. He was quite an asset. Let's see what else—I know some other things about Ehrenfest. Haven't thought about him for years. Well, maybe I'll think about it. I can't remember right now.

TERRALL: OK. I'd like to ask you some things about the course that you taught in E&M.

SMYTHE: Oh, I taught this course in E&M, which was required for candidacy. I told you why they set up these courses. Mine was the longest survivor. As more new branches of physics kept developing, they didn't have time for the other required courses, but this course was never cancelled in EE [electrical engineering], it was still required until I retired. In physics, they removed that requirement just a year or so before I retired, but a lot of people still took it—that is, it became optional. In this course was where I had most of my famous people. I had six Nobel Prize winners in that course and a lot of people who became famous in engineering. The last class I taught was in '64, that's when I retired, and that was a candidacy course. You couldn't get by from memory. I would give the students copies of the old exams and help them with any questions they had and so forth, but it never did help them any. They had to be able to figure things out in the course.

TERRALL: Was the course similar to one you had taken at Chicago?

SMYTHE: No. No, the Chicago courses were all absolutely stereotyped. If you remembered verbatim what the lecture had, that was enough. They never stuck you with a new problem that depended on the theory at all—neither Millikan nor Michelson.

TERRALL: Was this your idea, then?

SMYTHE: No, I think it was Bowen's. We had these disgraceful PhD exams. These fellows had memorized their stuff and they knew by memory everything they'd been taught—theories and so forth. But you couldn't use them—you couldn't use them at all. They'd give them a situation: Now, what would you do if you found this situation? They were stumped. They didn't know what to do about it, and it was really disgraceful. I'm pretty sure that Bowen was the one who said we ought to give them problem courses so they'd have to use the theory and use it in a situation they had not seen before. They had the background theory necessary. And so these three courses were set up. There was optics with Bowen and mechanics with Zwicky—that was the only one where there was

any trouble—and E&M with me. For me, electrical engineering also required this course, and so I taught it for many, many years. See, these are the grade books. I've had all these famous people. Any physics graduate here that's become famous is in these lists someplace. There's a lot of famous engineers in there, too.

TERRALL: Did you enjoy teaching it?

SMYTHE: Yes. I didn't expect to. In fact, when I came here, I was firmly set against teaching. I was going to stay here just until I got my research fellowship finished, and then I was going into industry. I had a kind of a contempt for teaching. I don't know why. "Those who can, do; those who can't, teach." And so I had no intention whatever of teaching. But then I taught that first course that I showed you the book from. I taught that course because it was material I didn't know anything about, and it was new material, and I thought I ought to learn it and maybe a good way to learn it would be to teach it, because I'd have to get it down cold while I was teaching it. But I kind of enjoyed that, so when my fellowship finished, they offered me—let's see, did this happen before I finished my fellowship? Anyhow, there was a fellow who'd been teaching E&M who graduated, and then they put the course on me and I taught it. It was Jeans' [*The Mathematical Theory of Electricity and Magnetism*[5]—it's up there on the top shelf—and Bowen took the optics and Zwicky the other. Then Zwicky was replaced by somebody; I don't know who first replaced Zwicky. There were several fellows here who taught that course. But anyhow it was passed around to various people. And one result of that course was that I was on all PhD exams. All of them. Sometimes I'd have four PhD exams in one week, each one taking half a day, in both EE and physics. My job there was as equalizer. You could pick two committees to examine a person, and their standards will be entirely different. One of them may be easygoing and want to treat the student nicely, and the other one may be hardboiled and say, "Well, he didn't know this," and so the grading on the exams is very uneven. So I was put on all of these committees as an equalizer. Now that job is divided, and I don't know who does the experimental, but Jon Mathews does the theoretical. Jon Mathews, incidentally, was one of the people

[5] Jeans, Sir James H., *The Mathematical Theory of Electricity and Magnetism* (Cambridge, U.K.: Cambridge University Press, 1908)

who took over that mechanics course, and Leverett Davis was another, I think. So I began to enjoy it, so I stayed with it. Each year for about five years after I started, I'd tell myself, "When I get through with this year, I'll be finished," but by that time I'd have a new research project going and I didn't want to leave it unfinished, so I never did get cleared up.

