Harvey Fletcher

**History of Harvey Fletcher

Written by Him for his Children

Early Boyhood

I was born in Provo, Utah, on September 11, 1884, in a little frame house at 139 South 2nd East which is still in good condition. Just north of it--131 South 2nd East--is where I spent most of my boyhood. My father built both of these houses. I was christened on November 6, 1884, by John Giles in the First Ward Chapel. I was given the name of Harvey Fletcher. My mother asked my father to tell Brother Giles to give me the name of Harvey Miller Fletcher. Apparently this message did not get across and I was named Harvey Fletcher. When I was about 7 or 8 years old my mother told me about this and asked if I would rather take the name Harvey Miller Fletcher. I told her I thought I should take the name that I was christened and so have carried that name throughout my life. I do not know where the name came from since there was no Harvey Fletchers at the time of my birth among the descendants of Robert Fletcher, who was the first Fletcher to America. Also in my mother's ancestors there is no Harvey in the records which we have. However at the present time there are five Harvey's in our immediate family.

I was baptized in March, 1893, by William McCully in the basement of the old church which stood a few yards from where the tabernacle now stands in Provo. The old church building has long since been torn down.

Here I have jotted down a few things that I remember about my early childhood when I lived in the little frame house.

I remember my first Christmas in the house at 139 South 2nd East. I must have been only 2 or 3 years old. When I was awakened by the older children I found Santa Claus had left me a china plate with A.B.C. around the edge of it. I clutched the plate and would not let go of it. So they put me back to bed, plate and all, between my mother and father.

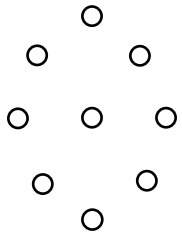
When I was about 5 years old I remember going into a tantrum such as boys that age frequently do. My brother Calvin was about 3 years older than I. And is usually the case with both these ages, I tagged him everywhere. There was a picket fence between the south entrance to our house and the lane that went from the street to our back yard.

In the back yard there was a large barn, with stalls for our horses and a corral for the cows. There was a large yard in front of the barn for storing a wagon, a buggy, and several farm implements. This was our play yard.

Coming back to our story, Calvin ran from the back and jumped over the picket fence, but I found I could not follow so I tried to crawl under the fence and my clothes caught and I was stuck so I could not go either way. So I started to cry and yelled to Calvin to get me out, but he just smiled. That made me angry so I stamped and yelled and called him every vile name that I had ever heard. He smiled and said these words which I have never forgotten, "Sticks and stones will break my bones, but names will never hurt me."

Since there were five boys in the family we had various types of games for boys in our back yard, which was a very spacious playground. The oldest in the family was a girl, Sadie, and the three youngest were girls, Erma, Eula, and Zoe. These last three are the only ones besides me that are still living when this is written.

Since our backyard was an ideal place for boys' play, most of the neighborhood boys joined in the play in our backyard. It might be interesting to describe some of these games. One was called "Old Sow." The diagram below will help to make clear the way that the game was played. There are small holes drilled into the ground around in a circle, the number depending upon the number of players. There was a hole in the center of the circle. Each player had a stick shaped like a hockey stick. It was usually made from the branch of a tree. To start the game, one of the players was selected to be “Old Sow.” He had a small ball which would roll along the ground guided by his stick. It was his aim to get the ball into the center hole. The other players were assigned places around the circle and must keep the stick in his hole or else Old Sow could steal the hole by putting his stick into the vacant hole and owning the stolen hole became Old Sow. Then the new Old Sow would try to get the ball into the center hole and thus it would continue until someone succeeded in getting the ball in the center. Then Old Sow would put his stick in the center and all the other players would lay their sticks across it. The sticks were then thrown into the air. All scrambled to get his stick into one of the holes. There was always one more player than the number of holes in the circle. So



Old Sow

Myself at 3

Veomi Betty Sadie Father

there would always be one player who did not find an empty hole, and he became the new Old Sow.

The game was a little rough at times but the boys enjoyed it and played nearly every day after school.

Another game that was frequently played in the winter time was ice hockey. A lot near our home was leveled and a retaining edge put around it so that it could be filled with water. When winter came it froze over and made a nice skating pond. We had many an exciting game here.

It was about this time that I formulated the following philosophy of life.

As I looked around Utah Valley I thought that the tops of the mountains that I could see in any direction represented the end of the world where people live. On the other side of these was the great ocean. There were cracks in the wall that held the ocean back, so that the water from the ocean leaked through and formed the various streams that came down from the mountains.

We also had many excursions -to the Utah Lake where we frequently had excellent skating, but it was somewhat dangerous and sometimes the ice cracked. Strange to say, no one ever thought of skiing and most of us had never heard of it. However, in the summer time we climbed all over the mountains east of Provo, especially at Easter time. We would go up the mountain to about where the Y is now, and sometimes to the top of the front mountain, that is Maple flat. There we would sit and look at the valley below. The trains crawling along looked like toy trains. Many times I measured the time that the sound traveled from the train to where we were sitting on the mountain. We could plainly see the white steam come from the whistle on the train and then look at our watch to see how many seconds before we could hear the whistle. It was between 10 and 20 seconds depending where the train was in the valley.

In the winter we played nearly all the indoor games, checkers, old maid, crokinoll, tiddle winks, etc.

The boys and father frequently took fishing trips to the various canyons. It was before the automobile, so our transportation was usually with a pair of horses and covered wagon. For trips around Utah Valley we usually walked, to the river, to the lake, and to the mill race through the first ward pasture where the golf course and fairgrounds

Sadie

Father Sadie Mother

Harvey Gene Francis Calvin Milton (front)

Erma Eula

Zoe Eula

are now. I am giving here an account of one such outing, up to the mouth of Weber Canyon.

We had a span of horses named Dick and Doll and a covered wagon. It was loaded with provisions to last ten days, a tent and bedding and of course our fishing gear. This was very simple, usually just plain cane poles to which we had attached leather bands to hold the reel, and homemade wire eyes through which the line was threaded. When we reached the head of the Weber River we found a pasture owned by a rancher which was completely enclosed by a fence. We paid the rancher a small sum to permit us to

leave our horses in his pasture. We made our camp a few steps from the stream. We had a wonderful time, about a week, fishing up and down this stream, when our grub began to get very low so we decided to start the next morning for home.

When went to get our horses we were shocked to find they were gone-where, we did not know. Some of us tried to find a ranch house where we could get food and also find a telephone. We were unsuccessful until we reached a. small village--Wanship--where there was a drugstore and a telephone. We called our mother at home and she told us the horses had gotten home that morning. We will never know how they found their way home. Mother got our cousin Archie Thurman to drive the horses back to our camp. We gave him specific instructions about the way to go. He found us all right, but he had driven the horses so fast that they were not much use after that trip. You can imagine how some of us younger boys felt, not knowing how we would get home and begging at some of the farmers homes for something to eat.

I always thought it was a wonderful thing that the horses found their way home; from the Weber river, over the Kamas bench down the headwaters to Provo River, through Heber Valley, down Provo Canyon, and to their own stalls at our home in Provo. We had made that trip only the one time and they seemed to retain a map in their minds to guide them. We had many such trips with father up Provo River, out to Strawberry Valley, along the Duchesne River, etc. It was during this time that we all went together as a family that I became very fond of fishing. My brother Calvin was even a more rabid fan than I.

These fishing trips were only for the boys, but we took many camping trips for the whole family, mother and father and the nine children. One or two other families would join us and we would have a glorious time together. Occasionally our stay was as long as two weeks. Some of the places where we camped were at Stewart's Flat which is up North Fork of the Provo River. At that time there was no road up this fork of the river so it was a difficult trip. Three spans of horses were attached to each covered wagon to pull it up over the rocks in the creek bed. We would start from Provo at 3 a.m. and arrive at our destination about 4 p.m., then quickly pitch the tents for sleeping and build the tables for eating. Those who have been there know it is still a beautiful spot. We always made a trip to the falls which was near the base of Mount Timpanogos (a tape recording

in our possession gives an account narrated by Sadie and Albert of this trip up the canyon).

Other favorite camping places were at Meachain ranch; up South Fork; another at the intersection of the Provo river and the South Fork stream, sometimes on the north side and sometimes on the south side. These trips were highlights of my boyhood. On nearly all of these trips we were accompanied by the family of my mother's only sister, Alice Miller Thurman. She and my mother were married on the same day. So their children were all about the same age. So we were constantly together as children. I wonder where they all are now.

As children we played the usual games, nuts in May, ring around the roses, drop the handkerchief, post office, etc.

The first school that I attended was the Webster School which stood where the First Ward meeting house now stands. Here is about the only incident that I remember. The teacher's name was Mrs. Anderson. I remember that for some misdeed, I was placed on a high stool which was placed on top of a table and dance cap placed on top of my head. Although I did not know what I had done, I do remember all the stares of the class as I sat fidgeting on that high stool. The thing that made me most angry was the fact that my brother Calvin was permitted to sit comfortably in a chair drawn up to the table where I was perched and was drawing animal pictures instead of getting his lessons. This is about all I remember about the school, although I have pictures in my mind of the interior of the school room. After finishing the fifth grade we had to go to the Parker School which was about 6 blocks north of the Webster School. Here I took the last three grades of the public schools, and received a diploma. I then thought I had finished my education. Vilate Eliott was my teacher in the sixth grade. J. M. Jensen in the seventh grade, and William S. Rawlings in eighth grade. He was the father of Calvin Rawlings, the noted Democratic politician in Utah. My brother Calvin was also in Mr. Rawlings class and was one of his pet students. For this reason he named his son after my brother Calvin. His daughter was Ethel Rawlings Peterson who was a close friend of Lorena and me.

There were only two graduates when I first graduated--Frank Bennett and Harvey Fletcher--at Christmas time 1898. Since I had nothing else to do I took the last half of

the eighth grade over again and graduated with a larger group in the spring of 1899. I remember among this group was Ascha Eggerton Paxman, Mamie Beasley Davis, Fern Smoot Brimhall, and Edna Holdaway.

It was shortly after this graduation that I went to visit Sadie and Albert in the little town of Mammoth which is near Eureka. Veoma was a baby and I remember carrying her around in my arms. Albert had charge of the only store there. The particular thing that stands out in my memory is a very large barrel which was full of hard candy. I know I sampled it very often. This was one of the first, if not the first, trips that I had taken away from home. I had to ride the train so Mammoth seemed a long way from Provo.

After this trip I went to work for my uncle George E. Howe in his grocery store located at 50 South Main Street in Provo. I was the delivery boy. Each morning I hitched the horse to a small wagon and drove it to the back of the store, and then filled it with the groceries which were to be distributed to our customers. When I was not busy on the delivery wagon I waited on customers in the store, or straightened the items to sell on the shelves provided for them.

During that year Albert and Sadie moved back to Provo and opened a grocery store at the corner of Academy Avenue and 3rd South. So I then went to work as a delivery boy for him until school started in the fall of 1900.

On December 31, 1899, I expected great things to happen as the old century went out and the new one came in, so I stayed up all night for the first time in my life. We played games all through the night. When daylight came we realized nothing spectacular had happened; it was just another night.

During the year that I was delivery boy I met a girl named Maud Dunn. She was good looking and had a sweet disposition. She lived down west at about 8th West which seemed like a long way from our house at the time. I rather liked her and she seemed to take a "shine" to me. So we started going together and I saw her at least once each week. I remember we were just 15 years old at this time but I had graduated from the 8th grade and thought I was grown up to maturity. After I had been at her house two or three times I learned that another boy had been going with her before I showed up. I also heard that he was going to do something to me if I did not "lay off," that is, stop coming to see her.

This made me more determined although I confess that I was frightened when I had to walk home Sunday nights after dark from 8th West to 2nd East. One night when coming home the dreaded thing happened. Maud's former boy friend had collected four or five boys and waylaid me. They picked me up bodily and took me to the stream at 5th West and threw me into it. It was a much bigger stream then than now. I lost my hat but reached the bank without too much difficulty and got out O.K., but my new Sunday clothes were dripping wet. I looked around and found the gang had all run away and I never saw any one of them again. I kept going to see her until that fall when I entered BYA. Our little love affair soon cooled off and was forgotten.

After a year's work in the grocery business I had saved enough money to pay my tuition at the BYA. I do not remember what salary I was getting but it was very small. One of the clerks who had worked at Howe's for more than ten years was only getting $40.00 per month. So in the fall of 1900 I decided to enter, not because I wanted further education but because it would be fun to be with my schoolmates again. There was no other school in Provo, giving work above the 8th grade. The state high schools were not then in existence.

I remember walking timidly into the front door of the Academic building on the old campus--the only building then on this block--looking for a place to register. Since I had been in the grocery business I thought I should enter what was called the Commercial department. I found that the tuition for this department was nearly twice that for the Normal department, so after thinking about the small amount of my savings, it did not take me long to decide that the Normal department was best for me.

When I now think on this important time in my life, it frightens me to realize that I almost decided not to go to school any more after the 8th grade. And my motive when I finally did go was anything but high minded. I breezed through the mathematics courses, Algebra, Geometry and Trigonometry in the first two years. It seemed so easy I thought I must have studied them before. But I neglected the other subjects. One of these was Physics. I understood the subject by just sitting in the class and listening to the teacher and plying him with questions, but I did not do any of the assigned work, particularly to keep a laboratory journal. As a result I obtained grade F, a failure in this course. It was the first and only grade failure that I ever received. This jolted my pride

and I think from then on I took my education seriously. I repeated the course the next year, obtained the highest grade in the class, A+, and was given my first paid job in the school, an assistant in the laboratory. During the following three years I taught physics and mathematics courses while carrying the regular college courses. At the end of these three years I graduated with a B.S. degree. The next year I was a full-time teacher at a salary of $750.00 a year.

During the early years of my schooling at BYU we formed social groups and went off together on hikes and on picnics. On one such occasion we camped on North Fork where Wildwood is now located. There were about 10 girls and 10 boys. The girls were camped a short distance from where the boys were camped and we ate our meals together. Here are the names of some of this party: my brother Calvin, Nicolas G. Morgan, Bert Eastman, Gene Roberts, Archie Thurman, May Thurman, Ascha Eggertson, May and Leone Billings and others.

Calvin and I, even at this time, had a good reputation as fishermen. We supplied the camp with fish. Each evening about 4 p.m. we started fishing at North Fork and waded down the river to south fork. He took one side and I took the other. We always used fly hooks and we could throw across the river at any spot likely to have fish and now the story of “The Hero Comes to Camp." Both Calvin and I had caught a creel full of fish. There was no limit in those days. It was getting dark so I called to Calvin and said we better go back to camp. He replied "in a few minutes.” I left the river with the heavy creel of fish over my shoulder and went up a small trail toward the railroad track near the South Fork. Suddenly a coyote at the top of the trail stood upon his hind legs and growled and snarled at me. This was very unusual for these animals usually run when they see a person. So I backed down the trail and put down my creel of fish and the fishing tackle on the ground, looked around to find two good-sized cobble rocks and started back up the short trail. Mr. coyote was still there looking as ferocious as ever so I threw the rock and hit him in the forehead and knocked him unconscious. I rank quickly to him and finished him with my hunting knife.

I called to Calvin and told him I had had a fight with a coyote. He was across the river and some distance away so he did not get a clear notion of what happened, but thought I was hurt. So he rushed back to camp to get help. In the meantime I gathered

my fish and fishing tackle and put the creel over one shoulder and the coyote on the other and started back to camp. When I got about one half of the distance to the camp I met Calvin and several of the boys who were to my rescue. Of course, all of the girls were expectantly waiting to see what had happened. Well, as I walked into camp that night with a creel full of fish on one shoulder and a coyote on the other and flanked upon either side by the boys who were bringing me home, I was indeed a hero--probably a greater one in my own mind than in the mind of any of my fellow campers.

You have probably seen the photograph of Calvin and me with the fish and the coyote. We had the skin tanned and we kept it in our house long after Lorena and I were married.

I dated several different girls which were going to the BYU, none of them for any length of time until I met a girl named Sidonia Olsten from Manti. This was my first year

Harvey Calvin

in college so I was then about 20 years old. We went steady together for a little more than a year and had a lot of fun together. She was a beautiful girl just about 1/2 inch taller than I. She was a good sport and had a jolly disposition, although she was somewhat spoiled as an only child naturally would be. She was admired by other boys, but reasons unknown to me I just could not think of her as the girl I would like to marry. Our ideals were somewhat different. After being together for more than a year I am sure she sensed this feeling on my part and started going out with another fellow. It was sort of a jolt at first but I soon got over it.

For several months I dated several different girls until I met your mother, Lorena Chipman.

The first time I met her I knew who she was and her family in American Fork. Before meeting Lorena I had already met Virgie in one of her classes and I thought she was a very nice girl. My first meeting with Lorena was under the following circumstances. I was at conference in the Provo Tabernacle and became sleepy and started to nod. It so happened that Virgie and Lorena were sitting about two rows back of me, between the north aisle and the wall. Lorena seeing me nodding threw a rose which she had and hit me on the head, I turned quickly around and saw Virgie and also a girl sitting next to her (who turned out to be Lorena) and who was blushing in spite of the fact she was trying to act innocent. So I knew who had thrown the rose. At the time I decided that at the first good opportunity I would try to get a date with her.

The opportunity came on Founder's Day. After the athletic exercises which were held on the hill where the main campus of BYU is now; I hurried down the road (still there now) at the southwest end of the campus and waited there for the students to come down expecting to see Lorena. Sure enough she soon appeared with some other girls. I confronted her and told her I would like to speak to her a moment. The girls took the hint and went on down the hill. I chatted with her for a minute then asked for a date to go to the Founder's Day Ball that evening. She said she did not have a date and would be glad to go. I found out where she was living and we set a date when I should call. It was at the Partridge home on University Avenue.

Imagine my surprise that night when I called I had three dates, Virgie, Lorena, and Fern. At that time in their young lives they looked very much alike. Also that evening

HIGH SCHOOL GRADUATING CLASS
Frances Kirkham; George R. Hill; Orson Kelly (back row)
Mamie Beeslet; Del D. Boyer; G. N. Childs; Loelette Christensen; Harvey Fletcher (middle row)
James Ollerton; Marie Parker; A. M. Cheney; Sytha Brown; Franklin S. Harris (front row)


THREE-YEAR COLLEGE GRADUATES
CLASS OF 1907
Hans C. Peterson
George R. Hill
Harvey Fletcher
Robert H. Sainsbury
Georgia Hoagland
Franklin S. Harris

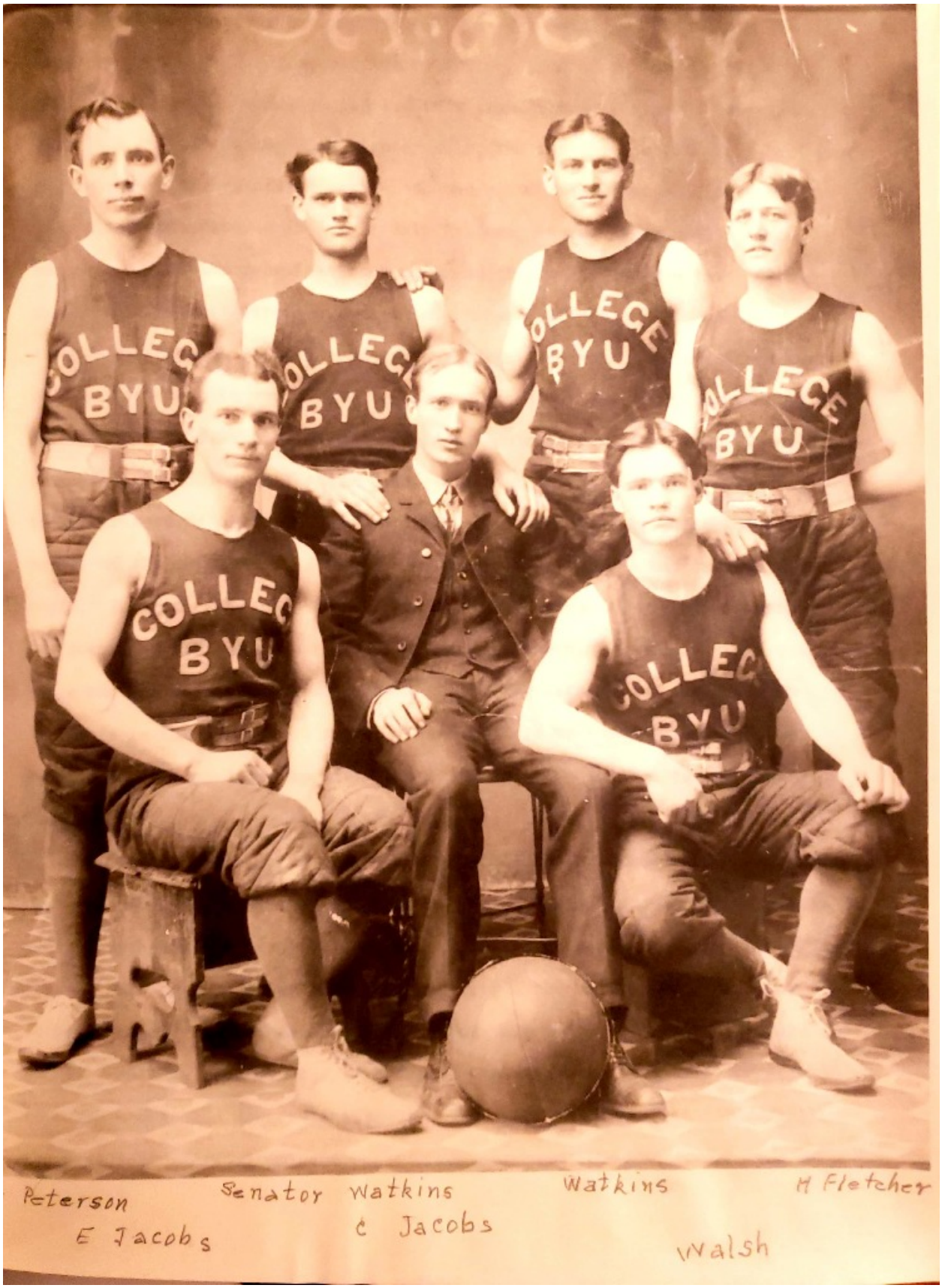
they were dressed alike so I had great difficulty in being sure which one I was dancing with. This was the beginning of our courtship and we were married about a year and one half later on September 9, 1908. She thought she was too young to get married, but I persuaded her that I needed her to go with me to Chicago to get my post graduate schooling.