TERRALL: What kind of industrial job were you planning on getting?

SMYTHE: Oh, I had no very definite plans. I was thinking about people like General Electric or some of the geophysical people and things like that. I had known people in all these projects. That's what I was thinking about doing, but I certainly didn't intend to do teaching.

TERRALL: Did you ever do any undergraduate teaching?

SMYTHE: One year only, and I had two distinguished people in that class. One of them was [William] Pickering, who was director of JPL [Jet Propulsion Laboratory; 1954-1976]. That was a sophomore class. I had the honors section of sophomores one year. The other one was a fellow up at Cal [UC Berkeley] who won the Nobel Prize [1951]—Ed [Edwin] McMillan. They were both in that class, very good. It was a good class; it was the honors section. It was the best group of undergraduates. But that's the only time I ever taught undergraduates, except that undergraduates often took my course. It wasn't required; they got graduate credit. If they got that off their chests, then they had just that much more time for research and thesis and so forth after they became graduate students. Lots of them were prepared by the time they got to be seniors, so they could take it just as well; in fact they do a good deal better, usually, than the graduates from other institutions will do here.

TERRALL: So you taught the same course for all those years.

SMYTHE: Yes, I taught the same course. And I have all these comments—I wonder if I have that here. You know, they used to have a business of rating courses. Well, you'd be

interested in some of the [students'] comments on that course, if I can find it. Some of them thought they didn't get enough credit for it, and all sorts of comments.

TERRALL: Let me ask you one more thing. Did you know many people who were not in physics—in other divisions?

SMYTHE: I knew *all* the EE's in the old days, and a few students in the other departments. I had students from math. For instance, there's one who goes swimming every day, [professor of mathematics] Robert Dilworth. He goes swimming almost every day. He's a good swimmer and was an A student. They could take it by examination if they wanted to, and there were several that passed it by examination, but not many of them. I think [professor of physics] Bud [Eugene W.] Cowan passed it by examination, and there's a few that had enough E&M and knew how to use it to pass it by the examination.

TERRALL: Did you have students who failed the course?

SMYTHE: Usually about 10 percent or so. But right after the war, it was terrible. They had all of these people who got free tuition at any university, and this place was just swamped with them. I had a tremendous class. I think I had three sections or something like that. And there the flunk rate was tremendous. Let's see how many students there are here—sixty-two. [Looking through class lists.] I think this is one of the postwar groups. Nineteen F's and then D's—a D doesn't count, either, for graduate work—nine D's. Now, this is a total of sixty-two students.

TERRALL: That's pretty terrible.

SMYTHE: Pretty terrible, yes. But these fellows were just absolutely hopeless. Just hopeless.

TERRALL: So, what happened after that. Did they drop out?

SMYTHE: I think most of them just dropped out of school. They did equally badly in other courses, too. The other people had the same trouble; they just didn't catch on to anything. The trouble was two things: Either they hadn't had the preparation, or they had had it so long before—five or ten years before—that they had forgotten all about it. I don't know what the trouble was.

TERRALL: During World War II, were you teaching the Navy men who were here?

SMYTHE: I just taught this same course.

TERRALL: Were there as many graduate students here?

SMYTHE: No, oh no, I should say not. Let me see how many there were. Only the cripples. In 1945, there were twelve students in the class. This was July 1945. The next class has twelve also. There was a good student there, though; he was a fellow who was blind, essentially. He was a good student. Yes, these fellows who came back after the war—I knew that I was going to have this problem. I usually never repeat examinations, but I repeated examinations on which somebody had gotten 100, so I knew they were feasible. I used old questions to make up the exams then, because I had a feeling that I was stuck with a bunch of students who were unqualified, and so I gave them exams on which I had records, and the averages on those exams were around 70 or 80 or something like that, so I knew there weren't any trick questions. Once in a while, you give a question that nobody seems to be able to do, which you realize afterwards just has an angle that is strange to them. But I was very careful after the war to use old examinations of twenty years before or so, on which I had a good record, and I knew the students could do them well if they were qualified. But I didn't make up any new exams for them.

TERRALL: Well, we talked about the rocket project a little bit.

SMYTHE: Oh, boy, now you've got into something. This first one of these rocket launchers was built down in the physics welding shop. They had hundreds of these. As

soon as they had the first one out, the Navy ordered 2,000 of them. They mounted them on trucks, they mounted them on boats this way, they used them in all kinds of places. The spinners were built by Richards in the physics welding shop. He went down there and just cut it apart and put it together, and cut it apart and put it together, until he got it to work. He would put these rockets in, stack them, and it had a great advantage over any other method of loading because they were loaded from the side, so if you set them off or anything, it wouldn't hurt anybody. And they fed by gravity—that was really a clever thing. I can read you what it says here. [Reading from booklet on rocket project.] "During 1943, Caltech devoted much time perfecting a series of barrage rocket launchers. . . .[T]he most important improvement in launching devices was the twelve-round gravity-feed launcher. Functioning automatically, it could fire a single round, or loose, would full load in less than a minute. Light in weight and safer to operate in that it could be loaded from the side. . . .By 1944 the Navy had procured 20,000 of these launchers." There was a Navy admiral, I think, who went out when they first tested them, I remember. And the minute he saw them, he was extremely enthusiastic. This Richards was not a Caltech man. He was a teacher at the University of California in Riverside or San Diego or something like that, and he quit to go on the rocket project and he made a lot of contributions. This is by far the most important. And when he went back to his job, they had reduced his rank and everything, because he'd been away. They gave him no credit at all. He was hit bad. They were building special ships for rockets, but they never got into action. This is a special ship for rockets.

TERRALL: What part of it were you working on?

SMYTHE: I was in it from the beginning in all parts, almost.

TERRALL: Were you involved in the testing up in Eaton Canyon?

SMYTHE: Yes, I was up there. I didn't set up those tests, but I was up there. I remember I had something to do with it—I don't remember what. No, Charlie Lauritsen was the one who was up in Eaton Canyon most of the time. But I was up there, yes; I worked up there. There were about six or eight of us who were with the rocket project from the

beginning to the end. There was Willy Fowler and both the Lauritsens—it was a busy, busy time.

Then I invented this yaw camera. It was for spinners. We started building spinners. They don't have fins to get bent and things the way the others do, and we didn't know much about them, so we built this yaw camera. This is the way it goes. It has a flywheel in it, and when the rocket starts to spin on the launcher, the flywheel has inertia and stays behind. This is the parts of it. [Showing picture.] Here are the drawings for it. The original drawing was wrong, but we built twenty or thirty of them that were working perfectly, from the original drawing. What happened was they didn't look at the drawing; they took the previous model and looked at it. The interesting part is to see what happens to a rocket when you do different things to it. There's when a rocket *wow-wows*. It suddenly begins to get unstable and it misses the tail end, and instead of spinning this way, it gets going around this way. It makes this funny noise, *wow-wow*. And that's the yaw camera record of it. Here it shows how it started, turning this way, and then it went unstable. They never explode, because they would hit on their side. And that is due to the position of the center of gravity. The precessions—that's the long motion—die out, but the nutations build up, and to prove that, here's two records. They had the same weight and the same amount of spin, but the center of gravity in one was two inches in front of the other, and look at the difference. This one is like an artillery shell, it has a precession going like this. This one goes along here and has the nutations going; it's different. That is because the center of gravity is further forward, where artillery-shell formulas do not apply. This was proved by the yaw camera. After we discovered this, the theoretical people were able to get the formulas and put the proper constants in them, so they could predict rocket behavior. Without the yaw camera, they would never have been able to get that straightened out. All ballistic books were for shells.