Coming back to an account of my school days at BYA I wish to add the following. , When I entered I was told that I could graduate in 6 years. There was no division between high school and college, just a six-week course. In my third year at school the courses were divided into high school and college- four years high school and three years college. So at the end of four years I graduated from high school at BYA. The following is a list of the graduates:

A. M. Cheney
Sytha Brown
Marie Parker
Manie Beesley
Del D. Boyer
Frank S. Harris
George R. Hill, Jr.
D. J. Edmunds
Orson N. Kelly
Harvey Fletcher
G. N. Childs
Francis N. Kirkham
JAS. Ollerton
Leolette Christenson
Hyrum S. Vance

The graduate exercises were held in College Hall, May 23, 1904.
The next fall I entered on the three-year college course and as stated before I also was on the faculty teaching part time the subjects of physics and mathematics. At the end of three years I graduated with a B.S. degree. There were six members of that graduating class that year:

George R. Hill
Robert Sainsbury
Frank S. Harris
Hans Peterson
Georgia Hogland
Harvey Fletcher


Peterson
E Jacobs
Senator Watkins
C Jacobs
Watkins
Walsh
H Fletcher

Georgia Hogland was considered sort of a freak as she was the first girl college graduate at B.Y.A. It was generally supposed that girls should not graduate from college.

The two Jacobs boys and I made up the class in drafting in the first year in college. In the spring of 1905 Elmer Jacobs and I decided to put some of our knowledge to work. Provo City was putting in a new water supply from a short distance up Provo Canyon down to the city. They divided the trench to be built into several sections and asked prospective contractors to bid on the work to complete the various sections. Elmer and I thought it would be good practice for us to estimate from our book knowledge how much it would cost to excavate each section. So we sampled the soil and rock in each section and from the dimensions of the trench given by the city engineer, we estimated the cost of excavation. We went by the book to find how many hours work would be required and then knowing the prevailing cost of such labor made an estimate of how much it would cost to excavate each section. We worked very carefully, checked and rechecked our results, and came up with a cost for each section. We felt so sure of our results we thought we could turn them in as bids with ourselves as contractors. But to be sure that we were not to be awarded any of them we doubled all our estimates. We wanted to be sure that no bids would be awarded to us because we were not prepared for such work. We were making the bids as a practice in our civil engineering course.

We were surprised and even shocked when we found one half of the sections were awarded to us. We felt obligated to proceed since our estimates were made on the basis of using men, plows, and scrampers with horses. We had no difficulty recruiting the men and equipment for doing this work. It was really exciting supervising this work. We completed all the sections well under our estimates except one. This section struck part of a ledge that we had not expected. The trench had to go 12 feet deep at that point. We had to hire some men who knew something about blasting. As a result it cost three times as much as our estimate for this section. Overall, we were considerable ahead in finances and way ahead in experience. I learned a real lesson in engineering, namely, when estimating the cost of a job with which you have had little experience, be sure to double your final estimate. You may be interested to know the

wages which we had to pay at that time. A man was paid $1.50 per day (8 hours), a man with team $3.00 per day. We furnished the other tools and implements.

During the second year in college Professor Partridge and three of his students, namely, Elmer Jacobs, Clarene Jacobs and I, climbed the mountain side and staked the outline of the big letter "Y". The method was as follows. The transit was securely placed at the foot of the Y and then after leveling it the telescope was set on the flagpole at the top of the high school building; that is the first building which was built on the lower campus. Then we read the inclination angle, that is, the angle between the horizontal and the line of sight. Then this enabled us to calculate how long the big letter must be compared to its width to make it appear in the right proportions when viewed from the lower campus. To do this the length of the Y was about 330 feet, while the stem was only 50 feet. Originally there were no blocks at the bottom of the stem or at the tops of the prongs. We also staked out a B at the left and a U at the right of the Y. These dimensions seem all out of proportion when you stand up on the mountain near the big letter.

The surveying was done on the day before student body was to carry the lime, sand and rocks to cover the Y. When the officers of the student body arrived very early at the site and saw the shape of the letter as outlined by the stakes they refused to go ahead with the work. They were sure the surveyors had made a mistake. A hurried call was sent for Elmer who was president of the student body that year. He hurried up the mountainside, and did considerable arguing before he convinced the ones in charge that the survey was correct and they should give the signal to start the work, The students stood in a zigzag line about 8 feet apart stretching from the bottom of the hill to the site of the Y. The first man took the bag of lime, sand or rocks and carried it 8 feet and handed it to the second man. The second carried it another 8 feet and handed to the third man and thus the bag went up the hill, each man shuttling back and forth along his 8 foot portion of the trail. All the students started with enthusiasm as they expected to be through by 10 o'clock a.m. But it was a much bigger job than anyone expected. It was 4 p.m. before the Y was covered and then by only a thin layer. So no attempt was made to cover the other two letters. It was very hard work and most of the boys had had no breakfast and no dinner. No one dared to quit as it would break up the line. In

the afternoon it was more than some of them could take and they fainted and had to be helped down the hill. I am sure those who worked in that line that day will never forget it. They were somewhat rewarded when they got back to the campus and looked at the beautiful white Y on the mountainside in just the right proportions. It looked like it was standing in the air just above the ground.

There has been a lot of controversy about who planned and put the Y on the mountain the first time. Well, the four of us mentioned above located the site for it and set the stakes for it as outlined above, but I am sure there were many before us who had suggested such a project.

The area of a B and U on either side of the Y would be 3 to 5 times as great as that for the Y. So the work looked too formidable. It seemed much easier to change the official letter for the school from BYU to Y. This was done the next year, but perhaps there were also other reasons that made it desirable to change.

At the end of that school I accepted an offer to join a surveying party headed by Scott and John Stewart. They had a contract to survey the land around Vernal and along the Green River. The Jacob brothers were included in the party. Also Professor Ward who was then a professor of mathematics and who also taught surveying was included in the party.

We took the train to Price and there met teamsters with two or three wagons and horses and several pack horses also loaded with equipment, water and food. We then started toward Vernal and finally came to our starting place somewhere in the Indian Reservation several miles from Vernal. I will only give a brief outline of the surveying work. The transit man would locate the beginning corner of a section of land. We made a pile of rock or blazed a tree to mark the spot. We then walked 1/2 mile north, being kept on line by the transit man and measuring the distance with a tape. Another corner marking was made to indicate corner of quarter section. Then we would continue another 1/2 mile and put in another marking to indicate it was the corner of a section. Then we turned a right angle and went west 1/2mile and put in a quarter section corner, then another 1/2 mile and put in a section corner and thus we went around a square and marked the corners of each section. If the work had been sufficiently accurate we would land at the starting place within 2 or 3 feet. If we closed within 10 feet it was

considered sufficiently accurate. Thus we worked each day from morning to night. About sundown we started to find camp which was supposed to be moved to a spot somewhere within three miles of the last corner. After the long walk to camp we dumped our bedding on the ground and made a bed, gobbled down the supper the cook had prepared and rolled into bed and slept soundly until the breakfast gong sounded in the morning. On one such morning as I got up, I was startled to find that a rattlesnake was also sleeping a few feet from my bed.

Each of us had a bed fellow. Andrew T. Rasmussen was my bed fellow. He later married Gertrude Brown, the younger sister of Psytha and a friend of Lorena's. Andrew was professor of biology at the Y and later went to the University of Minnesota. He became one of the leading men in the country on neural anatomy.

The above was the routine nearly every day during the summer. We were told we could spend the fourth of July watching the celebration in Vernal. On July 3, I was given a horse and saddle and told to go fix one of the corners which needed to be moved slightly. Then I was given directions to go to Vernal and join the rest of the party. When the mission was finished it was beginning to get dark. There were no roads or trails or other landmarks except the shape of the mountains which were some distance away. As I started for Vernal I was somewhat confused and I was not sure of the direction to go. For a little while I was very frightened. Here I was all alone in this great desert with no roads, no trails, no houses, and no people. These thoughts made me shake with nervous apprehension. "Get hold of yourself, Harvey, you know a little surveying and astronomy; now use it." I knew that Vernal was in a valley due east of the plateau where we were surveying. The sun was just setting and it was only 12 days past the summer solstice so the sun must be about 23° north of true west. The long shadows gave the direction opposite the sun, I estimated the direction 23° south of these shadows and started the horse galloping in that direction. It was further to the rim of the valley than I had expected. So after about an hour I slowed the horse down to a walk. Previously I had located a forsight (a marking) on the mountain ahead which I followed, but it was getting dark and I could no longer see it. But fortunately the brighter stars started to come out so I could get approximately east from them so I went along more confidently and came to the edge of the plateau, and could see the lights down in the

valley at Vernal. It was not long after that I found the road going into Vernal. Needless to say I was very happy when I found the rest of the party down in the center of town.

After our celebration in Vernal we started the subdivision work over near the Green River and worked north along the river. Our surveying line frequently crossed the river or bends in the river. It might be interesting here to say something about the geological structure of mountains through which the Green River runs.

The strata which formed are folded rising and falling like a wave. The top of the wave is called the anticline part of the fold and the bottom the syncline. If the surface of the earth followed parallel to these strata folds, the rain and snow would fall into the anticlines and finally wear a river bottom there. But it is just the opposite. When these folds were twisted into shape, great stress was produced at the surface of the convex side, and the bending broke the large convex folds at the top and produced great large cracks at this position of the fold. The rain filled these cracks and the rivers thus formed work down the sides producing the large chasm which now exists.

Our surveying frequently went across some of these chasm formations and we had to get the distance across by triangulation. Shortly after leaving Vernal the party separated. John Stewart (our party) went on the west of the Green River and Scott took his party over the river and went up the east side. The parties planned to meet on the east side of the river at a point which I think was near the present little town of Manila in Dagget County. At that time there were no houses there and only a few cattlemen in the surrounding hills. This was about a day's journey for our camp to go there from our last surveying point.

Even then I had a good reputation as a fisherman. So they gave me a horse and saddle and told me to catch a basket of trout for the camp and I would be relieved from camp moving duty. On horseback I could move much faster than the camp could move. The boss told me to follow the little stream and then pick up the mule tracks and they would bring me to their camp. Also they would tie the horse along the stream about a mile in the direction they were going. Well, one would not expect many fish to be in this small stream, but there seemed to be a fish in every little hole. I was having so much fun I forgot all about surveying and how I was going to get back to camp. My crude creel was a flour sack tied with a string over my shoulder. It was getting very heavy and

I thought that it was time to go but I said just one more fish. Before I could put my line in the water I heard some Indian war hoots and then pistol shots. I ducked down in the bushes and trees which were along the bank of the stream. I peeked through the branches of the trees and could see three Indians stripped to their waist riding three cayuse ponies. They had war paint stripes across their bodies and it was evident they were on a rampage for some reason. Apparently they did not see me but as they drove by I wondered if they would steal my horse and leave me there all night. I hurried along the stream to find my horse. To my great relief I found him a short distance from where I quit fishing and he was tied behind a group of trees by the stream and was not easily seen from the open plain.

So I was over the first difficulty but there were others ahead. I tied the bag of fish to the saddle horn, mounted into the saddle and rode away and soon found the mule tracks without much difficulty and was on my way, feeling very happy with myself. After about two hours I had lost the fear of meeting Indians but became very lonesome out in that country all alone with just the mule tracks to follow.

The sun was getting low in the west. For a long time the stream was a good guide to follow but suddenly the mule tracks turned away from the stream and started over some small hills. They then led to a small depression where they suddenly seemed to be confused, leading in all directions. I could not pick them up in any direction. Not knowing which way to go I sat in the saddle and watched the sun go down. Again I was a frightened young man being all alone in that wild country and not knowing which way to go. At about dusk I was happy to see a camp fire about 1/2 mile away. I quickly rode over to this place thinking it was our party, but to my disappointment I found it was a sheep herder's camp. I asked him if he had seen a surveying party in this neighborhood during the day and his answer was no. But he said, "If anyone is camped around here, I can see their camp fire from this small hill over here." We both soon went over there and sure enough we could see a fire in a little valley just a short distance from where I had stopped due to the confusion of the mule tracks. I soon reached the camp and was I glad to see them. This was the last time that I was ever separated from the party. I always had at least one member of the party with me. I learned later that the two

Indians were part of a group that had left the Uinta Indian reservation and went north to join the Shoshone Indians in Wyoming.

There is one more experience I had on this trip which is worth relating. When we arrived at the point along the river where we were to cross and meet Scott's party we had a real dramatic experience. We had no boat, no bridge and no ferry. I don't understand why the Stewarts did not know how we were going to cross the river here at the time we separated but I guess they thought they could find some way to cross. It would take four or five days to go down the river to where there was a bridge. Since there were plenty of dry logs around there it was decided to build a raft to carry the precious surveying instruments and the records made during the summer across the river at this point. We cut a number of logs about 10 feet long and lashed them together side by side until enough were used to form a square. A second set of logs similar to the first was made and lashed perpendicular to the first set. When two men stood upon the top set, the lower set still kept the upper set out of the water so we thought it would be safe to carry our equipment and men across.

But how could it be propelled across the stream? Professor Ward and I proposed this scheme. Let two men on opposite corners be provided with crude paddles. They then could keep the logs diagonal across the stream. The water running between the logs would push the raft across. We told the bosses that two of us would make a trial voyage across the river and back to demonstrate that this scheme would work. They consented so the two of us got on the raft, kept it at right angle and made a safe landing on the other side about four river widths down the stream. Scott's party was there to meet us, and a shout of victory went up from parties on both sides of the river as we landed safely.

A rope was tied to the raft and horses pulled it up stream about as far as we landed downstream from the first starting point. We then guided the raft back to the first starting point without difficulty. Everything looked fine for transferring the whole party across the river. As it will be seen later it was not so, and tragedy almost overtook us.

I was asked to be pilot and stand in the middle of the raft. I stationed a man with a paddle on each corner. The bedding, records, and camp equipment were placed in the middle of the raft. Then 5 or 6 men also were in the middle. We tested this load before

letting the boat loose from the shore and the raft seemed to carry it satisfactorily. We started out okay and went about 1/3 of the way across when the raft started to rotate. I yelled at the four men handling the oars at each corner to hold it from rotating but they became confused and the load was so heavy that they could not keep it from rotating. So to the middle of the river we went with the stream. The men who were on the shore where we were supposed to land could see our predicament. One man with a long rope hooked over the saddle horn on his horse rode into the stream intending to reach us, and pull the raft in to shore with the rope. But when he got about 1/3 of the distance to us, down went horse and rider and all, out of sight because the water was too deep. The rider soon came up but the horse floundered a long time and then finally made it back to shore. In the meantime another horse and rider had ridden out at far as he dared and threw a lasso s rope across our raft. Four or five of the men grabbed the rope. The shore end of the rope was quickly tied around a tree. When the moving raft took the slack out of the rope and tightened it, the men which were holding to the rope were jerked off the raft into the water. The rest who could swim jumped into the water. This left only Professor Ward and me on the raft. But the pull of the rope that took the men off also pulled the raft nearer to the short and it struck a rock which stopped its progress downstream. Another man from shore with another rope threw it across our raft and I was able to fasten it to one of the logs. We instructed them to pull us ashore but the boss said, "No." He was afraid it would start downstream again. We were about 25 feet off shore. Some of the boys started walking through the water towards our raft and found the water came only to their shoulders. So all of the things on the raft were held above our heads and carried to shore. In spite of the rough time none of our equipment, our instruments, or our records were lost, and no one was seriously hurt, but nearly everyone had a bad sun burn, as we worked most of the day with bare backs.

This is the story as I remember it but there were probably many other versions of the exciting incident which were sent in letters to sweethearts and parents.

Here is one more story that I want to tell of an incident that happened on this surveying trip. Remember I was then 21 years old. We were running a line north and south on a wide stretch of land covered with sagebrush. We were suddenly surprised to run into a deep canyon with the Green River at its bottom. We were within three or four

hundred yards before we could see it. We then soon reached the edge of the mesa which was also the brink of the chasm and looked down at the river. The river had carved it out during me the past centuries. It made a great horseshoe bend. On the convex side of the river, the cliffs came almost perpendicularly down to the water's edge. I don't know how high the edge of the mesa was from the water but it seemed like at least 1,000 feet. The fast running water was continually carving away at the rocks on the convex side of the stream and leaving a deposit on the concave side. As a consequence the land on this side was sloping gently down to the water's edge, making a small valley in the great bend of the river. As we gazed down at the grand view we were startled to see a small house down in this valley near the water's edge. There was a flower garden around the house. The sloping land back of the house looked like a fine grazing pasture. This was unusual because we had not seen any houses or people for weeks. As we looked down into the valley suddenly a woman came out of the house. Immediately we all started to yell to attract her attention. She immediately saw us and returned our yell. The children came out of the house and called "hello." They were as excited as we were for as we learned later they had not seen anyone except the family for months. The children ran back into the house and brought out a phonograph, an old Edison type with cylinder records and morning glory horn. They played some records. The sound came up to us loud and clear over this long distance. By raising our voices we could talk and be understood. Apparently the section line we were running went through their property. They invited us to come down and cross the river to visit them. They told us how to come down off the high cliff and where we could cross the river. A short distance down the river from where we were there was a trail leading down from the high cliffs to the river's edge, and we could easily ford the river at this point. So we decided to rest in this valley near their home for a couple of days. . We had a jolly good time with the family. They cooked us a good meal and told us some of their experiences living all alone in this beautiful little valley. The wife told us that they raised cattle in this valley and each spring her husband would drive a herd up to Green River City. There he would market the cattle and buy a year's supply of groceries. He then built a raft, loaded it with this supply, and floated back down the river to their home. He was now away on one of these trips. The oldest girl was about

seventeen and had been only once on such a trip. So for a few hours she had seen other adult persons besides her father and mother, but the three younger children had seen only one other adult person outside of their own family. They were certainly isolated from the world, but living comfortably.

During this visit the older girl took a "shine" to me, to my great embarrassment, for she had no restraint in showing me and the rest of the party that she liked me. The other boys, as you can well imagine, were teasing me, so I had to keep dodging to keep out of her way until we left. When we had been gone from this house about one half day out on our surveying line we saw someone on horseback coming over the plain at a very rapid gait. It looked like a girl. She looked around and spotted me on one end of the measuring chain. It was this same girl. She quickly rode over to me and dismounted and presented to me in a very polite way a large bouquet of beautiful wild flowers which she had gathered that morning. You can imagine my embarrassment as all the boys were smiling. But I thanked her kindly. She then got on her horse and rode away. I will never forget this incident for this girl had no inhibitions whatsoever in showing her emotions. She had never been in society and acted more like an animal than a human being. I have often wondered whatever happened to this family. But I never heard of them again. I never saw these cliffs and the little valley again until the fall of 1966. Lorena, Elva, Ray and I took a boat ride down the Green River from the dam near Vernal up to the little town of Manila in Daggett County. I looked carefully to see if I could spot this place and I finally recognized it. The forest ranger guide who was with us said, "Why, that is the famous' Flaming Gorge'."