This describes the Mousetrap rocket. The Mousetrap rocket does not explode unless it hits the submarine. A miss does not disturb the water, so the sound-ranging equipment still works. A depth charge goes off even when it misses and makes such a turmoil that the sound-ranging equipment loses contact entirely with the submarine. Then you have to find it again.

Begin Tape 4, Side l

SMYTHE: They got a lot of subs that way. If they spotted a sub, the sub would spot them at the same time. The sub would start to duck and they'd go in after them, and they'd know that it wouldn't be very far down. They dropped the rocket on this side, and these solid-head ones were quite fast under water; they'd puncture the hull and it would have to surface. Then they could kill it. So that was a big advance from a very small change in nose shape. The water cavity was now just big enough to hold the rocket. You wasted no energy to make a big bubble. That was one of Bowen's bright ideas.

Incidentally, this [yaw camera] was approved by Bowen. When I first presented the idea, we were having a terrible time, because our rockets were doing all sorts of things not predicted by artillery ballistics. I took it all over to Bowen and he approved the yaw camera and made some good suggestions and decided it would work. You have to have a sunny day, because those are images of the sun. But it gives you a complete record, and you can tell all about the stability. They had a rocket museum over here that was torn up about ten years ago, I guess. Willy [Fowler] had it. That's [the photograph] from the museum. They went to Europe, in the Normandy invasion, and they used these rockets with tremendous effect. We were shipping them by air from here to the East Coast. They were five-inch HVARs [High Velocity Aircraft Rockets]. They were also used in the landings in the south of France. They could put those tanks out like nobody's business. They just knocked the treads off of them.

I went to Key West the first summer, trying to put our rocket projectors on little boats. I told you all this—they were sinking ships off Key West all the time. One day, I was in dungarees helping these guys; everybody in uniform was off chasing a sub that had just sunk a big tanker right off Key West. As a civilian, I had to stay ashore. They didn't get anything. I was sitting awaiting their return when we got this radio message that the secretary of the Navy, [Frank] Knox; the commander-in-chief of the Navy, Admiral [Ernest J.] King; and a lot of admirals are on the way, flying, to see a demonstration of the Mousetrap. Well, the second lieutenant who got this telegram hadn't been able to get hold of the ships that were chasing subs that day. He was utterly frantic with this telegram. "They're on the way, so *we've* got to put on this exhibit," and would I do it? So I said, "OK, we'll do it. Give me some men." And they gave me a

fellow who had driven yachts all the time before the war, and a couple of other men. We had only one Mousetrap available at the time, and I set it up. Then the brass arrived, and here I was in dungarees—an awful mess—but I explained everything to them. I don't know who they were besides Secretary Knox and Admiral King. Those are the only ones I was introduced to, but there were about a dozen Navy captains and so forth, and maybe some admirals, I don't know. So I explained it. I think I did a pretty good job of explaining it. Fortunately, the tide was low, and there was a big mud flat where there was usually water, so that you could see when these things lit. As I say, I got this Navy fellow and these other two guys to load the Mousetrap and I explained everything to them. We fired, it went up nicely and hit in the proper pattern out there—they saw everything. And the Navy officer who had called me frantically in the first place came around and complimented me afterwards on what a good job I did. He was pleased as the dickens, because it was just exactly what they wanted and everything went perfectly. No misfires or anything. I used good ammunition, I didn't use reloaded ammunition.

Well, anyhow, that was one thing that happened. It was very much like the same thing that happened in France, when they fired that big gun. Here all of a sudden I had to take charge of the firing of the first big gun in France and all of these generals and so forth turn up. This was the same sort of a thing. But it was very nice. I thought I had all good ones. When you reload [the ammunition] in a place like Key West, where the humidity is about 100 percent, there's just an appreciable danger that if everything you put in isn't airtight, the charge that ignites these big sticks will get damp and misfire, so that you have duds. The thing goes off and it's just barely enough to push the rocket off the end of the launcher unless it ignites the main charge. We had a lot of those, because we were reloading; we didn't have many new rockets, so we had to reuse old ones. In Key West, this was an awful problem, because of the moisture. Everything got wet. Very pretty at Key West at times. They had a big storm there one day and it was beautiful—lightning and thunder and clouds. It stirred up the coral bottom so the sea was bright green, and a submarine came up and it was jet black—very pretty. Well now, what's next?

TERRALL: Well, I think we've finished with the war, haven't we?

SMYTHE: Oh, you asked about DuBridge here. Well, I'll tell you about that. It DuBridge's arrival as Caltech president, 1946] made a big change at Tech, but it wasn't due to DuBridge particularly. It was due to the fact that the NDRC [National Defense Research Committee] and other national organizations were financing experimental work, and we in particular had a great many projects financed by that. And they required reports every three months, so that they had to get hundreds of secretaries—a hundred or so I think, I don't know what it was—a tremendous number of secretaries appeared. Every project had to have one or two, and that changed everything. Before, it hadn't been like that. Before that, it was very simple to do research, but after that it got complicated. You had all these reports to get out all the time.

TERRALL: This is because of government funding?

SMYTHE: Yes, because of government funding. We didn't have it before the war. It arrived at the same time that DuBridge arrived. It wasn't his fault. He of course was familiar with the place, and I knew him pretty well. He did a good job because he'd been already in charge of the Radiation Lab in Massachusetts [at MIT]. He was very well qualified, but I don't think you can blame what happened on DuBridge; I think it was due to the fact that before the war we had none of this government funding. After the war, everything was supported by the government, and that required progress reports, one after the other, and that meant the great multiplication of secretaries, which ran up the cost, so they needed more funding, and the atmosphere around here was changed entirely. Furthermore, after the war a high percentage of the graduate students were married. Before the war, a married graduate student was a curiosity; you never found a married graduate student. And you worked seven days a week—it was just as busy on Saturday or Sunday. I was married, so I didn't come down on Sunday, but the students worked right through. Everything changed after the war. Married students made a lot of difference. Instead of getting their PhDs out in three years, which was the usual thing before the war, it began to take four, five, and six. You look at that list on the bulletin board and you'll see how long it takes them.

Well, another thing: There were big projects, projects that involved a dozen workers maybe. Now, on a project like that, the speed of progress is much slower. A man may come in at the bottom of the board and do very good work, very fast, but it doesn't do him any good, because the people who have been hired earlier will be the first ones to get degrees—so that research slowed up. That was another thing: not only the married people, but that happened after the war, too. Projects got bigger. The simple experiments that one person could do by himself had practically disappeared by that time. Every experiment was cooperative, and there were a lot of people involved, lots of expensive apparatus and so forth. That also came up after the war. That made the PhD a much slower process. Some of the people took nine years to get their degree!

TERRALL: What were you working on at the time?

SMYTHE: Well, one of the jobs—I don't remember exactly the time—I was working on the separation of isotopes. I'd been doing that before the war; in fact, I did these separations first, when nobody else was doing them. Then they went to work on the atom bomb, and at Los Alamos they spent millions of dollars, for instance, separating uranium-235, the one that they wanted for their bombs. So that made all of this sort of equipment that I had around here obsolete. So I more or less quit on it, though I worked on it a little while after the war, for two or three years, before they got around to working on some of these that I was working on. For instance, we separated out heavy carbon with the diffusion apparatus downstairs. One of the fellows who worked on that was Charlie [Charles H.] Townes; he was a Nobel Prize winner [1964]. Another one who worked on it was Dean Wooldridge, with the same apparatus later—no, he was first and Townes was second. Wooldridge is on the Board of Trustees of Tech now. We were very successful; we got this heavy carbon. And the people it really helped were the astronomers. When they got a sample that had about fifty-fifty carbon-12 and carbon-13, then they began to get the spectrum of molecules which were 12-12, 12-13, and 13-13, and that wiped out a lot of mystery in many of the astronomical spectra. So I sent them up my best plates of this spectrum. They used them for comparison up at Mount Wilson, and it explained a lot of troubles they'd had before with identification. Having the isotopes separated cleared it