I went again with this surveying party during the next summer, 1907, just after my graduation at the BYU. We surveyed the land between Green River City and Rock Springs.

During the school year 1907-1908 I was a full-time teacher on the faculty at a salary of $750.00 per year.

During the summer I worked with Clarence Jarvis for Roy Murdock's father. We surveyed the lakes at the head of Provo and Weber Rivers. We measured around the boundary of each lake. From sightlines taken to Reads Peak from the two ends of the lake, we were able to locate the lake properly on a map. We also took enough

soundings in various parts of the lake to enable us to calculate the water capacity of the lake. At that time there were no fish in these lakes but they were full of little salamanders. They lived part of the time in the water and part of the time on land. The fish were planted later. But the mosquitoes were terrible. We could only work by having mosquito netting covered over our head and reaching to the ground. This, then, ended my surveying days.

This is an incident that happened at the BYU when I was teaching a class in physics in the spring of 1906. I was rather young--21 years old--and many of the students were as old, some much older than I. They frequently challenged statements that I would make and I found it difficult to gain their confidence. One day I received a call to come into President's Brimhall's office for a conference. Four of the older students in my class were there as a committee complaining that I was teaching false laws of physics. They repeated a statement that I had made that day in class about action and reaction. I said that when a pair of horses was pulling a wagon down the street, the wagon pulled back with just the same force that the horses pulled forward. They said any simpleton could see that the wagon would not move under those circumstances. Of course, that is a very fundamental law in physics and my statement represented the basic fact in mechanics and dynamics. I argued with President Brimhall and with the students and even with a chemistry professor who was there, but to no avail. I had to leave with Brimhall saying, "Now, Brother Fletcher, you are young and when you have a little more experience you will see the fallacy of this statement."

This taught me a lesson about teaching. You must have prestige as well as learning to be received as a good teacher. After I received my Ph.D. I could teach them anything and they would accept it without question.

Lorena and I were married at the end of that summer on September 9, 1908. Soon after we went to Chicago and I want to say a few words about this, our first trip.

To save a few dollars we decided to go with a group on a group ticket. We neglected to inquire about the accommodations, thinking they would be all right as some very nice people were in the group. When we got on the train at Provo we found we were riding in a chair car and had to sit up all night with the others. It was hot so we opened the window. As you can imagine, the next morning we were covered head to

foot with dirt and soot. We must have been a sorry looking sight for a bridal couple. After breakfast I contacted the conductor and was able to get a lower birth for the remainder of the trip. It might be interesting to note that in this party on the train were Dr. and Mrs. E. G. Peterson, just newly married. They were on their way to Cornell to continue his graduate work. He later became president of Utah State Agricultural College.

We arrived in Chicago and found a small apartment near the University campus which we shared with another couple. We soon found it was miserable to live together with another family, so in two or three months we moved to an apartment where we could live by ourselves.

My first problem was to get admitted and registered in the graduate school. I went to the admission authorities and presented my credits. They glanced at them and said it would take a little time before they could give me a definite answer. They made an appointment four or five days later when I should come back. In the meantime I had become acquainted with Professor Millikan and others of the faculty of the physics and math departments.

When I went back to the admission group I got the sad news that I must do four years of college work at Chicago before I could enter the graduate school. This was a great blow to me. After a sleepless night I decided to talk to Professor Millikan about admissions. At that time he had just been made an assistant professor, and seemed to be a very likeable fellow.

He indicated a way out for me. He said I could enter as a special student and select the courses a first-year graduate student usually takes. If I then passed them successfully, the admissions committee might reconsider my entrance into the graduate school. I told him I was sure I could pass successfully all of the courses he outlined as first-year graduate courses. As a matter of fact, I had already taken similar courses at the BYU to some of these. So through his help I was able to enter as a special student.

I was able to register for these courses. They were not difficult and I passed them all with high grades among the top in the classes. With this record I went back to the admissions committee and they decided to let me enter the graduate school as a candidate for the doctorate with the condition I would make up one year of

undergraduate college work at Chicago, preferably in those lines in which I was deficient such as history, English, foreign languages, sociology, etc. This was a great relief and I started to work on this program. This was fair since I had taken only three years of college work at BYU. At that time this amount of course work was sufficient for a B.S. degree. I was able to make up the additional required college work along with my regular graduate work. I thus spent three full school years and two summers at Chicago and graduated in 1911. I was as well, if not better, prepared in physics and mathematics as any of my classmates who had graduated from the College at Chicago. But I was below them in my knowledge of subjects in the general educational field.

I had to borrow some money to complete my first year of graduate work. After that I was able to get some kind of work in the University which paid enough to defray my school and living expense for the remaining two years. During the second year I was given a job teaching science to high school students in the College of Education. I cooperated with other members of the faculty to map a general science course which would be suitable for boys and girls of that age.

This teaching work was a real experience for me. These young students were very bright for they were children of faculty members and wealthy parents, but I could not get them to study when they were away from class. One day they sent a committee appointed by the class, to discuss the matter of study with me. They said that I had a wrong impression concerning what they were supposed to do. They said none of the teachers required them to do homework. They said they were supposed to get all their learning while in the school building. Anyway, they did very well in their class work without doing any work at home.

Also that year I took charge of lantern projectors for various classes. I received a dollar for each lecture. This also helped out my finances. It was also at the beginning of this second year that I went to Professor Millikan to see if he could suggest a problem upon which I could work for a doctor's thesis in physics. He was a busy man and I had a hard time making an appointment with him. Finally, he told me to come down to one of the research laboratories where he and Professor Beggeman were working and he would talk to me. First he and Professor Beggeman showed me the research work that

they were doing on the electronic charge, and reviewed the work that J. J. Thompson and Regener had been doing along this line in Cambridge, England.

They had arranged a little box having a content of 2 or 3 cubic centimeters which was fastened to the end of a microscope. A tube was attached from an expansion chamber to the little box. By opening suddenly a petcock, a sudden expansion of the air in the little box was made which caused a cloud of water vapor to form. Then viewed through a microscope this cloud was seen to be composed of a large number of tiny water drops. The droplets would soon drop from the top to the bottom of the box under the influence of gravity. A conducting plate was arranged at the top and another one at the bottom of the box so that an electric field could be produced.

When this electric field was turned on it would retard the fall of some droplets. They were trying to make the field just right so that the droplet would be suspended in the air between the plates. From the speed of the droplet, that is the fall speed, and the intensity of the field to stop the droplet, one could calculate the electrical charge on the droplet. This was essentially repeating the experiment that Regener did in England. However, the water forming the droplet evaporated so fast that the little droplet would only stay in view for about 2 seconds. So it was difficult to get more than a rough estimate of the charge.

We discussed ways and means of getting around the difficulty, and I think we all agreed that we should have a droplet that did not evaporate if we could get it small enough and could control it. Mercury, oil, and two or three other substances were suggested. In a discussion of that kind, it is rather difficult to be sure who suggested what. I left with the impression that I had suggested oil for it was easy to get and to handle. However, in Professor Millikan's Memoirs he said he had been thinking this before this conference. Of course, I cannot say yes or no to that but I do know what happened after this conference.

Professor Millikan said to me, "There is your thesis; go try one of these substances which will not evaporate." So out I went to do this and get started on my thesis. To build an apparatus like they were using would take considerable time. So I decided to make a crude setup in the laboratory and try it before designing an elaborate one. So I

went out to the drug store that afternoon and bought an atomizer and some watch oil. Then I came back to the laboratory and set up the following apparatus.

First an arc light with two condensing lenses in front of it was set up. The combination made a bright beam of light. The experience which I had with projection lanterns for lectures made it possible to get this together very quickly. I then used the atomizer and squirted some oil spray so that it fell through the beam of light. The light made these tiny drops of oil look like tiny stars. This indicated this part of the experiment would probably work. I then went down to the student shop and found some brass sheets about one-eighth of an inch thick. From them I cut two circular plates about 20 centimeters in diameter. Then I fastened (soldered) a stem onto each one so that they could be held by an ordinary laboratory stand with clamps. A small hole was then bored in the center of the top plate. These plates were then set up horizontally being about 2 centimeters apart. In this first set up the air between the plates was not enclosed. So I moved the stands holding the two plates over into the beam of light. I then put a large cardboard between the light and the plates and cut a hole just large enough to permit the light to go between the plates without touching them. I then found a cathetometer (an instrument commonly used around a physics laboratory) and placed it so the telescope on it was turned and raised and lowered until its line of sight went between the two plates and at about 120° from the direction of the light beam. The distance from the telescope to the plates was about one meter. I then tried out the apparatus. I turned on the light, then focused the telescope, then sprayed oil over the top of the plate, then came back to look through the telescope. I saw a most beautiful sight. The field was full of little starlets, having all colors of the rainbow. The larger drops soon fell to the bottom but the smaller ones seemed to hang in the air for nearly a minute. They executed the most fascinating dance. I had never seen Brownian movement before here was a spectacular view of them. The tiny droplets were being pushed first that way and then this way by the actual molecules in the air surrounding them. I could hardly wait until I could try an electrical field upon them to see if they were charged. I knew there were two or three banks of small storage cells in the laboratory. A large number of these small storage cells had been connected in series and mounted in storage compartments on a small trunk. Each one of these units would produce

1,000 DC volts at its terminal. So I soon rolled these into place near my crude apparatus. Insulated wires were attached electrically to each of the plates. The other ends of these wires were attached through a switch to the two terminals of the 1,000 D.C. battery. I finished most of this that first afternoon. The next morning I spent some time adjusting it and installing a meter to read the volts applied by the big storage battery. I was then ready to try the battery on these tiny oil drops.

The atomizer was used to spray some of the oil across the top plates. As I looked through the telescope I could see the tiny stream of oil droplets coming through the hole. Again I saw beautiful stars in constant agitation. As soon as I turned on the switch some of them went slowly up and some went faster down. I was about to scream as I knew then some were charged negatively and others positively. By switching the field off and on with the right timing one could keep a selected droplet in the field of view for a long time. I went immediately to find Professor Millikan, but could not find him so I spent the rest of the day playing with these oil droplets and got a fairly reasonable value of e before the day ended. The next day I found him. He was very much surprised to learn that I had a "set up" that was working. He came down to the laboratory and looked through the telescope and saw the same beautiful sight of the starlets jumping around that I had already seen and have described above. He was very much excited, especially after turning on the field. After watching for some time he was sure he could get an accurate value of e by this method. He stopped working with Beggeman and started to work with me. We were together nearly every afternoon for the next two years. He called the mechanic who worked in our physics shop and we outlined a new design for our apparatus and asked him to build it. The principal changes were to make the plates more accurate, and enclose the air between the plates to prevent air drafts. Also we obtained a radium source or X-ray source which we could shoot at the chamber to produce a greater ionization. The actual design is described in the first paper published about this work. I want to say more about this first paper later.

This took about a week after which we started in earnest on this research work which was later to become so famous. After working five or six weeks we had the press come into our laboratory and see and hear our results. We also made a popular

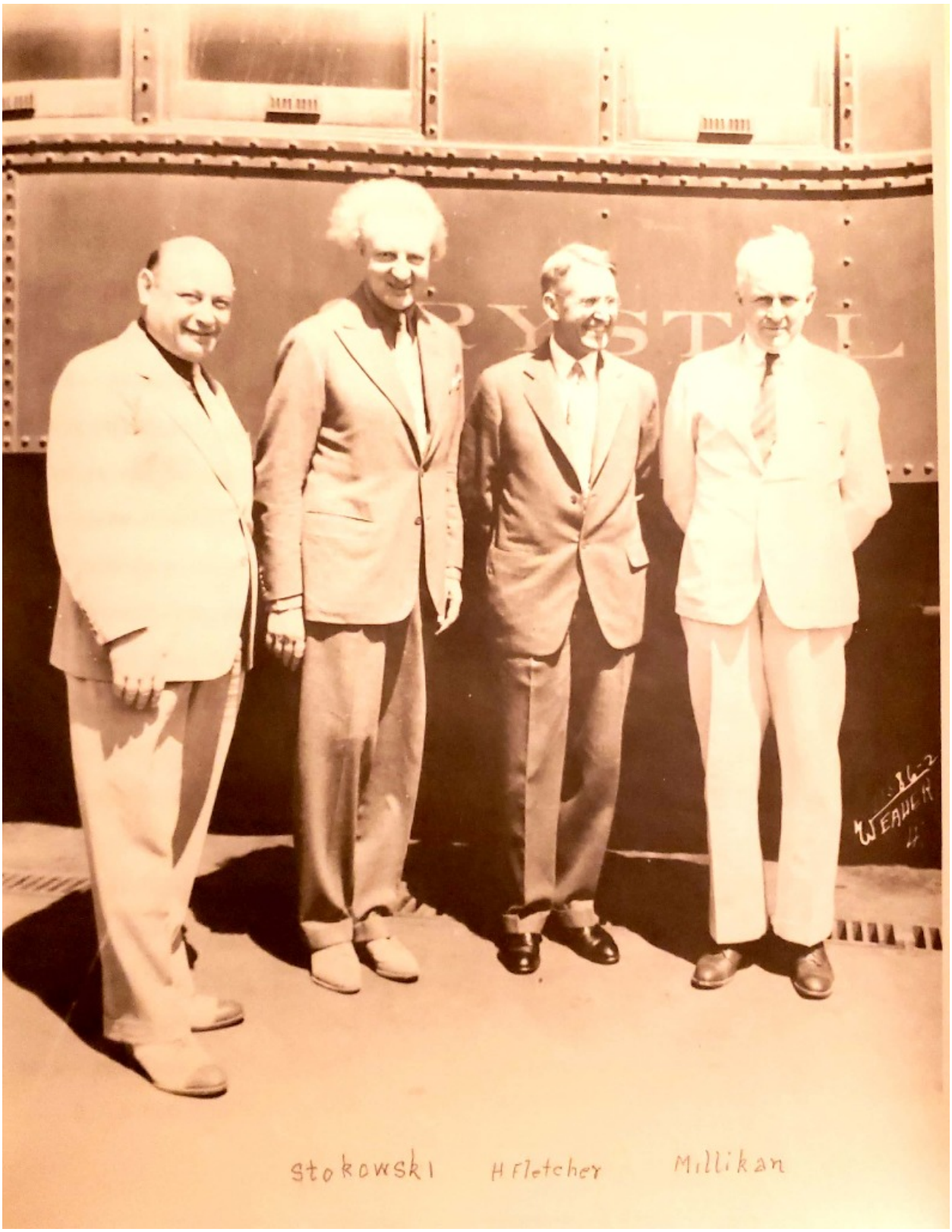
presentation. The papers were then full of this wonderful discovery. It was the first real publicity that I had received. My name ran right s along with Professor Millikan's in the newspaper. I spent considerable time showing these experiments to various VIPs from all over the country.

I remember one of them was the great hunchback from the General Electric Company. He was one who did not believe in electrons. He could explain all the electrical phenomenon in terms of a strain in the "Ether." After watching these little oil droplets most of one afternoon he came and shook my hand and said, shaking his head, "I never would have believed it. I never would have believed it," and then left. Also at this time H. D. Arnold started working on the new things we had uncovered about Stokes law. He was working under Millikan for his Ph.D. He was working on tiny particles falling in various gases and liquids. He carefully measured their diameters and times of fall and formally correlated them to Stokes law. When I turned down the offer to go to Bell Labs, Arnold went in my place. He was thoroughly acquainted with all our work on the "Electron." Within three years after he went there he had invented the vacuum tube. It might have been my invention instead of his if I had accepted the job offered there. But I still have no regrets for coming back to BYU.

This was all great publicity for Professor Millikan. At that time his rank was only assistant professor. He had never published a noteworthy research. But he and Gale--another faculty member--had published an excellent high school physics text. I began to wonder if this work was to be my thesis as Professor Millikan promised at that first conference. We had never spoken about it since that first conference in December 1909. However, during the spring, we started together writing a paper to be published about the new research.

I wrote more of it than he did, particularly about the modification of Stokes law and the arrangements of the data. He went over it all and changed the phrasing somewhat to make it read better. All the time I thought we were to be joint authors. Before going further let me quote some from that paper. It was published in Science, September 10, 1910.

The title and quote of some paragraphs are given here. If you want to read the whole paper, it is available in the library.



Stokowski H. Fletcher Millikan

"The Isolation of an Ion, a Precision measurement of its Charge and the Correction of Stokes Law"

"Mr. Harvey Fletcher and myself', who have worked together on these 35 experiments since, December 1909 have studied in this way between December and May from one to two hundred drops *which* had initial charges from 1 to 150 and made from oil, mercury and glycerin and found in every case the original charge on the drop to be an exact multiple of the smallest Charge which we found that the drop caught from the air."

Throughout the paper such statements as this occur:

"Mr. Fletcher and my own mean times on a given drop generally differ from each other by less than 1/100 second."

Phyllis was born May 21) 1910, and as *you* will see that is about the time we finished this paper. When she was about one month old, I was babysitting with her as Lorena had gone out somewhere with some of her friends there. Answering a knock I went to the door and was surprised to see Professor Millikan. I wondered why he had come to our humble apartment. I soon found it was to decide who was to be the author of the paper referred to above, There were four other papers in the formative stage that were coming out of these oil drop experiments and I expected they would, all be joint papers. He said that if I used a published paper for, my doctor's thesis that I must be its sole author. The five papers on which we did the experimental work together were:

1. The Isolation of an Ion, a Precision Measurement of its Charge and the Correction of Stokes Law. Science, September 30, 1910- Millikan
2. Causes of Apparent Discrepancies and Recent Work on the Elementary Electrical Charge. Phys Zeit, January, 1911- Millikan and Fletcher
3. Some Contributions to the Theory of Brownian Movements, with Experimental Applications. Phys. Zeit., January, 1911- Fletcher
4. The Question of Valency in Gaseous Ionization. Plul Mag., June, 1911- Millikan and Fletcher
5. A Verification of the Theory of Brownian Movements and a Direct Determination of the Value of Ne for Gaseous Ionization. Phys. Rev., August, 1911- and Le Radium, July 1- Fletcher. This was my thesis.

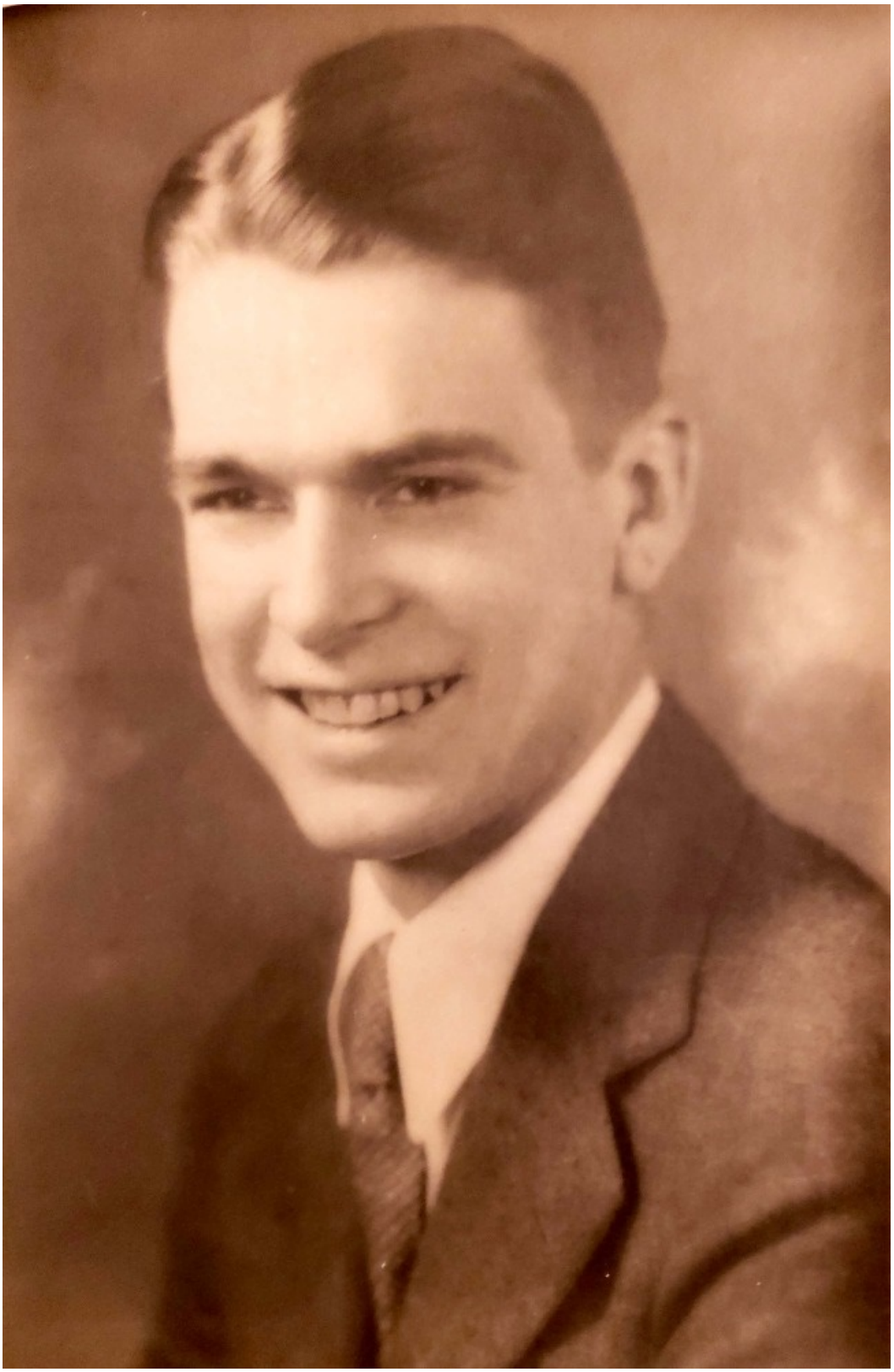
Phyllis

Stephen

Stephen Phyllis

It was obvious that he wanted to be the sole author on the first paper. I did not like this but I could see no other out and I agreed to use the fifth paper listed above as my thesis and would be listed as the sole author on that paper. As you will note from the above, I was sole author on 3 and 5 and joint author with Millikan on 2 and 4. Thus the authorship of these papers was settled in our humble apartment about one month after Phyllis was born. After I left Chicago in 1911, Millikan wrote a number of papers which came from experiments with this apparatus. People have frequently asked me if I had bad feelings toward Millikan for not letting me be a joint author with him on this first paper which really led to his getting the Nobel Prize. My answer has always been no. It

Phyllis 1965



Steve

Charles Wendall

is obvious that I was disappointed on that first paper as I had done considerable work on it, and had expected to be a joint author. But Professor Millikan was very good to me while I was at Chicago. It was through his influence that I got into the graduate school. He also found remunerative jobs for me to defray all my personal and school expenses for the last two years. Above this was the friendship created by working intimately

together for more than two years. This lasted throughout our lifetime. Remember when we worked together he was not the famous Millikan that he later became. When he wrote his memoirs shortly before he died he had probably forgotten some of these early experiences.

I graduated with a Ph.D. in Physics in 1911 with an honor "Summa Cum Laude." This was the first such high honor that was given to a physics student at Chicago. At this graduation I was also elected an honorary member of Phi Beta Kappa. I received very warm praise from my classmates who said that I richly deserved it. You know that students are usually better judges of the ability of their fellow classmates than their teachers. It was from these classmates that the rumors arose that I had been unfairly treated by Professor Millikan, and these rumors persisted at the Ryerson Physical Laboratories for many years after I left there, and some of them were magnified beyond the real truth. This is one of the reasons that I have outlined in some detail my connection and contribution to the famous oil drop experiment.

In the summer of 1911 we came back to Provo and moved into a two-family house owned by Brigham Smoot at 248 North 2nd East. It was here that Stephen was born November 20, 1911. Also Fern lived with us here that year.

The work on the oil drop experiment was continued at the BYU. I had an office and laboratory down in the southeast corner of the basement floor of the Educational Building on the old campus. I found time to build the necessary equipment. It took a little time to build two or three 1000 DC volt batteries. The rest of the equipment was easier to build. This equipment was in the laboratories for 15 or 20 years after I left the BYU in 1916. During the 5 years I was at BYU I managed to publish two papers entitled: "A Determination of Avogadro’s Constant N from Measurements of the Brownian Movements of Small Drops Suspended in Air", Pley. Rev., Nov. 1914; and "Upon the Question of Electric Charges Which are Smaller Than the Electron", PIes. Zeit., Aug. 1915.

After one year at the Smoot House we moved into a house at 168 East 5th North. It was owned by Mrs. Meldrum. We lived in this house and in another house owned by her which was next to the first one at 158 East 5th North during the remaining four years of our stay in Provo. Our third child, Charles Wendall was born there.

At first I was somewhat discouraged at BYU, since nearly all of the subjects that I was asked to teach were high school subjects such as algebra, geometry, and high school physics. I had been teaching college and graduate courses at Chicago. I worked hard to get students interested in more advanced subjects. Before the end of the five year stay, I had some large classes in both college mathematics and college physics and had a well-equipped physics laboratory. Some of the students in these classes made good and are well known:

- Vern O Knudsen, Chancellor of UCLA
- Ray Olpin, President of U of U
- Dilworth Walker, Head of Business College, U of U
- Wayne Hales, Chairman of Physics Department of BYU
- Jos. Nichols, Chairman of Chemistry Department of BYU
- Milton Marshall, Chairman of Physics and Math Department at BYU
- Carl F. Eyring, Dean of College of Arts and Sciences at BYU (Eyring Science Center was named after Carl)

I am giving an incident which happened during this period. As stated above, my laboratory was only one block from where we lived, so Phyllis and Stephen frequently came over in the afternoon to my laboratory. One day Phyllis was running around the laboratory while I was at my desk. Suddenly I heard her scream. I turned quickly and saw that she was holding a 220 volt open switch. She fell to the floor as I ran to her expecting the worst. I picked her up and although her face was white with fright she had apparently suffered no physical damage. She was soon smiling again. But I have often wondered if this heavy shock may have slightly damaged her heart. The doctor first picked up a slight heart murmur when she was about 20 years old. This finally grew into the heart trouble that caused her early death. I have some conscience about the neglect I had for leaving a bare switch carrying 220 volts that was within the reach of a child her age. I assure it was soon fixed after this incident so that it would not happen again. It may be interesting that the student that built this switch board was Paul Ashworth, brother of Claud and father of Dell.

It seems appropriate to outline here my church activities, first in my childhood, second in my teenage period, and in Chicago," and finally in this period at the BYU, 1911-1916. I was active the Primary. My mother would very seldom let me miss

attending it, but I learned to enjoy and looked forward to going with the other children. There are two things that I remember about it. A speaker from BYU spoke to our class one day, Professor N. L. Nelson and the message was "Dream on, oh youth, and thy dreams shall be your prophets." It greatly impressed me and I resolved to try and do something worthwhile in life. The other thing that I remember was a short speech which was delivered from the top pulpit of the Provo tabernacle at a conference when Brother Maeser was present. I do not know now what I said but I am sure it was memorized and composed mostly by my elders. When I finished, Brother Maeser stepped forward and put his hand upon my head, and said in substance, "This boy will go a long way in the Church and among the leaders of men." I think the Primary is the greatest organization in the Church for orienting young men and women toward the right ideal of life. When I turned 12 years of age I was ordained a deacon and later became president of the deacon's quorum. Then I was ordained a teacher and became president of the teacher's quorum. One day at the priesthood meeting the Bishop asked me to speak. I was then about 14 or 15. I responded, but was so frightened that I stood and then leaned first on one foot and then on the other and I could think of nothing to say. But finally I blurted out, "I would rather be good than great," and sat down. The boys laughed but I had given my first impromptu speech. I have thought about this many times and realize now that it was a very good sermon.

I was never ordained a priest but when I was about 21 I was ordained an elder. I was then on the faculty at BYU.

I have frequently been asked why I did not go on a mission. The answer is simple. I was never called. In those days a young man did not go to the Bishop and tell him he wanted to go on a mission. He had to wait until he received an official letter from the Presidency of the Church. However, I learned indirectly that the Bishop sent my name in for consideration for a mission but teachers for mathematics and physics were so scarce at that time that the brethren, after consulting with the President of BYU decided not to call me.

I was never ordained a seventy and remained an elder for a long time. During the 10 years I presided over the New York Branch I was still an elder. It was only when the New York Stake was organized and I was chosen a member of the High Council that I

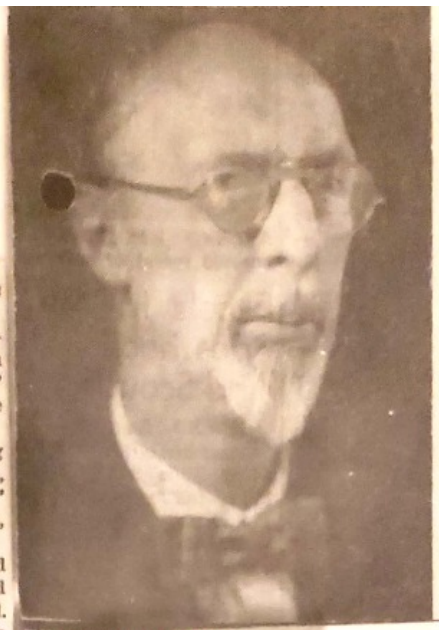
was ordained a High Priest. I attended the M.I.A. and was a member of First Ward Choir.

Both Lorena and I took positions in the Chicago Branch. We traveled one hour on a street car to get to Sunday School and Church on Sunday. At the first fast meeting after my graduation with a Ph.D. at Chicago, I bore my testimony. Brother George Albert Smith was at this meeting and apparently was impressed with what I said as he mentioned it many times in his sermons after that. Ever since that meeting in 1911 he was very friendly with me and called me by my first name.

When we returned from Chicago to Provo, I was called to be a counselor in the Elders' quorum of the Provo Fifth Ward. I worked hard at this job and enjoyed it. We had considerable success in increasing the attendance and the general enthusiasm for the work. Next position in this ward was Y.M.M.I.A. President at the same time Lorena was made President of Y.L. M.I.A. For two years we had wonderful success with this organization. We increased the number in the young men organization from 6 or 10 to 100. The young ladies also increased until we had 100 in each organization. At that time competitions were held in oratory, men and women quartets, etc. We won a number of these events in the finals held at Salt Lake City.

After three years of this ward work I was asked to be Stake Superintendent of the M.I.A. My counselors at that time were Carl F: Eyring and Herald R. Clark. Just recently Herald told me that the BYU had erected three buildings in memory of the former stake presidency of the MIA in Utah Stake; namely the Eyring Science Center, the Herald R. Clark Book Store, and the Harvey Fletcher Engineering Science Laboratories. Of course he was "kidding". But these three buildings do stand next to each other on the BYU, Campus.

Being Stake President was an interesting experience as the stake at that time included Springville, Spanish Fork Canyon, all of Provo and Orem. It was while I was Ward President of M.I.A. that the Scout program was introduced into Utah, just one year after it was introduced into the United States. As Stake President I had general charge over the scout work in Provo. Jennie B. Knight was the President of the Y.L.M.I.A. during the time I was president. The two boards had monthly meetings together.



Pres. George Albert Smith of the Council of the Twelve who delivered baccalaureate address to U.S.A.C. graduates at Logan, Utah.

RELATES EXPERIENCE

I am thinking of your opportunity to divide—to divide with someone else as your instructors have with you. Let me tell of the little incident that I experienced. I had been quite familiar with the life of Michael Pupin, one of the great physicists and one of the most important men in Columbia University. He was a scientist and had established his faith in God. One time when I was in the city of New York I decided I would like to obtain his viewpoint. I told Harvey Fletcher, who was then and is now a physicist in the Bell Telephone laboratories in New York, that I would like to know Dr. Pupin better. He said that he would find somebody who could arrange a meeting. I told him that I was going to Boston for a few days, but if the opportunity presented itself for me to meet Dr. Pupin to let me know and I would return at once. I had been in Boston only two days when I received a telegram to come at once to New York to meet Dr. Pupin. I returned and Harvey Fletcher and myself were invited to Dr. Pupin's apartment to dine with him.

He was a great character. He had received some of his education in Europe and later in America.

One day in his youth his mother called him to her and said: "Michael, I want you to go to school in Prague."

He was a Yugoslavian. He replied:

"I prefer to work with father on the farm. I think he needs me."

She said then with great earnestness: "Son, I don't want you to grow up to be blind as I am."

"But mother," he said, "you're not blind."

She instructed him to bring her a book and looking at it, she said: "What does that say?"

He read it to her and she said, "I cannot see that."

It was then he understood that she meant she was blind because she couldn't read. Michael Pupin went to Prague and later came to America. When he arrived he was just a poor boy with less than a dollar in his pocket. The immigration officials weren't going to let him into the country because he didn't have enough to take care of himself until he could get a job and earn some money. They asked him if he had any relatives in America. He said that he did not. Then they asked him if he didn't have any friends here.

He thought a moment and then replied, "Yes, I have two, Benjamin Franklin and Harriet Beecher Stowe."

Both had been dead several years. The officials were so struck with his statement that they asked him:

"Is that the kind of company you have been keeping over there?"

He said, "Of course. If they were good enough as friends over there they should pass over here." The officials admitted him and as a result he later became a citizen of the United States and one of the world's great scientists.

FAR-REACHING INFLUENCE

As we sat at the dining table enjoying his hospitality, Dr. Pupin talked about his experiences and how Robert A. Millikan became his student. He discovered his genius and was interested in his possibilities. When he finished at Columbia Millikan proposed to secure employment in New York but Dr. Pupin advised him to find someone who would lend him some money to go to Europe and complete his education. Millikan said that he doubted that anybody would lend him any money because he thought he didn't have enough background. Nevertheless, after some persuasion, he went out to try to obtain the money. After a few days he returned empty-handed.

He said, "See, I told you that no one had enough faith in me to lend me any money."

Pupin said, "Well, I have faith in you and I will lend you the money."

Then Dr. Pupin turned to me and said, "See what I gave to the world—it's greatest physicist."

Then Harvey Fletcher said "You may be interested to know that it was Dr. Millikan who gave me my start and opportunity and enabled me to become what I am today."

Dr. Pupin was more than pleased to learn that he had been instrumental not only in giving the world a Millikan but also a Fletcher who has three fine sons following in his footsteps going to school at Harvard and Massachusetts Institute of Technology. This is what I mean by dividing your opportunities with others.

Today I am thankful that I am here with you. You are just starting out to make a record for yourselves and I hope that I may have the pleasure of becoming acquainted with those

I want to relate here a story about one of our faculty meetings during this five-year period at the BYU. The faculty at this time numbered about 40 or 50. We discussed the problems very informally all together in a small room just to the left of the west front entrance as one came into the Education Building on the lower campus. Ten percent was deducted each month from our salary pay check. I felt angry every time I received such a check. This anger carried over to one of our faculty meetings, and so I exploded and told them in no uncertain terms what I thought of such a practice. Under these conditions the tithing was not a donation, it was a tax. In those younger years I could become "fired up" and say things that sounded like scolding. After I sat down everything became very quiet and after a few minutes President Brimhall called for the next item of business without commenting on what I had said. I could see that President Brimhall and Brother Keeler were upset. So I thought I had done wrong, probably approached this the wrong way, and did not feel good about it. However, after the meeting, the other members of the faculty swarmed around me and shook my hand and thanked me for being so brave to speak so plainly about this in faculty meeting. I thought that I might lose my job. I fretted about it all week until next faculty meeting. Then I apologized for my outburst the week before that I had probably approached this problem in the wrong way. Still nothing was said on this subject, but our monthly check thereafter had no deductions.

Also during this period I was very active in athletics. I was chairman of the faculty athletic committee and Gene Roberts was head of the Physical Education and Athletics. The rivalries were just as strong then as now between the three large schools in Utah.

When I left Chicago the University offered me a teaching position on their Physics faculty. Also Dr. Frank B. Jewitt who was head of the Research at Western Electric Company came to Chicago and tried to induce me to join his organization in New York. However, I was on leave from BYU and felt an obligation to return there. But every spring I received a letter from Dr. Jewitt asking me this question, "Which is more important in your mind this year, business or sentiment." After five years of this I finally accepted his offer to have me join his organization in New York City.

When I told President Brimhall of my intentions, he thought I was being disloyal to the church, and asked "Why don't you talk to President Joseph F. Smith and ask his

advice." President Smith was then president of the Church. He was coming to Provo soon to attend a board meeting of the BYU and so I made a date to see him. I explained Dr. Jewitt's proposition and then told him about the Research Department of the Western Electric Company. I said this department did most of the research and engineering for the entire American Tel and Tel Co. So I just felt an urge to try my skill against the intellectual giants in this laboratory. After listening to my story he sat quietly in a thoughtful mood for a few minutes and then said, "Yes I want you to go and take this position, but promise this, that you will keep your testimony strong and keep up your Church activities. If you do so you can do more good for the Church in New York City than you could do here at the BYU at the present time and you will be successful in your work. We need more Mormon boys to go out into the world of business and scientific research to represent our ideal of living.

I greatly admired Apostle John Henry Smith. So I made an appointment to see him in Salt Lake City and told him about my new position in New York and asked him if he would give me a blessing before I left Utah. He gave a beautiful blessing and closed with this quotation, “Seek ye first the Kingdom of God and its righteousness and all these will be added unto you." These two blessings gave me a great sense of security. A number of the faculty told me that I might stay with the Church and live in New York City but certainly all of our children would gradually drift away from it. Well, I am thankful that this did not happen to our family as it has happened to some others. Our children and their families are all respected Latter-day Saints. The biggest factor in bringing this about was Lorena's staunch faith and constant guidance.

Lorena and I discussed our plan together and decided that I should go out alone for the first two months, so I could have time to find a suitable place to live. Before leaving I had arranged for a shipper to come and pack all our things and have them shipped to an address in New York as soon as I found where we were to live. I also persuaded my sister Euler to go to New York with Lorena and the children and stay there nine months with us. Phyllis then was 6, Stephen nearly 5, and Charles Wendall one, a baby.

During the summer I lived with Gene Roberts in a small apartment uptown in Manhattan. I visited all the suburbs around New York before deciding on a place to live. I finally found a very nice house and lot at 51 Cedar Street, Wyoming, New Jersey.

Wyoming is part of Milburn. At the end of the summer the family came out on the train and I was certainly glad to see them. I remember Stephen shouting as he stepped off the train, "Is this New Ark?" Lorena was delighted with the house and surroundings. It was quite a change from Meldrum house to 51 Cedar St., Wyoming, New Jersey, but we found some fine neighbors there, particularly the Wrights and Idlers (I wonder where they are now). The nearest BYU meetinghouse was in a Mason's Lodge Hall on l25th St. in New York City.

It was while (1916) we were living here that the U.S.A. declared war on Germany. The First World War started in 1914 while we were still in Utah. We first heard the news while I was on a fishing trip to Strawberry Valley. At that time we did not think Woodrow Wilson would permit this country to get into Europe's wars.

I commuted from 51 Cedar St. to 463 West St. for the next three years. The Lackavvana station was about 1/2 mile from the house. The train went to Hoboken. Then a ferry ride took me to a short distance from 463 West St. where my office was located. It was on the tenth floor and my west window faced the Hudson River. Across on the other side the big German steamship "The Deutschland" was anchored in the Hoboken docks. Since the U.S.A. was not at first in the war, this famous steamship stayed there during the first two years of the war.

Soon after I came to the laboratories it was rumored that the U.S.A. would soon enter the war, even the date was set. The day before this date three U.S. battleships formed a semicircle in front of the Deutschland. So the next morning we were all watching out our windows to see what would happen. Nothing happened that we could see. We learned later that the U.S. Navy had taken charge of the ship and the men on board were taken prisoners. However, they had spiked their guns and machinery so that it cost about one million dollars to get the ship going again. It was used then as a troop ship and was called the Leviathon.

During the first four years that I was at the laboratories the record indicates that I had no published papers. Two of those years I was busy on war work. It was during this time that my mother died, on February 15, 1918. I did not know she was ill and I was holding a conference in my office when my secretary brought the telegram announcing her death. It was a terrible shock as I loved my mother dearly. My brothers and sisters

always teased me by saying I was mother's pet. After talking to Lorena we decided to take the children and go to Utah for the funeral. She was only 61 when she died. She was Relief Society president and sat up all night with a sister who was very ill with pneumonia; she contracted the disease and died within a week. After about a week's visit, Lorena decided that she wanted to stay longer with her parents. So she and the three children stayed with Sister Chipman in American Fork, while I returned to New Jersey.

It was during this month that Phyllis and Stephen had an accident. The Interurban Railroad had a side track near the Chipman home, and a freight car was parked on it. Phyllis and Stephen were climbing up on it when Phyllis fell to the ground. Something struck her nose and nearly pulled it off. She was rushed to the hospital and it was sewed on again and it healed with hardly a scar. As far as the doctors could tell there were no other injuries at that time.