all up. But we did a very good job on carbon, and we also did the same thing on nitrogen. And that was also helpful to them. They'd get absorption lines in the atmosphere that they couldn't explain, in the nitrogen. Well, they were working with ordinary nitrogen, they thought, but it turned out that they were using a rare isotope of nitrogen. So I worked on that for several years after the war. Then that stuff became obsolete as soon as the equipment at Los Alamos became available for working on all isotope problems, because it entirely outclassed anything we had.

Then I worked more on theory after that. I did a lot of theory, and I wrote my book; the first edition came out in 1939. There's a lot of material in that book that is not anywhere else in the literature—eddy currents for instance; there's no place else you can find out about them except in there. As I say, I had a fellow in here last week from the Illinois Institute of Technology and he said, "We're much more practical than you people are in physics. Our people always get jobs, even in a depression. Your people don't. They work on things that don't have any practical applications." And since a lot of the stuff they do involves electrical work, he said they use this text. I'd never seen him before. But that's where some of them are going. I know it's still selling, and I couldn't understand exactly why, but that's the reason: It's still practical. I know that a lot of students here buy it—electrical engineering students—for reference. For instance, on conformal transformations, something which is practically neglected around here now—in physics they get a little bit of it in the senior year I guess. Jon Mathews was over at a PhD exam in electrical engineering, examining a student in physics, and he gave the guy a problem, which is a straightforward conformal-transformation problem, and said, "What would you do if you had to solve this potential problem?" And the fellow started writing down series, and one thing and another, all very elaborate stuff, and finally Jon says, "Did you ever hear of a conformal transformation?" No, he'd never heard of a conformal transformation! Apparently they don't teach them now, and the books don't have it either; this [Smythe book] has quite an elaborate treatment. And so it's for things like that, and the eddy currents, which are not treated anywhere. I don't have a copy of it, but the text they use here has a paragraph at the beginning of one of their chapters which says, "The subject of eddy currents has not been included in this volume. If you want to see about this—" and then they refer to this [Smythe book]. Eddy currents are important,

but they're not very glamorous. They're a blame nuisance at times. They account for a lot of troubles people have.

Well, the effect of the Army–McCarthy hearings on Caltech. I don't know anything about that. I know absolutely nothing about that. I expect they maybe had some effect, I don't know. I don't remember hearing anything about it. Oh, come to think about it, I expect that that accounted partly for the troubles of people like this fellow Bruce Dayton and [J. Robert] Oppenheimer himself, because of his brother, Frank Oppenheimer. He suffered because of his brother. He was accused of being a Communist and so forth; it was partly because of his brother. Well, those fellows had a rough time. Bruce Dayton had a fellowship to Europe. Let's see, the government would not issue him a passport because of his record. He wasted a whole year because he had this fellowship, but he couldn't go without a passport. Frank Oppenheimer had a perfectly good job in Minnesota and they kicked him out. This was partly due to McCarthy, I think. They kicked him out of Minnesota because he'd been in this perfectly innocuous little Communist group at Berkeley. He's a genius of a teacher, a perfect genius. We knew that because he had some little tiny school in Colorado where he was teaching, and here every once in a while we'd get a student from this place for a PhD student and he'd be a whiz. It turned that he was one of Frank Oppenheimer's students. And finally he [Frank Oppenheimer] made such an impression that he got a really good job up near San Francisco. He's really a genius as a teacher. The background of that probably was due to McCarthy—this rabid anti–Communism. I think that probably could be blamed on him to a certain extent, I don't know. Maybe that's the reason the government wouldn't give any passports—because they were just afraid McCarthy would jump on them.