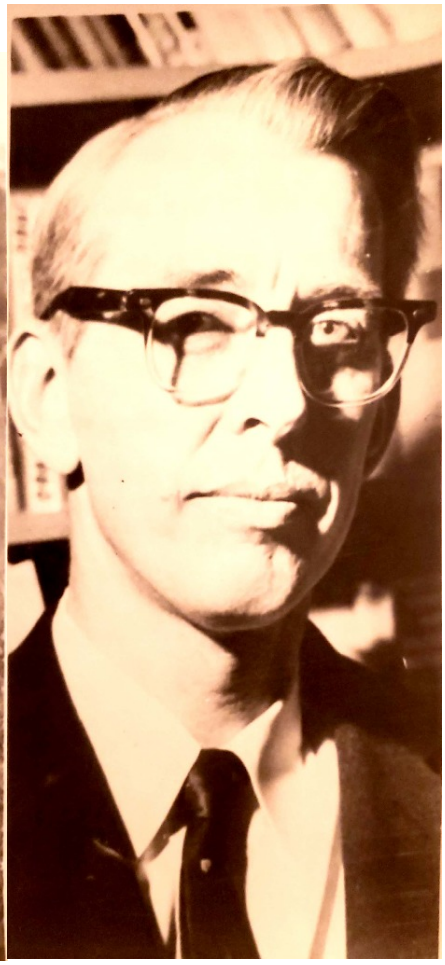
Soon after this Charles Wendall became ill with some kind of digestive upset called acidosis. After nursing him for about two weeks, he caught chicken pox from the older children, and in his condition it turned out to be a serious case. He was unable to throw it off and died April 13, 1918. He was nearly three years old then. Sister Chipman offered to accompany Lorena, Phyllis and Stephen back to New York and stay a while in New Jersey so I did not go to the funeral since I had just returned from Utah. Ofttimes when I think of this I have a somewhat guilty conscience for not dropping everything and going to Lorena's side at this time of sorrow.

Things began to go back to normal as we became settled again at 51 Cedar Street. The spring weather was making the landscape a beautiful garden. It was hard to forget these two great sorrows in our young lives. But about one year later June 5, 1919 a new baby arrived, James Chipman Fletcher, and then our sorrow was soon forgotten and the love we had for Charley was soon turned to Jim. He was such a beautiful child with golden hair.

When the armistice was declared in 1918 there was a great celebration in New York, Lorena, Phyllis and I went into the city and walked down Broadway with the rest of the great throng of people shouting and singing with the jubilant crowd. The four of us

held our hands tightly together as we marched along. "We had made the world safe for Democracy".

Soon after the war there was a mad scramble for places to live. Soldiers and young married couples who had waited during the war were all looking for homes. My landlord told me that I must buy the property where we were living or else move out so they could sell it. The price that they were asking seemed very high so we decided to move. As I now look back on this, I realize that it was a mistake economically speaking. However, we also wanted to get nearer the Church meeting place which was 125th Street Manhattan. I looked around at all the suburbs of New York, New Jersey, West Chester, Long Island, and Brooklyn and could not find a house of any kind to rent. On three or four occasions I answered ads in the paper. In all these cases I arrived at the place less than an hour after some other party had rented it. I was becoming desperate and just about decided to go back to Utah. I finally heard of a 5 room apartment at about 150th Street in uptown Manhattan, near the Polo Grounds. Three or four other L.D.S. families were living in that neighborhood. I found the owner and the apartment had not been rented. So, I told him I would take it without seeing it and put down a: deposit to hold it. When I got to see it I found the bedrooms very tiny, hardly large enough to hold a bed with no other furniture. We decided that it was the best we could do since we were forced to move; so we stored about one half of our furniture in the basement of the apartment building and used the rest in this small apartment. I kept looking for better apartments until finally about nine months later, I found one at 181st and Riverside Drive. It was a nice apartment and had plenty of room but also much more expensive. By this time I had become conditioned to the much higher costs of rent for houses and apartments. We could see the Hudson River from our front window and watched the boats going up and down there. All in all it was a nice place to live and there were good schools there and good neighbors. Three or four LDS family lived in that neighborhood, the Strobels, the Midgleys, the Richard Follands, the Olpins, the Dave Howells and others. We lived here five years. It was here that Bob was born May 27, 1921. It was in the middle of the night and I almost had to act as midwife as the doctor had gone down to the street to pick up the nurse who was coming in a taxi.



Jim

Harvey was also born while we lived on 181st Street. But he was born in Dr. Browning's' private hospital on April 9, 1923. In the summer of 1925 we bought a house on 122 Street in Broadway, Flushing Long Island and lived there for 17 years. Our children will probably remember this as the place where they spent most of their childhood. In the summertime they went from here to the various summer camps in New York, New Hampshire, Maine, and Connecticut, etc. All of our children except Paul graduated from high school while living here. Also Phyllis and Stephen were married while we lived here.

We then moved to Summit, New Jersey at 5 Westminster Road. This was shortly after the U.S.A. entered the Second World War. We lived here for the next 10 years. Lorena loved this place and said many times it was her dream home. Unfortunately none of the children except Paul lived here with us except for short visits. The older grandchildren will remember it as they all came together here many times and especially at Christmas. It was here that Paul graduated from high School. It was a private school, Pingree Preparatory School in Elizabeth, New Jersey. From Summit we moved back to Provo at 1615 N. Willow Lane.

We go back now in our story to the beginning of my scientific work at the Bell Telephone Laboratories. The first year I worked away from the laboratories in various parts of the Bell system to become familiar with the operation of the telephone. I helped install telephones at residences in various parts of New York City. I then worked in a central office and learned how to make connections at the switch board as a "Hello Girl." Before doing this I went to a school for training telephone operators. The main thing that I remember from this experience is that my ear became very sore for leaving the telephone earpiece clamped to my ear so tightly for such long periods. After this I worked as a repair man stretching and soldering wires and adjusting relays until I was familiar with all the working of a telephone central office. I then spent two or three months in the Long Distance Office in New York City. All of the long distance calls coming into and going out of New York City were routed through this building. All this was a good experience. But after a year I was very glad to get back to a permanent office at 463 West Street. But things there were very unstable as described above the U.S.A. Soon joined the world war and I was left to find my own jobs, as my supervisors

Bob

Harve

Paul


Standard Flashlight Co. ⟨
1595 BROADWAY NEW YORK

were away most of the time consulting on war work. I did some war work. I devised a capillary microphone to work under water. It consisted simply of a glass tube which was drawn out into a capillary at one end. The tube was filled with mercury and held in a vertical position. The capillary was so small the mercury would not run out but formed a convex meniscus. An insulated pair of wires with bare ends was connected to the device. One end was immersed in the mercury and the other end in the water outside of the tube. The other end of the pair was connected to electronic devices so that a DC current was sent through the mercury when the device was immersed in salt water. Any sound in the water disturbed the mercury-water meniscus such as to modulate the DC current which was amplified by an amplifier. I have given this much detail as I don't know where there is any record of it.

There were other under water microphones which were more rugged that were being developed so I stopped work on this and spent the rest of the time until this war was over outlining the research work that we should be doing on speech and hearing processes and their reaction on the design of the telephone system. I.B. Crandall was the principal cooperator in this work. I was in the group headed by R. L. Jones and Crandall was in the group headed by H. D. Arnold. W. H. Martin of Research and Development department of the A. T. & T. Company also was head of a group that was working on this. We had many conferences and finally came up with an outline that I followed most of the time I was at the laboratory. It was this extensive planning at this time that led me into the acoustic field.

Also during the first four years at the laboratories there is no record of publications by me. My first publication there was in 1920. It was "On the Relative Difficulty of Interpreting the English Speech Sounds", published in the Physical Review.

This reminds me that I had been elected a member of the American Physical Society before I left Chicago in 1910. This was only 11 years after the founding of the society. So when I came to New York I could easily attend the meetings of the society and frequently took advantage of this opportunity. You may be interested to know that the entire membership at that time could be accommodated in one of the large classrooms at the Physics Department of Columbia University. It was a rather intimate affair listen-old timers discuss papers. Dean Pegram was among those early pioneers.

The research in acoustics in the past had been energy involved in the transmission of sound was so small there were no instruments with which accurate measurements could be made. As outlined above, the vacuum tube had just been invented and developed just before U.S.A. entered the war. So when I came to the laboratories, oscillators and amplifiers were just being developed. These tools made a great Renaissance in acoustics possible. So in the beginning at the laboratories we had had a great advantage over the other scientists who were interested in this field. This is the main reason why the Bell Labs became the leaders in this field. Of course there were some excellent scientists there also.

During the period from 1920 to 1930 I published 22 papers. A list of my publications is given at the end of this history in appendix D. From 1930 to 1940, there were II papers, from 1950 to 1960, there were 5 papers and from 1960 to present there have been 4 papers. Also two books on speech and hearing have been published.

Also, a list of gold medals and honors are given at the end of this history. (Appendix B) The first honor besides those given when I graduated with a Ph.D. was in 1922, a gold medal awarded by the Franklin Institute. It was for the paper, "The Nature of Speech and Its Interpretation." You can see from the list we started work on audiometers and worked on various phases of it 1926. I think the 2A audiometer and the phonograph audiometer were put into manufacture soon after this last date. During this period I had some interesting experiences with hard of hearing people. They were usually sent to me by some of the executives of the A.T. & T. Company or of Bell Labs. I wish to relate some of them here.

The very wealthy Duponts had a history of deafness in their family. One of them Alfred Dupont, was a friend of Mr. Gifford, president of A.T. & T. Company. Mr. Gifford asked me if we could help his hearing. So I made an appointment to see him. By this time we had oscillators, amplifiers and attenuators, so we could produce a known frequency and intensity of a tone. In other words we had the essential elements of what later was used as an audiometer.

When Mr. Dupont came to my office I asked him about his hearing and he said his ability to hear fluctuated. It was better after a treatment from a doctor he had been going to frequently. But as soon as he got home it returned to the same old level. I then asked

him to tell me what the treatment was. The treatment was an X-ray beam directed at his ear. I became very skeptical and asked him if I might accompany him for one of these treatments and he consented. Before leaving the laboratory we made a careful audiogram of his hearing with our embryo audiometer. The doctor's office was in a fashionable part of Manhattan. We took an elevator to the 5th floor. The elevator opened into a large room which was filled with all kinds of electrical gadgets. Large Whimhurst and static machines with large brass balls across which large sparks would fly; X-ray machines; Geissler tubes; etc. The doctor said he would test Mr. Dupont's hearing before the treatment and then after the treatment.

The following was the method used in the test. There was a path along the floor marked off in feet. It was about 20 feet long. Mr. Dupont was asked to stand at one end of this. The doctor stood at the other end and said in a very weak voice, "Can you hear now?" Mr. Dupont shook his head. He kept coming closer and asking the same question in the same weak voice until he came to about two feet from his ear, where he said he could hear. His hearing level was found to be two feet. Mr. Dupont then was asked to stand four or five feet in front of an X-ray tube with his ear facing the tube. The X-ray was turned on two or three times. He then turned his other ear toward the tube and had a similar treatment. He then stood in the 20 foot path and another hearing test was made. But this time as he started to walk toward Mr. Dupont he shouted in a very loud voice. "Do you hear me now?" As the doctor reached the 10 or 15 foot mark, Mr. Dupont's eyes twinkled and he said he could hear.

I could hardly keep from laughing because what happened was so apparent. The intensity of the loud voice from 15 feet was just the same as the weak voice at 2 feet. The doctor must have been aware of this but the patient wasn't. Mr. Dupont was quite elated until we got back to the laboratories to make another audiogram and it turned out to be exactly the same as the one made before he had the treatment. I explained to Mr. Dupont what had happened. This was tried again in about a week with the same result. After that Mr. Dupont never paid a visit to this doctor.

It was evident that this doctor made a large amount of money from each hard of hearing patient.

I wish to insert here the story of Mr. Carlton who was the President of Western Union Telegraph Company. He came into my office one day and said that he was getting deaf, hard for him to hear, and he wanted me to tell him what to do to get well. Of course I told him that I didn't know what was wrong with his hearing but I'd make some tests to find out. I made a test with the audiometer and discovered deafness was almost entirely nerve deafness, he was just getting old. And consequently I told him that as far as I knew, there was nothing we could do to help his hearing and it would be even difficult to make a hearing aid which would help him. He said, "Oh bosh, there must be some medical man that can help me." I said, "Well it's my opinion that you'd probably waste your time going around to the various doctors with the Expectation that they would produce a cure." Well he stomped out of my office and that was the end of that interview. It was a little over a year later he came stomping into my office again. He said, "Well, I've been all over the world and I've found you're right." He said, "I've been to every damn doctor in the U.S. and Europe that has any reputation for knowing something about the ears and none of them know anything." Then he said, "I guess I'll have to live with it as you told me in the first place." Well that was a rather interesting episode, and a very interesting man to meet.

After these experiences I decided we should develop and manufacture an audiometer which the doctors could use in their offices. Also, soon after Mr. Gifford asked if we would make an amplifier set to aid Mr. Dupont's hearing, particularly for his office. I had another talk with Mr. Dupont, and he was particularly anxious to hear the speakers around a special table at his board meetings. I had an ordinary telephone microphone and receiver connected through an amplifier set in my office, I talked to him through this set using first one ear and then the other and he could hear almost perfectly. I then told him we could make a set with which he could hear, but it would be large and very expensive. He said not to worry about expense. So we made him a binaural set, that is, using two complete systems such as the one experimental set we had tried. The two microphones were placed in the middle of the board room desk and the telephone receivers in a headband for Mr. Dupont to wear. The amplifiers, transformers, condensers were large so it took a cabinet almost as big as a desk to house them. It was made to fit under the board room table. It turned out to be very

useful and he used it for many years. The binaural system enabled him to sense the direction of the speaker and as well as understand him. I think that the bill for this work was about $5,000. This was the first hearing aid using vacuum tubes that was made by us and I believe by anybody.

This experience led us to the business of manufacturing hearing aids by the Western Electric Company.

Now just a few more words about audiometers. I have frequently been called the inventor of the audiometer. This is not strictly true. I think it is fair to say that I was most responsible for getting an audiometer made and into the hands of the otologist for use. Here is the history of audiometry.

You will notice from the list of published papers that Wegel and I published one in 1921 entitled, "The Frequency Sensitivity of Normal Ears", Proc. Nat. Acad., Nov. 1922.

This paper showed that the sensitivity of persons who were supposed to have normal hearing varied greatly with different frequencies and with different people. At about this same time Dr. Seashore, Dean of the Graduate School at Iowa State University was working with a device he called an audiometer. A small device like an electrical buzzer, when connected to a telephone receiver would emit a buzzing sound. A series of resistance boxes were connected between the electrical buzzer and the telephone receiver. By putting in the proper resistance the sound could be reduced below the threshold of hearing. A device similar to that had been used in the Bell System for years. It was not used to measure hearing but for measuring the magnitude of live noise on any telephone connection.

Somewhat later Dean and Bunch at Iowa State used an electrical oscillator and amplifier similar to our set up described above. It was used in the medical school to determine the hearing loss of Hard of Hearing patients. Also about the same time that we presented our first audiometer to the otological professions Dr. Vern 0. Knudsen in California working with Dr. Jones, an otologist built an audiometer similar to ours and Dr. Jones used it in clinical work and Vern used it in research at UCLA

The first audiometer called the IA was built at the Bell Telephone Laboratories and was designed by R. L. Wegel, a head of one of the departments in my group, and Dr. E. P. Fowler, a prominent otologist in New York City. It was built in the labs under Wegel's

supervision. Wegel and Fowler then gave a paper before the Otological Society and the instrument was demonstrated there in 1922.

It was considered too complicated for ordinary use in a doctor's office but five were made and given free to the following persons. E. P. Fowler. (He told me that he was still using it about two years ago, 1965, but he died about a year ago, 1967); Central School for the Deaf, at St. Louis, John Hopkins University at Baltimore, Harvard University and I think Princeton University. This was done because these were essentially research instruments and we were sure a lot of new facts about hearing which would be valuable to the Bell System would come from their use at these institutions.

I sketched out a simpler design and worked with our apparatus design group to get an audiometer that would be very reliable and much cheaper than the lA. It was called the 2A. Since I had sketched out the original block diagram the patent was issued in my name (See APPENDIX E, Case 7, 8, and 9.)

A third audiometer called the 3A was an adapted noise meter, the one used in measuring live noise. It was similar to the Seashore audiometer but would measure a very much larger range. It was not used very much. The last one that was developed and sold was a phonograph audiometer called the 4A. These were used extensively in schools as evidence of this. See the paper listed in 1926, "Three Million Deafened School Children." The four types of audiometers are described in my book, "Speech and Hearing."

It is interesting to note here that just last month (October 1967) I received a report discussing what should be the zeros at each frequency on the audiometers. This is 43 years after we set the zeros on the 2A audiometer. We set the zeros in a very simple way. It took only about one week. We had Dr. Fowler examine about 20 of our employees to see if he could detect any which he thought had abnormal hearing. They were then tested with one of our 2A instruments and the threshold for each frequency read on the average of these twenty was taken as the zero. The voltage created across the telephone headpiece was measured for each setting. Then if the telephone headpieces were alike the zero setting would give the same sound in all audiometers. Three of these receivers were given to the Bureau of Standards, which were carefully used for calibrating all new audiometers. The audiogram chart for plotting the hearing

loss was also invented at this time. The curve is called an audiogram. It has been used ever since then with only minor variations.

This work on audiometry brought me into close contact with the otologists and the leaders of the various organizations for the Deaf and the Hard of Hearing. Due to this I was made an honorary member of the Otological Society and I still get all the printed proceedings of the society.

Some of the principle friends among the otologist were Dr. E. P. Fowler of New York; Dr. Goldstein of St. Louis, Dr. Newhart of Minneapolis, Dr. Hallowell Davis of Harvard and later of St. Louis. There were many others. Most of the above were not only interested in treating patients, but were interested in the social welfare of Hard of Hearing patients and took part both in their local and national organizations. And thus I became acquainted with the local and national societies for the Hard of Hearing such as the New York League for the Hard of Hearing and American Federation of Organizations for the Hard of Hearing.

After attending one of their national meetings I could see that it would be a great help if they had available a group hearing aid so that they could hear the speaker. So I persuaded the Bell Labs to make such a set. It could be made from parts available in the Labs. Telephone head pieces, jacks, attenuates, and amplifiers. As I remember it small strips were made with five or six jacks and attenuators wired in parallel. Any number of these strips could be connected together by simply plugging connecting cords into the end jacks. There were about 20 of these strips so that about 100 headpieces could be connected in parallel to the transformer coming out of the amplifier. These were arranged according to the seating in the hall. As the hard of hearing person sat down he could reach for a head set and then turn the attenuator until he: obtained the loudness with which he could best understand. The first installation was at Hotel Astor at the annual convention. When everybody became quiet for the beginning of the meeting, they asked me to talk and explain how to use these sets. Some of the people could hear and helped the others to adjust the headbands. When they all had finished fussing with the head band I started to talk slowly and in a normal volume and greeted them and told them to adjust the attenuator if they needed more volume. Most did not but sat with tears running down their cheeks crying, "I can hear, I

can hear." It was the first time most of them had ever heard a public speech. After they had quieted down I turned the microphone over to the president and he carried on the conference. It was a memorable occasion and these hard of hearing persons never forgot it. The Bell Labs donated the system to the national organization and it was used for many years after that time. The officers of the Federation took their group hearing all over the USA for meetings in various localities.

After this emotional experience I felt that I should help these people more if possible. They urged me to be a candidate for the President of the National Organization. So in 1929, I was elected President of this organization and I want to tell you a few experiences in that capacity.

The first national meeting after I became president was held in Cleveland, Ohio in 1929. Lorena went with me on this trip. Officers of the local organizations from all over the country attended this convention. It lasted three or four days. I spent most of the first day getting acquainted. Mrs. Garfield was president of the Cleveland League for the Hard of Hearing. She was the wife of James A. Garfield a prominent leader there. He was the son of James A. Garfield, President of the USA. The son was Secretary of the Interior in the Theodore Roosevelt cabinet. He said he was well acquainted with Senator Reed Smoot who was in the senate at the same time.

I was supposed to make a presidential address to this Hard of Hearing group. The group hearing aid was installed so most of them could hear the speaker. For this reason I gave considerable thought to the preparation of this talk. I thought they needed encouragement to face life bravely and remember they were not handicapped in doing the good things in life that bring joy and peace of mind to them. It was essentially a religious talk and I had borrowed much from my Mormon background. It was entitled "What Can I Do". If any of you are interested in getting this particular talk it was published by the Volla Bureau in Washington that year 1929. A brief summary follows:

I asked the question what it was that gave them joy and happiness in the world. They were just as anxious for getting joy and happiness as persons with normal hearing. I started to review the things that gave people sorrow in life. I quoted the passage "The wages of sin is death” I pointed out that there were few good things in life that normal hearing persons enjoy that cannot be enjoyed equally well or better by hard

of hearing persons. They must be reconciled to the handicap of not hearing that is no handicap for enjoying the better things in life. I related an experience that I had had that day. A hard of hearing young man came up and spoke to me. He said he had been helped by the local organization to lip read and to go to college where he had graduated. So now he no longer needed to be a member of the organization. I looked him straight into the eye and said, "You should not consider how much you can get out of the organization but what can you put into it. This was the theme of my talk, “What can I do.”

The talk seemed to be well received and as soon as I had finished a large number rushed forward to congratulate me and left a check saying this is what I can do. There was more than $2,000 donated after that talk. This was a great surprise to me for I had said nothing about money or donations. But since the talk was religious in nature and they had been in the habit of donating after such sermons in church it probably seemed to them like the right thing to do. The money was welcome as money is the most difficult thing to get for running such an organization as this.

While we were in Cleveland there were two other interesting experiences which I will now relate.

I was invited to visit Dr.Crile's Clinic. It had made an excellent reputation as a place to treat difficult medical cases, but Dr. Crile wanted to show me some research experiments which he was making and of course I was very glad to accept the invitation. He said the only difference between life and death is an electrical charge and he wanted to demonstrate to me that this is true.

A microscope was arranged so that we could see a tiny one celled animal called an amoeba wiggling around on a microscope slide. A small needle was inserted in the nucleus of this one-celled animal and it was electrically connected to a sensitive galvanometer. A ground wire was connected to the outside of the amoeba. "You see the galvanometer is deflected showing there is an electrical potential difference between the outside, and the nucleus of the amoeba. The wiggling of the animal shows us he is alive." He then put a drop of chloroform on the amoeba. It gradually stopped moving and the galvanometer gradually went back to zero. "You see it is now dead and there is no potential difference. So you see the only difference between life and death is a

potential difference." I said, "Let us now use a small battery and put the potential difference back on and bring the animal back to life." "Oh, no," said he, "It is dead and nothing you do will bring it back to life."

To emphasize this he took another live amoeba and put it on the microscope slide and put the electrode needle into the nucleus. The potential difference was indicated by the galvanometer. Looking into the microscope showed it was moving and alive. He then put on a potential difference equal to one showing on the galvanometer but opposite in polarity. The movements of the amoeba stopped. It had been electrocuted and was dead and nothing could bring it back to life. So I said if you cannot bring it back to life by reversing the process there must be something more than a potential difference between a live amoeba and a dead one. This was an unusual experience and I have used it in some of the talks which I have given.

The other experience in Cleveland at that time was a dinner party given by Mrs. Garfield. She lived in a suburb some distance from Cleveland. She told me her home was the one that her husband's father (President Garfield) lived in and the land around it was homesteaded by her husband's grandfather. So that three generations of Garfields had lived there.

When Mr. Garfield was secretary of the interior he had charge of Indian Affairs and consequently had many gifts from various tribes of Indians. So after dinner he invited the men to go to the smoking room, which was a fine library where all the gifts he had received from the Indians were displayed. The women were invited to the sitting room. It is interesting to note that at this period in U.S. history no respectable woman ever smoked.

Mr. Garfield told us very interesting stories about the various Indian trophies that he had received. He then told the following story. "You might be interested in a story that my grandfather told me while I was sitting on his lap as he sat in this big chair facing this window. There were some undesirable people living in a small village called Kirtland, a short distance from here. We young men around here decided to get together and go over there and kidnap the leaders. So we went over there one dark night and kidnapped two of the leaders, Joseph Smith and Sidney Rigdon and brought them over here. We stripped off their clothes and put tar and feathers all over their bodies and told them to

get out of town and stay out, and this took place in the yard right out there. Some of the doctors knew enough of the Mormon story to recognize the names and began feeling sorry for me as they knew I was a Mormon. I quickly spoke up and told him I was a Mormon and was glad to hear this story first hand on this spot where it happened. Since before this time I had only read the story from books. "Well," he said, "you might be interested to hear the sequel to this story." Before I give this part of the story let me write down some dates. The grandfather must have been born about 1805. President James A. Garfield born 1831 died 1881 and his son James A. Garfield was 75 years old in 1929 and must have been born about 1854. So grandpa was about 55 or 60 when the grandson was about 6 years old. These dates give credibility to the story. And now the sequel as told by Mr. Garfield at this dinner party.

"You know Senator Smoot was a close friend of mine and one time I was visiting out west and I called on Senator Smoot in Salt Lake City. The next day was what they called conference and the Senator invited me to go. He thought I would be interested in hearing the great organ and choir. I went with Senator Smoot but sat on a side seat near the front. After singing and prayer one of the men on the stand spoke. Then Senator Smoot leaned over and said something to the Presiding officer. He stood in front of the pulpit and asked me to come to the stand. When I got up there he asked me if I would say a few words to the audience. I was confused for all I could think of was the story my grandfather had told me."

Having worked with audiometers and hearing aids in the laboratories, and then being president of the American Fed. of Org. for the Hard of Hearing, sort of made me an expert in this field. Because of this I had the privilege of meeting some important people in the USA who were hard of hearing. I have written about Alfred Dupont but there are some others that I wish to tell about here. The first story is about Thomas A. Edison.

He came to the laboratory with one of his Chief Assistants. We made tests of his hearing and found that he was very hard of hearing. If one talked very loudly into his ear he could understand. His hearing loss was about the same for high and low frequencies, which is very unusual for one having as great a hearing loss as he had. The fact that he could understand speech when one shouted into his ear encouraged

me to think we could make a hearing aid with which he could hear ordinary conversation and we" agreed to do this . The necessary equipment was placed in a box about l6x8x8 inches; the microphone was on the end of a cord and headpiece on a headband. Instead of a battery for a source it had power pack which operated on AC current.

When I took this hearing aid over to his office I had this interesting experience. When I came into his office he greeted me with the following, "I understand you are a fine mathematician." I admitted that I had studied a little mathematics. He then replied, "You know I started to study mathematics, but I got only as far as Algebra. When I struck the plus and minus signs in this, I became all confused and quit. And I haven't done anything with it since." This shows that at least in his day the lack of mathematical ability did not handicap inventability. He was a fantastic inventor but no scientist. While I chatted with him in his office, I noticed that he had one of these old fashioned roll top desks. There were small drawers in the top part having labels on them. I noticed one was labeled taxes, another coal bills, and other such items like these. I was very much surprised that a man as noted as Edison close associates that he would not let anybody else do the work. I also did not delegate such matters to someone else. I understood from some of his that he had a peculiar elevator connecting his three or four floors in his laboratory. He would not let an elevator company install a modern one. He made the one that they were using.

Then he said, "I understand you have a hearing aid there that might help me." I said, "Yes, we would like to try it." Then he said, "I hope the gadget does not work on AC current because we have none of it in the place." As he said this one of his assistants in back of him started to wave his hands at me and whispered, "Yes, we have but the old man doesn't know it." So I only answered, "I guess we can make it work." It was well known that he had had a great controversy concerning AC and DC especially for running street cars and always insisted on using DC. Because of this the majority of the old hotels around New York were nearly all wired for DC and the street cars were using DC. We found he could hear very well with the hearing aid and he used it for a long time after that. He took it to some of the dinners at which he was a special guest. He was a much wanted celebrity. A Few years later I met him and asked how it was working. He said it was O.K. "When I used to attend these dinners I sat in silence

Cable Address "Edison New York"

From the Laboratory of

Thomas A. Edison,

Orange, N.J.

June 17, 1929.

Mr. Harvey Fletcher, President,
Acoustical Society of America,
463 West Street, New York City.

Dear Mr. Fletcher:

Your letter of May 21st was forwarded to me at Fort Myers, Florida, and I assure you that I feel highly gratified and honored that the Acoustical Society of America have, by unanimous vote of the Executive Council, chosen me to be the first honorary member.

Naturally, I am greatly pleased to be offered this place of honor and I am very glad indeed to accept the membership which you have so kindly offered me.

Yours very truly,

Thos A Edison.

wondering what the after-dinner speaker was saying and wishing I could hear him but I was content to turn my thoughts toward some of my inventions. But now with the hearing aid I can hear and understand the speaker but usually find it so dull I turn it off and turn my thoughts to my inventions." He did tell me the story of how he lost his hearing.

He said when he was just a boy he worked on a railroad train in the express postal car. While the train was stopped he was fooling and kidding the other man in the car who was much older and stronger than he was. Edison played some prank on the older man. To get quickly away he jumped out of the car door to the ground. The older man grabbed at his head and caught both ears and pulled Edison back up into the car. Edison felt a terrific pain in both ears and knew something had ruptured. Since then he had been hard of hearing. This is the story that Edison told. But this may have been a primary cause, but there must also have been a secondary cause that acted upon the nerves then or later to produce the profound deafness that he had. He said it had not handicapped him very much particularly when it was necessary to solve a perplexing problem.

I had another experience with Edison as follows. His first assistant (the foreman) in the research laboratories came to my office one day and said he would like to have an audiogram of his hearing to compare it with Edison's. He said Edison insisted upon passing upon every phonograph record that went into stock for sale. He would hold one end of a morning glory horn against the phonograph loud speaker. The other end was fitted with a rubber tube which he fitted into his ear. In this way he passed or rejected every record that was sold. The foreman said, "You know and I know that he doesn't hear these records like a person with normal hearing but I just cannot persuade him to let us do this inspection work. Now, if you make an audiogram for me we will compare it with Edison's audiogram which you made and probably this will convince him." Well, I made the audiogram for him. It was normal through most of the speech frequency range but dropped very badly above 2000 cycles. Edison's audiogram was much lower but about the same through the whole frequency range. The foreman sort of frowned when he saw the audiogram but thanked me and left. I think he discussed the audiogram with Edison but I think Edison kept on testing the records in the same old way. Edison was a

genius as an inventor but was stubborn and had very little business sense. His inventions would have brought probably a billion dollars if he had let someone manage the sales and promotion of them. Just look at this list which is just a few of his inventions.

Incandescent light, Electrical railroad, Direct current generator, Phonograph, Motion pictures, Carbon button microphone. (An improved model of this microphone is still the standard in the Bell Telephone System.)

As mentioned above during the 1920's there was a sort of Renaissance in problems of the deafened and deaf. The invention of the audiometer and hearing aid and research work on various aspects of hearing stimulated the National Research council to call a conference on the Problems of the Hard of Hearing persons. People all over the U.S. who had made important contributions in this field were invited to attend. Dr. Dunlap of John Hopkins and I were appointed as a committee to try to raise some money to finance the programs which were formulated in this conference. We had hoped to get enough money to have an institute which would be devoted to this one field.

Dunlap and I thought we might persuade Mr. George F. Baker to donate a large amount of money to this project. We promised the conference that at least we would try. Mr. Baker was a very wealthy man; he was one of the early promoters of A.T. & T. Company and held a large amount of its stock. I thought I had an entree because I was working on Hard of Hearing problems at the Bell Tel Labs doing research work, and I knew he was very hard of hearing. Mr. Gifford, President of A.T. & T. had made arrangements for us to see him.

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Thos A Edison.

So Dr. Dunlop and I went to his home located in the thirties on the east side of 5th Avenue in Manhattan. His home was very beautiful but not too large. It apparently had been built before the business houses of New York City had reached that far uptown (north) and they had gradually grown up around it. As we entered the house we were met by the housekeeper. She said Mr. Baker would see us in a few minutes, but wondered if we would like to see the, paintings which were hung all over the walls. We said we would be delighted to do so. Then she told us that Mr. Baker had furnished most of the money that built the New York Museum of Art, including the paintings and sculptures. In this collecting process he had kept the ones he considered most famous and hung them in his own house. So it was a great privilege to see these valuable paintings that were too good to go into the Museum. We also learned at that time that the man who worked with him in building and equipping the Museum was a Mr. DeForest. I shall say something about him later.

After seeing these beautiful paintings we went to meet Mr. Baker in his 66 library. When we saw him it was obvious he was very old (88 years old I believe) and wore very thick-lensed glasses and was not very alert. The first thing that I said to him was the wrong thing as I said, "Mr. Baker you must get a great deal 0f pleasure looking at these wonderful pictures that you have collected.” "Well," he said, "I would enjoy them but I can't see them." He was nearly blind which accounted for the very thick glasses and his hearing was very low so one had to speak very loudly and be close to his ear before he could hear you. We told him what our mission was.

We hoped he would donate an amount equal to his earnings on the stock market for the previous week. We had estimated his earning for that week to be well over 5 million dollars. We went into detail on why we needed to do this research for the Hard of Hearing. He kept smiling and nodding. When we got through, he suddenly turned to me and asked, "How is my boy Gifford doing on his new job?" Of course Gifford was then president of the A.T. & T. Company and he thought of him as a boy which he recommended to one of the telephone offices many years before. Then he thanked us for coming and we said good bye but I still think that he did not have the faintest notion what we came for. So we got nowhere on that visit. We thought we might contact his son, but after several tries we gave it up.

We did learn something more about De forest. Baker furnished the money but De forest managed the early development of the Museum. I had the privilege of meeting both Mr. and Mrs. Deforest. They were both hard of hearing. So I was asked to visit them. I first visited Mrs. De forest. She was then about, age 75. She told me this story about "Little old New York". This is the title of a book which was written about that time. She told me she furnished most of the information for the book. At that time she lived at the end of Fifth Avenue on the corner across the street north from Washington Square.

She said her mother moved there when she was a bride; which must have 67 been in the middle of the 19th century. Mrs. De Forest had lived there ever since she was born. When the house was built they considered themselves way out in the country. She had lived there and seen the city grow up around her. The old stables that housed her horses and buggies and sleighs were still standing and kept neat and clean. Mr. De Forest was getting very old and feeble. He was in a convalescing home where the nurses could take care of him. When I went into see him he seemed to be cheerful and talked a little about the early beginnings of the museum. His hearing was down very much but after seeing him I thought it would be foolish to try to do anything for his hearing. His nurses told me his pulse was down to 40/min. and remained there. I hardly believed a man could be so chipper with a pulse that low.

It was during this same period that the artificial larynx was invented. A man who had had a cancerous larynx removed was sent to us to see if we could make anything to aid in his speaking. The man, a Mr. Mapes was only in his early thirties and seemed to be in a vigorous health. The bosses thought that because we helped the deafened we should also be able to help the dumb. In cases of this kind the larynx is completely removed and the end of the wind pipe is sewed to a hole in the neck. The patient then breathes through this hole. Grandpa Chipman was not this kind of case. I will speak of him later. A patient like the above cannot speak for there is no air connection between the lungs and the mouth. Mr. Mapes was a cigar salesman. No doubt his smoking had caused the cancer. We told him we would try to fix up a gadget and then would call him. In the meantime another man with a similar operation came to see us and he had purchased in Spain, a small device you could hold in your hand. It was connected to a

tube that was fastened to the hole in the neck. He could hold the device up to his mouth. In this way he could make speech sounds.

We had already started the work on our device and it was nearly ready but it was somewhat similar to the one this man showed us.

The men in my group that were assigned to make this device were R.L. Wegel and R. R. Rees. The squeaker was a cylinder 2 cm in diameter and 5 cm long. To one end of the cylinder a flexible rubber tube was attached. This could be put into the mouth. The other end was a rubber tube that could be attached to the hole in the neck which connected to the lungs. When the lungs contracted it forced air through the device causing it to squawk. By directing this squawk into the mouth such a person could learn to talk. More of the detail of this is given in my book. This story might be interesting to you.

When Mr. Mapes came back we gave him this device but he fussed and tried hard but could not make any intelligible speech. He asked to take it home and he would practice with it. We consented and after a week, he appeared in my office smiling and with this device, said, "Good Morning, Dr. Fletcher. You see I can talk fine now. “I was very surprised but he could carry on a conversation with very little difficulty and was back selling cigars in about another week.

I have frequently been given credit for this device not of my own choosing for it was a group effort. It was finally put into manufacture by the Western Electric Company and was distributed by the local telephone companies at below cost to patients who needed this device.

Another story which I wish to insert here is the story about Pierre DuPont, another multimillionaire; I think he was chairman of the board of the big Dupont Company at that time. Apparently he had cancer of the larynx and he had his larynx removed. He heard that we had invented an artificial larynx which he thought he might use to help him speak again. I went to his home to see him and found that he was really quite ill. However, I promised to make an artificial larynx for his use. It was before we had actually established the manufacturing of them by the Western Electric Company. I did so, and he found 69 that he could talk a little with this but he was quite ill to do much talking anyway. However, he said, "Now for this kindness of coming to see me, I want to

give you something for your favorite charity, and if you'll go over to my son's office in downtown New York he will give you something." I didn't know just what was going to happen but it was in 1929 when I was interested in the Organization of the Hard of Hearing and I thought it might be appropriate to get a donation if possible from this rich man for this organization. So I went over to his office which his son was occupying at this time. It was on the top floor of the large Equitable Life Insurance Building in the financial district of downtown New York.

This building houses a population as large as many cities. It is estimated that if all the people in this building came out on the sidewalk at the same time they would fill the sidewalk closely packed together seven times, that is, they would have to stand on each other's shoulders until they were seven layers deep.

Well, anyway, I went up to his office and was quite impressed by the magnitude of it all and there I met the son. He was sitting, smiling, expecting to meet me as I'd made an appointment. He started the conversation and said, "Well, tell you what, a week ago I sold this whole building and I didn't tell my father about it and after I'd sold it and we concluded the deal, I began to worry about it for about a week and today I bought the whole thing back again." I don't know how many millions he lost in this transaction but I've never forgotten how lightly he spoke of selling such a large building in that financial district and then buying it back a week later. Well that's a little off the main theme but I thought you might be interested. Then, he said, "Now father says to give you a donation for your favorite charity, what is it?" I told him the American Federation of Organizations for the Hard of Hearing and he wrote me out a check for $2,000 which was a great help 70 at that time in the beginning of my administration as President of that Organization.

Here is a story about Mr. Stoddard who was elected treasurer of the American Federation of Organizations for Hard of Hearing at the same time I was elected President. He was hard of hearing but also had made considerable money through his inventions of the Amplico Player Piano. Various musical selections were stamped on rolls which could be inserted into the piano for playing.

A meeting of the board of the American Federation for the Hard of Hearing was held in my office not long after our meeting in Cleveland. Among others Mr. Stoddard was present. We had been in session just a short time when Mr. Stoddard left the room.

He was not gone long, but he repeated this two or three times during the morning. All except Mr. Stoddard went to lunch together. He excused himself and said he would join us after lunch.

We returned and assembled in my office and Mr. Stoddard was there O.K. but he repeated the going out and coming back two or three times during the afternoon. At the close of the meeting, Mr. Stoddard said he wanted to apologize for leaving so many times during the day. He said, “You may be interested to know the cause of it. I have been in contact with my broker all day and find I am now $100,000 poorer now than I was this morning.” It was the day in 1929 that the stock market broke. He lost considerable more the next day. Before the crisis was over he nearly lost all his million dollar fortune.

Mr. Stoddard was also the first treasurer of the Acoustical Society of America. It was also this same year that Acoustical Society of America was organized. It happened this way.

Mr. Wallace Waterfall, who was working for Celutex Corporation in Chicago, came to see me at the Bell Labs. He thought it would be advisable for all the workers in the room acoustics to form a society where there could be an exchange of ideas. Celutex was a manufacturer of acoustic materials. I thought it would be fine but the concept should be enlarged to include all workers in acoustics so it would include not only practicing engineers but also college professors. I also suggested that we write to all persons whose interest might fall into these categories, and invite them to come to a meeting to discuss the proposition. This was done and we had a large response. Such a meeting was held at Bell Tel Labs and we had a very interesting discussion. The details are given below. It was finally decided to form such a society although there were a few who were against it. They thought it would interfere with the American Physical Society.

Below is a copy of a talk that I gave at the 25th anniversary of the Founding of the Acoustical Society of America, May 1929.

Talk given before Acoustical Society of America on 25th Anniversary of the Founding of the Society, May 1954: Members of the Society, Ladies and Gentlemen: The first contact which I had with a young man named Wallace Watterfall was by a letter dated November 6, 1928. He addressed me, "Dear Sir: Within the last few years there

have been a great many developments in the subject of architectural acoustics. Architects, builders, and the public in general are beginning to recognize in the building industry a new engineering science which is approaching a state of development comparable with the other engineering sciences." Later in the letter he suggested we ought to have some sort of organization for acoustical engineers. He sent such a letter to about 15 men. On November 16 I replied to him and told him the idea was fine and suggested that the 15 men to whom he had written together with a number of others be invited to consider an organization at a meeting to be held December 27 at the Bell Laboratories. On December 5 another letter to Waterfall stated that at this meeting Dr. Arnold wishes them all to be his guests at a luncheon. As you all know, this meeting was held. There were 40 present, 36 of them are shown on this slide.* The ones who are not on the slide are Donald MacKenzie, Bert Graham, John H. Boland, and H. D. Arnold. We have extensive minutes of this first meeting, and I note that speeches were made by Professors Knudsen, Anderson, Watson, Richtmeyer, Miller, Saunders, and Messrs. Waterfall, Wolff, Stoddard, Maxfield, Hewlett, Taylor, Parsons, Chrisler, Hickman, and Frederick.