TERRALL: Were there any changes in the graduate program after the war?

SMYTHE: Oh, yes, because all this new material came up—all this nuclear stuff and so forth. So that whole new field opened up. It was no longer possible for them to get a thorough knowledge in every field, so what they had to do was cut down the general requirements. My course was the last one to be eliminated of the candidacy courses, but

there just isn't time for them to take a course that requires a great deal of time. So now they get a rather superficial knowledge of all the different branches of physics. They're supposed to be able to go ahead in any of those branches from that point, and that's perfectly true. That's the reason a lot of our guys didn't get employed when the people in a place like the Illinois Institute of Technology could get jobs. They just taught them practical stuff. We have all kinds of things, like the neutron experiments and such, that are much more exciting as a result, because it's entirely new, but for which no known applications exist. Only places like Bell Labs can afford to employ people who are working on things that have no known applications. Bell Labs has everything there. There is something down here about summer work at Bell Labs—I never worked at Bell Labs.

TERRALL: You weren't there before the war?

SMYTHE: I'll tell you what I did work at. I worked with the Sound Lab in San Diego.

TERRALL: When was that?

SMYTHE: In 1940, just before the war opened. In fact, I came from there directly up to the rocket project.

TERRALL: Was that war-related work?

SMYTHE: Oh, yes, yes. It was anti-submarine stuff. It was just for the summer; then Pearl Harbor took place. Our project up here started before Pearl Harbor took place, and I was yanked into this subject with Lauritsen and Fowler and so forth, and never went back to the Radio and Sound Lab down there. It's on Point Loma. I was getting interested down there, too. I had a very neat experiment that was very good for training people on the anti-submarine work. Somebody else carried it on, I know. I destroyed a trashcan for them with that, while I was checking it. I had a little charge that you could throw out that would make a tiny explosion and they could practice on it. I wanted to be

sure it would go off all right, so I put it in an empty trashcan. I didn't think it would do any harm, but it really ruined the trashcan. [Laughter] It was a little charge like that.

TERRALL: Well, can you think of anything we haven't talked about here?

SMYTHE: Well, one item: I never had a girl in class all the time I taught.

TERRALL: Really?

SMYTHE: Never. Although some of the graduate students—I didn't have many graduate students who were married, but the ones who were married sometimes brought their wives to class, but they [the wives] weren't students. No, I never had a girl in class. Although I was on committees where there were girls who were examined. That was because, as I say, I was on all committees as sort of an equalizer, and that was right up untill I retired, and by that time there were girls getting PhDs, too, in physics. They always had lots of them in biology and chemistry but not in physics. So I attended several PhD exams that girls had. But it was only one of them in which the girls did as well as I thought they should, from what I had heard of them. I told you about that girl?

TERRALL: No.

SMYTHE: Her name was Nora Josephson. She married Karvel Thornber, a man over in electrical engineering, and he's at Bell Labs, and she's teaching in New Jersey. She just sailed through this exam like nobody's business. Her grade record wasn't as good as the other girls'. I asked her afterwards how come she did that, and she says, "Oh, this is nothing compared to a piano recital." She was an almost professional-quality pianist, and she had to memorize all of the piano pieces and so forth, and she got so that nothing disturbed her—her audience didn't disturb her at all. And that was the reason she outdid herself on this candidacy examination. Her husband went to Stanford and he was a star—the best electrical engineer of the year, almost a genius. So Stanford got him, and then because he wouldn't come without his wife, they got her a job as research fellow or something—something that wasn't really necessary—and after two years they fired her.

As soon as she was fired, he quit. He went to Bell Labs and she got this job in New Jersey, so they lost him in spite of the fact that they thought they had him tied down. He was an astonishingly bright fellow. And this girl was an almost professional-quality pianist.

[Tape ends]