So you see our Society started out as a talking Society and it has continued so through the years. After all this speech-making a temporary set of officers was installed. I was honored to be your first temporary president. Here are the words spoken by me at that meeting. "I appreciate the honor as the first temporary president of a society which I think is going to make history. Fifty years from now, this little gathering will be referred to as the first meeting of the Acoustical Society of America. I hope some of you are living to describe it." Mr. Waterfall was elected temporary secretary, and I am sure you will be interested in noting what he said. "I appreciate the honor of being secretary of this society and I can assure you the letter writing will continue as it has in the past." I am tempted to ask Wallace at this time how many letters he has written for the Society since that promise. The Committee which was selected to form a constitution and by-laws were Richtmeyer, Miller, Saunders, Maxfield, and Parsons, together with the temporary officers. Thus ended this first meeting of the Acoustical Society with everyone present being very enthusiastic.

As you will see, this meeting was held 25 years ago last December. (We are celebrating the 25th anniversary now because the first official meeting of the Society was held here in New York City, May 10 and 11, 1929.) It was held in the auditorium of the Bell Telephone Laboratories. Those of you who were present remember that we had at that meeting two of the finest demonstration lectures that we have ever had, one by Dr. Arnold on Acoustic Facsimile, and one *This photograph is in my scrapbook by Professor Miller on Science of Musical Sounds. At this meeting permanent officers were elected as follows: Harvey Fletcher President, Very 0. Knudsen, Vice-President, Wallace Waterfall, Secretary, and Charles Fuller Stoddard, Treasurer. Members of the Executive Council were Paul E. Sabine, J. P. Maxfield, C. W. Hewlett, G. R. Anderson, Dayton C. Miller, and F. R. Watson. The Publication Committee Members were Wallace Waterfall, F. R. Watson, Paul E. Sabine, and Charles Fuller Stoddard.

Thus the Society was officially launched 25 years ago and the first issue of the Journal of the Acoustical Society of America came out in October, 1929.

LIST OF MEMBERS WHO ATTENDED FIRST MEETING DEC. 27, 1928 AT BELL TELEPHONE LABORATORIES

*Donald MacKenzie, Bell Telephone Laboratories, N.Y.C.
F. K. Richtmeyer, Cornell University, Ithaca, N. Y.
L. J. Sivian, Bell Telephone Laboratories, N.Y.C.
R. L. Wegel, Bell Telephone Laboratories, N.Y.C.
N. R. French, American Telephone & Telegraph Company, N.Y.C.
E. L. Norton, Bell Telephone Laboratories, N.Y.C.
W. P. Mason, Bell Telephone Laboratories, N.Y.C.
Clarence W. Hewlett, General Electric Company, Schenectady, N.Y.
John C. Steinberg, Bell Telephone Laboratories, N.Y.C.
G. R. Anderson, University of Toronto, Canada.
F. R. Watson, University of Illinois, Urbana, Ill.
John Bellamy Taylor, General Electric Company, Schenectady, N.Y.
Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.
Harvey Fletcher, Bell Telephone Laboratories, N.Y.C.
*Bert J. Graham, V.P. Macoustic Engineering Co., Cleveland, Ohio.
Charles Fuller Stoddard, American Piano Co., 29 W.57th St., N.Y.C.
C. N. Hickman, American Piano Co., (Research Lab.), N.Y.C.
Horatio W. Lamson; General Radio Company, Cambridge, Mass.
V. L. Chrisler, Bureau of Standards, Washington, D.C.
H. C. Harrison, Bell Telephone Laboratories, N.Y.C.
Irving Wolff, Radio Corp. of America, Van Cortlandt Pk. S. & Saxton Av., N.Y.C.

Joseph B. Kelly, Bell Telephone Laboratories, N.Y.C.
Vern 0. Knudsen, University of Cal., Los Angeles, Cal.
E. C. Wente, Bell Telephone Laboratories, N.Y.C.
Warren C. Jones, Bell Telephone Laboratories, N.Y.C.
R. V. Parsons, Johns-Manville Corp., N.Y.C.
Londsdale Green, Jr., Johns-Manville Corp., N.Y.C.
Wallace Waterfall, The Celotex Co., Chicago, Ill.
H. A. Frederick, Bell Telephone Laboratories, N.Y.C.
J. P. Maxfield, Victor Talking Machine Co., Camden, N. J.
Walter A. MacNair, Victor Talking Machine Company, Camden, N.J.
R. F. Mallina, Victor Talking Machine Company, Camden, N.J. *Members attending conference but not in Photo #34273
(The Acoustical Society of America) 74 D. G. Blattner, Bell Telephone Laboratories, N.Y.C.
A. T. Jones, Smith College, Northampton, Mass.
*John H. Boland, U.S. Gypsum Co., 17 State St., N.Y.C.
Frederick A. Saunders, Jefferson Physical Lab., Cambridge, Mass. (Harvard)
*H. D. Arnold. Bell Telephone Lab., N.Y.C.
E. J. Schroeter, Pres. Macoustic Engineering Co., Cleveland
H. A. Erf, Box 326, Nor. 0. Tel. Co., Bellevue, Ohio
Robert H. Schroeter. Chief Eng. Macoustic Eng. Co. , Cleveland

*Members attending conference but not in Photo #34273
(The Acoustical Society of America)

MINUTES OF FIRST MEETING OF

ACOUSTICAL SOCIETY OF AMERICA

DECEMBER 27, 1928

On December 27, 1928, a conference was held at Bell Telephone Laboratories, 463 West Street, New York City. Prof. Miller called the meeting to order. Dr. Fletcher was appointed temporary Chairman. Speeches were made by Professors Knudsen, Anderson, Watson, Richtmeyer, Miller, Saunders, and Messrs. Waterfall, Wolff, Stoddard, Maxfield, Hewlett, Taylor, Parsons, Chrisler, Hickman, and Frederick, respectively.

MR.CHRISLER (Bureau of Standards, Washington, D.C.)

Five or six years ago, the major part of the time was spent on problems connected with building acoustics.

The first is the manufacturer; he wants certain things. Next is the architect; he wants certain things. There is not, apparently, a very good basis for argument on making various types of measurements. Perhaps, the matter of absorption is the great

feature. Up to quite recently we had been making absorption measurements by means of a tube. Those results do not check with those made by other methods. One thing I have been more interested in than anything else is to see some way agreed upon by which these measurements shall be made. The most desirable thing was to get some standard way of measuring and the suggestion I have made to Mr. Parsons is that that could be easily done if the American Society of Testing Materials would have another sub-committee to take care of this kind of work and decide upon some kind of measurement.

PROF. ANDERSON (University of Toronto)

So far the objections to the formation of this Society have been the smallness of the organization. I recall some years back when a certain society which I belonged to - The Illuminating Engineering Organization - was organized, the same objections were made; that it was too small to stand alone, that the various points that we could bring out were too limited, and never could succeed alone. At the annual convention, over 550 people were present. It is now a flourishing society. I think that their interests are as narrow as those here proposed. They deal with lighting only. Acoustical work is largely an engineering problem. We should get away from the Physical Society. We should organize our own society and have our own journal. We will then have a place in which all communications could be collected and would not have to search all over the library for an article concerned with acoustics.

Even though we have other interests, I am all for the organization of this society and its acoustic purpose. Let it be as wide as it likes but taking in acoustic problems only.

PROF. WATSON (University of Illinois)

The object of the society is important. It seems to me that the object of the society would be investigations in acoustics in general, and under that heading there would be the questions of theory, experimental work, and also the applications which might come up. Prof. Miller's analysis of sound is a very general piece of work and there are others which could be quoted. One important question which would come up is the question of membership, and the qualifications of membership ought to be guarded very carefully to make sure that the society is on the high plane that we should like to have it, and just

what those qualifications would be is a little uncertain. It certainly would be an interest in acoustics, perhaps some sort of a contribution either in the way of publication on the theory or experiments or in the development of instruments. The financial question is one which would have to be met in some way. The question of publication I think I have sympathy for. One possibility in the matter of publications which is only a suggestion is that the Optical Society might be willing to let us have three or four pages and I am very much interested here in what Prof. Richtmeyer is going to say.

The question of standardization in certain directions is a desirable thing. A number of years ago I made special effort to secure cooperation among the different investigators to see that we could agree on methods, etc., and if I were wrong I was going to find out where I was wrong in order to be of real service to the people on the outside who necessarily have to depend on the scientists to get their information.

There are four objects:

1. The object of the society.
2. The important question of membership.
3. The question of finances.
4. Some questions of standardization.

My own policy has been to publish everything which I found out. I have gone out of the way to try to collect information and publish the results which I regarded as reliable for the information of the people who needed the data. So far as I am concerned, it has been my policy to get all the information together and put it in a systematic form and publish it.

PROF. RICHTMEYER (Cornell University)

One other point. When the Optical Society was formed, we had no means of taking down the reports of the various agreements pro and con. If, in the record of this meeting, the word "optics" were written in place of "acoustics", it would read like the minutes of the first meeting of the Optical Society of America. The arguments for and against the formation of an acoustical society are exactly the same as those for and against the organization of the Optical Society.

History of the Optical Society

It originated from the commercial interests in and around Rochester, N. Y., at which place was a small local society devoted primarily to what we might now call Optical Engineering. They saw some interests around the country, other firms, a few men in universities interested in geometric optics and they called a conference similar to this and formed the Optical Engineering Society. There were some who felt that such a society could not serve best by limiting its activities to engineering. The society was broadened so as to include both optics and the science of optics. Then came our first problem. What is optics? What is light? Is light the part of the spectrum which we see visually? What should the Optical Society deal with?

Our main trouble was not whether we should have a society, but what should be the scope of the society. What shall be published in our journal? Where shall we divide the line between the Physical Review and the Optical Journal?

Our interests are broad and yet we find a sufficiently common meeting ground to make our meeting of interest to the majority of members of the society. One argument was against the formation of another journal. Why another journal? You will have the same argument presented to you. Why in the world another journal? As a matter of commonsense, it seems to me that to recognize the fact that science both pure and applied is increasing. The Physical Review is getting larger. It seems to me that it is not going to cost more to publish two thousand pages whether those two thousand pages of material are scattered in two journals or in one. If you would collect into one journal the things pertaining to acoustics, you would do a very valuable service to both science and industry and also to the Physical Review.

About ten years ago there was presented to the editor of the Physical Review a series of three rather short articles on acoustic research by a physicist leaning in the direction of physiology. They were presented to the Editorial Board and after some little discussion rejected. The article happened to come to my attention, I asked for a reconsideration with the result that the article was published. The information was put to practical use in connection with a rather important engineering problem. By the formation of the Optical Society, we were able to bring added financial support to the publication of material on optics. This is true that those of you who attend the meetings of the Optical Society find there a group of men not too large, a list of papers not too

extensive, a program not too full - one can enjoy the meeting. But at least I do feel that the Optical Society has served so far a useful purpose.

Prof. Watson asked: "Is the Optical Society successful?"

Prof. Richtmeyer answered: "I just don't know what you mean by successful. Statistically, the society has a membership of about 550 or 600. We are publishing a journal monthly. A budget of the journal is somewhat around $15,000 or $18,000. Two meetings a year, one jointly with the Physical Society, another independently. We had been meeting with the American Society but found that the meetings were too crowded."

PROF, MILLER (Case School of Applied Science, Cleveland, Ohio)

I may perhaps state that personally my interests lie in connection with acoustic subjects. I am more interested in that than all science put together - musical aspects of it, radio, loud speakers, and also architectural acoustics. When the question of organizing this society was first mentioned, I was rather hesitant to approve of the organization. It was announced to be a society of acoustical engineers. If it is to be a society of acoustical engineers, I am opposed to the organization. The primary purpose was to organize a society which would apply to auditoriums, etc. I should say that I am opposed not because it seems to mean that limited aspect of the subject. The time is not yet ripe for a large society. A society in order to function must have a distributed consistency of more or less common interest and it cannot be organized and function properly when it is made up of a small number of individuals. After listening to the various comments that we have had this morning, I feel differently about it. I have the same interests that are represented here and probably others can be brought to join us in common interest. If they can work harmoniously, then I can certainly say that the time is appropriate for the organization of a society, but it should be a society of acoustics and if there are enough people who will come together and join their interests in these ways, then probably there is a sufficient nucleus to make a society successful. A society must have several hundred, say 500 people to support it. The Optical Society has a membership larger than that. The question of qualifications of membership is an important one and it must be so arranged that we shall not exclude or offend any of those whose interests will be helpful. In general, I am opposed to multiplying societies. I

am now a member of twenty-six scientific organizations. There is a definite difference between the people concerned with industrial and commercial organizations. I should like to go to the Acoustic Society meetings. I do not wish to miss the meetings of the other societies. I attended the last acoustic meeting of the Society of Motion Picture Engineers held at Lake Placid. I thought I was attending a meeting of acoustical engineers. Nearly everything had to do with sound, motion picture, talking movies, etc. Papers presented there should be presented to this new society if it is organized. Therefore, if the purpose, which I misunderstood, of making acoustical engineers, motion picture engineers, loud speakers, player pianos, organs, and the study of the ear, hearing, matters of speech, speaking, as well as these other things - if we could get those varied groups together and work together, we can organize this society"

I know I was Secretary of the American Physical Society during the time to which some of these men referred. I would have welcomed any papers that were submitted concerning acoustics. There was not a single one turned down - that is, all they could get - and if any of you have anything which is scientific in the way of acoustics I am sure that the American Society will welcome it. The council today wants a variety of programs. The absence of these papers is not because they don't want them.

Of course, there is the question of financing the publications. The Physical Society does not have money enough available to print the actual papers submitted. The result is that the papers have to be shortened and condensed as much as possible. They do not exclude papers on acoustics. They take all kinds of papers; of course, they do not take engineering papers. They will publish them on acoustics as well as any other subject.

The question of financing this publication is an important one and I really think that is the chief point to consider, I think Professor Richtmeyer is correct in stating that this new society will bring new support for this subject, but we must consider if it will be sufficient. Why is it that the Physical Society does not have ample funds to publish their material? They do not have it. If another society can help them publish it, so much to the good. It does remain for us to consider if we can find a good friend, or several good friends who would stand back of acoustics and support it. I doubt very much whether it could support a journal adequate to print the material. If we do have some persons, then

I say if organizing the society would bring them to our help, we must get them. If then, we take into account a further consideration of all these points and can work out a scheme of membership and financing, I think such a society including all of these aspects would be advisable. It would contribute to the development of science and in so far as science is developed, the industrial applications will be developed. I am in favor of the very thorough consideration of the question and considering the probabilities.

MR. HEWLETT (General Electric Company)

The Physical Review has a wide circulation. I think it would be advisable to have a separate Optical Society with a separate journal which would make the acoustical papers widely available: It seems to me that it would be better to form an organization, have membership dues, and publish whatever papers the Acoustical Society would wish to publish - a section for acoustics - and at the end of the year let the Society contribute whatever is fair to the publication of the Physical Review.

PROF. WATSON

The Physical Society has now under consideration the publication of a supplementary volume to take up more experimental work. The committee is already organized to be published to the members. It is possible that they will consider such arrangements which you have made.

The Physical Society does now put the papers on acoustics in one group and if there are a group of ten papers there would be a whole group of the Physical Society devoted to the acoustic group. There is no difficulty in arranging the program now.

Quite often the places where the Physical Society meets are not desirable for this society.

PROF. SAUNDERS (Harvard University)

I have not come here this morning with my mind set. I was bothered by the fact that when the first announcement came to me I should be too busy take part in an organization that I should like to. I don't see how several who attend college can afford to attend separate meetings. It is not only the question of expense but a college professor must have leave of absence to attend these meetings. There are a few occasions when they do not need to have leave, which are around the vacations, or some other very important meetings which they must attend. If the organization is to be

formed, I should hope to be a member of it and should subscribe to the journal adopted. Now, to get the information under the aspect of the Research Council or to arrange for a liberal society of mutual reprints which would be more economical, I do not pretend to be any judge.

MR. HICKMAN (American Piano Company)

I was overwhelmed with joy when I heard of this meeting. I have been interested in acoustical problems for a great number of years.

Several times I have suggested to the Physical Society papers that I would like to write if they thought they had a place to publish them and in every instance I have had a reply that was very discouraging. Perhaps these papers were more of an experimental matter. The papers, however, have never been published. I know several men who would like to write articles, but there is a question of not finding an outlet for the thing they are doing. That is the attitude of the commercial concern in giving out information. I don't know, yet I do know about the question of publication of papers, and in every instance they have already agreed to the publication of papers from our research laboratory. If that attitude is taken by the other concerns, I see no reason why there should not be a great number of papers dealing with experimental acoustics.

Whenever I hear of a paper that is interesting I send for it and in that way I get a fair collection of the papers that are dealing with the subject, but it is very annoying to have to fashion to obtain papers. I have several papers now coming from abroad. But there is very much delay their getting here.

There are a great number of people who have information only too glad to publish if they had a place for it. But it is very discouraging after writing a paper not to have it accepted.

MR. H.A.FREDERICK (Bell Telephone Laboratories)

I am very much interested in all that we have about the Physical Society as an outlet for work along this line. It seems to me the idea is that there is a great deal of work which will be of interest and would be welcomed by the Physical Society. Perhaps that idea has not been emphasized quite as much as it might be. I feel that there ought to be quite a lot of work along the lines of psychological acoustics which would be of very great interest. Personally, I certainly share the feeling that there are too many

papers already; I can't read all the papers that I get. I certainly would enjoy reading them, but there are too many. I would like very much to keep in touch with varied work along these lines if the work were gathered together in one place.

CHAIRMAN

The question is not whether we shall have a journal or not; it is whether an organization shall be formed. Probably the greatest good from such a society comes through the personal contacts which are made. For example, we will not see this particular group again unless a society is formed. I suppose we could make it a point to go and see everyone here but we won't. Will someone make a motion concerning the formation of a society?

MR. H. A. FREDERICK

I move that the American Acoustical Society be formed.

(The motion was seconded.)

CHAIRMAN

Does this statement include the name, or shall the name be left open for the present?

MR. H.A.FREDERICK

I did not necessarily mean to include the name of the society, but if we include the subject, it makes the idea much more definite. The intention of this motion is that a national organization on acoustics be formed and that the name be left for further consideration.

(Someone suggested that this society be considered a branch of the American Physical Society. It was put in the form of a motion but not seconded.)

PROF. RICHTMEYER

The American Optical Society and the Optical Society of America are two different, societies, so please keep them separate.

CHAIRMAN

Next then is the formation of the society. Shall we proceed in the usual manner, which I confess I do not like, of appointing a committee? Or shall we vote for officers?

(The question was asked" "Have you a draft of the organization?" Mr. Waterfall answered, "I have no draft of the organization.")

PROF. MILLER

Refer the matter of a well-selected committee to make any formal organization and study the constitutions and by-laws of other societies, especially those which have a somewhat similar purpose.

Study the question of the exact name to be given to it. The motion ought to be made that a committee (5 to 10) be selected to draft the definite organization. There are three important points: scope, qualifications, and limitations on membership. As to the name, I rather like the Acoustical Society of America. I think it should include every branch of acoustics, scientific and applied. The organizing committee should so arrange the constitution that it should include all of those branches. The qualifications of member- ship should be considered very carefully.

CHAIRMAN

Shall we decide on the name of the society?

PROF.JONES (Smith College)

I suggest that we leave the "al" off the name, and call it just "Acoustic Society of America".

PROF. MILLER

I believe generally used. I think that both are correct.

(Prof. Watson made a motion that the society be called the "Acoustical Society of America". Motion was seconded. All in favor except Mr. Taylor.)

CHAIRMAN

The name is "Acoustical Society of America".

(A suggestion was made that the officers for this organization parallel those of the Optical Society of America. Its purposes were so nearly like theirs that they could not only adopt infringement on their name but also a copy of their officers.)

PROF. RICHTMEYER

The usual officers are: President, Vice-President, Secretary, Treasurer, council members elected in their rotation - 2 for 3 years.

CHAIRMAN

Do we want to proceed with the election of some officers to call us together and provide a program?

PROF. SAUNDERS

I propose that we have a nominating committee of seven.

PROF. RICHTMEYER

It would be more convenient to nominate or elect a temporary group of officers to serve until the next meeting.

PROF. SAUNDERS

I propose that we elect a temporary set of officers as Prof. Richtmeyer suggested - president, vice-president, secretary, and treasurer.

(Motion was seconded. It was carried.)

CHAIRMAN

How shall we proceed to elect these officers, by balloting or by nominations from the floor?

(Nominations from the floor decided upon.)

(The first nominee was for Temporary President. The only nominee was Dr. Harvey Fletcher who was unanimously elected.)

CHAIRMAN

I appreciated the honor as the first temporary president of a society which I think is going to make history. Fifty years from now, this little gathering will be referred to as the first meeting of the Acoustical Society of America. I hope some of you are living to describe it.

(Mr. Waterfall was nominated for secretary, Mr. Stoddard for treasurer, and Dr. Knudsen for vice-president. All three were elected.)

PROF. KNUDSEN (University of California)

I have had my college training with Dr; Fletcher and it is indeed a great pleasure to work with him.

MR.WATERFALL (Celotex Company)

I appreciate the honor of being secretary of this society and I can assure you the letter writing will continue as it has in the past.

MR.STODDARD (American Piano Co.)

This honor is going to be very expensive for me. The American Physical Society goes into pure physics almost entirely. It does not come in contact with the other

sources of money which is usual in other groups. As this society has a much wider scope, it is going to embrace engineering and it embraces all of the branches that are connected with acoustics. We are going to make a direct appeal to these groups since we cannot exist without money. This society should have back of them a number of corporations who are making big money and have a broad enough view of our work to come right out and help us. At least, I want to appeal to those who have money. We need money to publish our journal. We want help from organizations with money, such as the Victor Company, Radio Corporation of America, and the American Piano Company. I hope those of you who are connected with these companies will come right out and help me with this difficult job.

(A suggestion was made that a committee be appointed to draft a constitution which will provide for a permanent set of officers. Mr. Harrison moved that the President appoint a committee of five combined with the four officers elected to constitute a committee for drafting a constitution embodying a permanent organization. A unanimous vote was taken. Members selected were:

Professor Richtmeyer	Mr. Maxfield
Professor Miller	Mr. Parsons
Professor Saunders	

Someone suggested that the committee prepare a program for the next meeting which may be called by that committee so that there will be some inducement to come.

A discussion arose as to when it should be and where. Mr. Stoddard said that that would be hard to decide now and that we should wait until everything is ready. A suggestion was made by Prof. Richtmeyer that perhaps some of the large corporations represented would invite the Society to hold the meeting at their place. The Johns-Manville Corporation (later withdrawn because of the impossibility of accommodating all that might possibly attend the next meeting) and Bell Telephone Laboratories (which was accepted, deciding that it be held in the auditorium) offered to take care of the meeting place.)

CHAIRMAN

When shall this meeting be, and where?

(Prof. Miller stated that it would be difficult for college professors to get a leave of absence to attend the meeting. He thought that a meeting in April would be convenient - when there were several meetings being held.)

It was decided that there should be a period of about three or four months' time before the next meeting. Some would wish to get work ready to present to the society, and in view of the fact that there were many meetings to attend, some could not attend the meeting of this society. Someone suggested a period of six months' time should elapse before the next meeting. It was finally decided that the next meeting would be at Bell Telephone Laboratories in April or June as this would be the most convenient time and place for everyone to attend.

Prof. Watson said that a university man sometimes gets a leave of absence at about the time the spring meetings are held. If the committee had about the length of time up to April, they would have an opportunity to get the society formulated. Personally, he would prefer to come to New York one day and then go on to Washington.

Mr. Stoddard suggested that a meeting before June not in the form of a formal meeting with papers may be desirable as we had some organizing to do. Then the formal meeting could be held in June when the Radio Convention and the Piano Convention were on. We wanted to interest more than the scientists and the engineers - we also wanted to interest the corporations and show them what we are going to do.

Mr. Waterfall then read a list of the members present, each one standing as his name was called. (List attached) The meeting was then adjourned.)

As a final result of this I was made first President of the Acoustical Society, Vern Knudson was made first Vice President and Wallace Waterfall was made first Secretary and Treasurer. This was in 1930 when the permanent organization was made. At this date, 37 years later, Wallace Waterfall is still secretary of this Society. I feel rather proud that I was connected with this fine scientific organization. We worked hard to get the organization going. Getting out the first journal of the Acoustical Society was a real problem. This publication of the Journal of the Acoustical Society of America is still one of the finest publications on acoustics in the world. There has been a lot of research work on acoustics done and these publications have gone into this Journal.

Two years later in 1932, the organization of the American Institute of Physics took place. I was also connected with it as a representative of the Acoustical Society. Carl Compton was the chairman of the organizing committee. We had an interesting time setting up this organization which has now become such a large organization and publishes papers for four or five national societies. At this time, Ray Olpin was considered for the position of Director of the Institute. Those of us who supported his appointment to this position were in the minority. Carl Compton suggested Harry A. Barton, and he was finally elected to the position of Director of the Institute. He has been with the Institute of Physics since that time. Now he is connected with the Institute only in an advisory capacity.

The Institute at first occupied rented quarters on the top floor of the Flat Iron building at Broadway and 42nd Street, New York City.

Phyllis worked on the editorial staff for 2 or 3 years during the beginning of this organization. I was on the board for about 7 years. Near the end of my tenure we had to move the institute to new quarters. I knew Paul Dixon was working with a real estate firm at that time. So I persuaded him to look for some new quarters for us. He found the second home of the Institute at 54 East 58th Street and the Institute purchased it. It was still operating at this address when I left New York in 1952. Paul Dixon came back to Salt Lake City and worked for KSL and later contracted cancer there and passed away.

It was in 1929 that Mayor Walker of New York City appointed me a member of the Noise Abatement Commission. I was head of a group of the Bell Telephone Laboratories that worked on the problem of noise. The Bell Labs were glad to cooperate as noise was a great nuisance in telephone conversations. We invented a noise meter and made a large number of measurements in the streets of New York City and in a sample of residences, and also in manufacturing plants. These measurements formed the basis for formulating laws that would help curb the tremendous noise about the city. I have a copy of a book in my office that was issued by the commission at that time which describes all of these measurements and our recommendations. The law that the City Council passed of making it an offense to sound automobile horns in the city limits did have a pronounced effect of ridding the city of this nuisance.

...AHNS, WHO HAVE MADE GOOD BACK EAST

This W...k's Sketch — Dr. Harvey Fletcher — By Roscoe A. Grover

Dr. Harvey Fletcher

Now, the next story I'll tell is about the development of stereophonic sound and my relations with Stokowski. It was about 1931 when I first met Stokowski and we made tests of stereophonic sound down at the Academy of Music in Philadelphia where the Philadelphia Orchestra held its concerts. There was a spare room in the Academy building which was large enough to house the orchestra so that we could have them play on the stage and listen to it up in this large room. In this way we tried experiments until we felt we had developed a stereophonic system. Originally, the theory of this system was that it should have an infinite number of loud speakers at one end and the same number of microphones at the other end. However, we found that in stage productions, three microphones, three transmitting lines and three loud speakers were sufficient. I'll not go into the details of the development work that was necessary to produce this. There are several printed papers on it. However, we did make nine loud speakers expecting that we might have to use three across and three up and down. However, we found that most of the action was horizontal and consequently, three loud speakers were sufficient. Those nine loud speakers have been scattered around the country and we have two of them at present in the lab at BYU. There are three of them at the laboratories at Columbia University where I had worked for three years after leaving the Bell Telephone Laboratories. There are scientific publications which describe just what was done at this time and I'll not include them here except to tell you about the first demonstration.

For this demonstration the Philadelphia orchestra was in Philadelphia. It was conducted by the Assistant Director, Smallen, and Mr. Stokowski was in Washington at the controls where the orchestra pieces were reproduced. I'll not go further into the details except to say that there was a very select audience there, the Cabinet to the President, Senators, and representatives and other officials of the Government were invited guests, and it was under the direction of the National Academy of Sciences; The President of the Academy at that time was Dr. W. W. Campbell and he introduced me and I will quote from the little booklet which tells about this. "With the assistance of the orchestra in Philadelphia, Dr. Fletcher then performed several experiments to demonstrate the important characteristics of the new apparatus. On the stage of the Academy of Music in Philadelphia where the pickup microphones were installed, a

The Bulletin

of Sigma Pi Sigma

Issued by the Executive Secretary at intervals as a means of making official announcements and presenting information of interest to the society.

VOL. VII JANUARY 14, 1937 NO. 1

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Sigma Pi Sigma Members Prominent Officers in Professional Societies

FRANK C. WHITMORE

NAMED PRESIDENT-ELECT OF THE AMERICAN CHEMICAL SOCIETY FOR 1938

Dean Frank C. Whitmore, of the School of Chemistry and Physics at The Pennsylvania State College, and an active and interested member of Gamma Chapter, has been elected president of the American Chemical Society for 1938.

He also recently received the William H. Nichols medal, given by the New York Section of the American Chemical Society for outstanding research work.

Dr. Whitmore has been a director of the Chemical Society since 1927. In 1932 he held the vice-presidency of the American Association for the Advancement of Science.

He came to Penn State in 1929. Gamma Chapter will join in honoring him at a School dinner on January 14.

HARVEY FLETCHER

SELECTED AS VICE-PRESIDENT OF SECTION B OF THE A. A. A. S.

Our most recently initiated honorary member, Dr. Harvey Fletcher, Director of Physical Research at the Bell Telephone Laboratories, has again received deserved recognition by election as vice-president of the physics section of the American Association for the Advancement of Science. It is in this section that Sigma Pi Sigma is an affiliated society. Dr. Fletcher will deliver the vice-presidential address at the annual meeting of the Association next Christmas at Indianapolis.

Dr. Fletcher, who received his bachelorate at Brigham Young University and his doctorate at Chicago, is famous for his research work and writing in the field of acoustics, speech, music and sound. A biographical sketch concerning him was given in the September, 1936, number of *The Radiations*.

F. K. RICHTMYER

STEPS FROM PRESIDENCY OF PHYSICAL SOCIETY TO SIMILAR HONOR IN ASSOCIATION OF PHYSICS TEACHERS

The unusual situation of assuming the presidency of the American Association of Physics Teachers immediately upon retirement as president of the American Physical Society is the distinction which has come to one of our honorary members, Dean F. K. Richtmyer, of Cornell University. At the Atlantic City luncheon of Sigma Pi Sigma members and guests, Dr. Richtmyer was our guest of honor.

The well-known researches of Dr. Richtmyer, lately in the field of x-ray spectroscopy, have gained for him an enviable position among American physicists. His reputation as an inspiring teacher is equally high. He has spoken at a number of our chapters and his advice has frequently been helpful in the formulation of our national policies. Gamma Chapter initiated him into our membership in 1930.

workman busily constructing a box with a hammer and saw was receiving suggestions and comments from a fellow worker in the right wing. All the speech and accompanying sounds were transmitted over the cable circuits to the loud speakers on the stage of Constitution Hall in Washington. So realistic was the effect that to the audience the act seemed to be taking place on the stage before them. Not only were the sounds of sawing, hammering, and talking faithfully reproduced but the correct auditory perspective enabled the listeners to place each sound in its proper position, and to follow the movements of the actors by their footsteps and voices. For another demonstration the audience heard a soprano singing "Coming Through the Rye", as she walked back and forth in an imaginary rye field on the stage in Philadelphia. Here again her voice was reproduced in Washington with the exact auditory perspective and the singer appeared to be strolling on the stage of the Constitution Hall. (The singer was Mrs. Browning.) An experiment which demonstrated both the complete fidelity of reproduction and the effect of auditory prospective was performed by two trumpet players, one in Philadelphia at the left of the stage of the Academy of Music, and the other in Washington at the right of the stage of Constitution Hall but invisible to the audience. Alternately they played a few phrases of the same selection. To those in the audience there seemed to be a trumpet player at each side of the stage before them. It was not until after the stage was lighted that they realized only one of the trumpet players was there in person. The music of the other was transmitted from Philadelphia with such perfect fidelity and reproduced into such true prospective that it was impossible to tell that one of the players was absent. The auditory perspective effect is not restricted to placing sounds in their correct position across the stage but is 3-dimensional. This was shown by having several sources of sound move around the stage in Philadelphia. Not only back and forth but high up in the center of the stage as well. The movement of each sound was faithfully reproduced by the loud speakers in Washington. Even when the sounds were carried high above the level of the floor! I think that's sufficient to indicate what this first demonstration was. I might say that it was a tremendous success. I remember going to the performance in Washington dressed in a silk hat and a full dress suit, white vest and white tie. A large number of officials of the AT&T Co. and Bell Labs were similarly dressed. I think I have had that outfit on only two

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and Commercial Standards Monthly

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1937

"**STRINGS** and woodwinds—together," the conductor gestures during exacting rehearsal.

"**PESANTE!**" Stokowski signals to the double basses. He wears blue shirt at rehearsals.

"**CANTARE**"—first violins. Nuances of expression and gesture guide musicians in playing.

"**MARCATO**"—trombones. He seats brasses at right rear instead of usual back center.

"**READY**"—**TRUMPETS.** His most frequently used phrase during rehearsals is "Watch me." Every eye in the orchestra concentrates on the vibrant, dramatic directions of arms and hands.

or three times since then. Senator William H. King was our guest that evening. He and Lorena sat together. This performance was in April, 1933. 21 years later, April 27, 1954, that is on the 21st birthday of the commencement of stereophonic sound a demonstration similar to the one described above was produced in the BYU field house. An orchestra and speakers and actors were on the stage of the Smith auditorium and it was transmitted over to the field house by wire and reproduced by using five loud speakers. An account of this demonstration here at the Brigham Young University is given in a Speeches of the Year pamphlet in which Mr. Madison, William Wolf and myself were the speakers.

About six years after the first demonstration, that is, in 1939, we developed a recording system in which the sounds were recorded and then later were reproduced. This recording reproducing system produced the same stereophonic effect as described above. A technical description of this is given in a pamphlet so I will not try to describe it here. But again with this apparatus, very dramatic performances were possible. The first performance with it was given in Carnegie Hall and it was accompanied by a lighted stage and again it made another dramatic effect upon the very sophisticated audience of New York City. This was later reproduced in the Eastman School of Music in Rochester, New York, and later it was again produced in Hollywood in one of the motion picture houses there. It was in this demonstration that the tabernacle choir had several selections. Also the tabernacle organists had several selections and they were considered probably some of the best selections for showing the stereophonic effect. The records for these demonstrations are still preserved at Columbia University. However, the apparatus is not now available which will reproduce them. These tapes are not the magnetic tapes which are now universally used for sound recording. The recording was done on motion picture film on the old type of sound track. As I said the apparatus for reproducing is not available so there is no way of reviving these records for which I'm very sorry because there were very fine records there. Well so much then for the story of stereophonic sound.

And now just a word about Stokowski. He was a wonderful conductor and was willing to try new things. That is the reason why he was anxious to work with us on this stereophonic sound at that time. You might be interested to know that Stokowski and I

were given medals by the Audio Engineering Society for this work on stereophonic sound. Stokowski was a fine musician, but he had a different moral sense than some of us. He had three wives, not at the same time, but at different times. The first one was Mrs. Selma Semoroff. She was a noted pianist. The second one was Evelyn Johnson and she was a millionairess in her own right, being the daughter of the tin plate King, so called. And the last was Gloria Vanderbilt and he married her when she was not yet 30; she was in her 20's and he was in his 60's. This was not received very well by the society of New York and so he was somewhat ostracized for a while. However, she gave him two fine boys before they separated.

I'd like to relate my relations with him because they are comical and peculiar. When he was married to his second wife, Mrs. Evelyn Johnson, he was to be the conductor for a new opera at the Metropolitan Opera. Lorena and I were invited to attend it and sit in his box. So 'we went and were received very graciously by Mrs. Evelyn Johnson. But to our surprise during the intermission in came his first wife, Mrs. Selma Semoroff with her daughter and they sat and chatted with each other and one said to the other one, "My, wasn't he wonderful tonight", and so forth. Well, we couldn't quite understand that fine relationship when one of them was a former wife and she was apparently on very good terms with the present wife.

We visited the Stokowski's out in Connecticut and became quite well acquainted with them. The next incident which surprised me was in New York; Mr. Stokowski called me and said he wanted to see me. I asked him where he was and he said in a penthouse up on Fifth Avenue. He gave me the address so I went up there and it was a rather fancy front and the doorman asked me who I wanted to see. I said I wanted to see Mr. Stokowski. "Oh", he said, "Mr. Stokowski doesn't live here, you are mistaken. Mrs. Semoroff Stokowski lives here but not Mr. Stokowski." "But", I said, "he just called me and gave me this address." "Oh, he did. Well maybe I'd better telephone then", and he telephoned Mrs. Semoroff Stokowski's apartment, and he came back kind of shaking his head and said, "Oh, he's there all right." So I was permitted to go up to Mrs. Selma Semoroff Stokowski's apartment where I had a talk with Stokowski on the matters he wanted to discuss. Apparently he was on friendly terms with both of his wives. The next time that I met the Stokowski's was in Santa Barbara. I was down there for a meeting of

OFFICE OF THE PRESIDENT

LEROY E. COWLES, PRESIDENT

UNIVERSITY OF UTAH

SALT LAKE CITY 1

May 24, 1944

Dr. Harvey Fletcher
Bell Telephone Lab. Inc.
Murray Hill Laboratory
Murray Hill, New Jersey

Dear Dr. Fletcher:

We are looking forward with a good deal of happiness to your visit with us at Commencement time. I presume that you will arrive in time to take part with us in the Baccalaureate Service, Sunday afternoon, June 4, and to attend the tea given jointly by the University of Utah Women's Club and the President and his wife.

On Tuesday, June 6, we have arranged for a luncheon immediately after the Commencement Exercises. We hope that you will accept the invitation to take lunch with us on that occasion. I am hoping, too, that you will bring your wife with you and that she can also attend the tea and the luncheon.

Very sincerely yours,

LeRoy E. Cowles

President

the Organization for the Hard of Hearing and I learned he was there. I went over to where they were building a house. There were the two of them, Mrs. Evelyn Johnson Stokowski and Mr. Stokowski. He was a sculptor in his early manhood and he was using a chisel and cutting a block and they had a man who was waiting on them bringing them mortar and they laid the stones the way they wanted them. He said that's the only way to build a house and when you build it with your own hands you appreciate it. Well, I thought that was rather interesting. But this lasted only about three or four months. I read in the paper that Stokowski had gone from Hollywood to Europe with Greta Garbo and apparently that was the end of this marriage because he traveled with her all over Europe although they weren't married. After returning I didn't hear much about Stokowski, except I did hear about the former Mrs. Evelyn Johnson Stokowski because I got an invitation to her wedding with a Russian count. So that ended our relations with that couple. Well I think it was four or five years later that Stokowski married this Gloria Vanderbilt and I was invited up to their house one day for a conference with Stokowski. The house was on the East Side of New York and it was quite a sight to go into the house. All the walls, instead of being paper, were painted with modern art; some of the most bizarre figures you ever saw. I learned that it had all been placed there by Gloria Vanderbilt. She apparently was a painter. Well, at that time we were discussing this new institute of music that we had hoped to get going but unfortunately the project failed. People were more interested in war than they were in developing music just at that time. The Korean War had just started. Well, so much for our relations with Mr. Stokowski.

I think next I should talk about the story of Pupin. It was in the Fall of 1934, the year after this demonstration of stereophonic sound that George Albert Smith came to New York City. He telephoned me and said he would like to get an appointment to meet Professor Pupin who was then the Professor of Electrical Engineering at Columbia University. I might tell you a little about Professor Pupin. He had invented a communication loading coil. It was a coil which could be put on the telephone lines spaced at specific distances to reduce the attenuation of the electrical speech waves which were traveling along the wire. With its use, they could use much smaller gauge wire, and therefore considerably cheaper wire, and the speech sounds would be

Feb 11 1946. NEWSWEEK

Noted Inventor, Dr. Fletcher Honored Today

Dr. Harvey Fletcher, director of research, will be honored at today's assembly for the part he played in the development of stereophonic sound, which is currently being used in cinemascope movies.

This assembly will be a demonstration of how stereophonic sound works and in many ways will be a duplicate of the first demonstration of the system on April 27, 1933. That first demonstration was under the direction of Dr. Fletcher, who was at that time director of acoustical research at the Bell Telephone Laboratories.

To Be Broadcast

Part of the program will be conducted from the Smith Auditorium. It will be broadcast in the George Albert Smith Fieldhouse through five loudspeakers spread across the main floor of the Fieldhouse.

Some of the items scheduled on the program in the Auditorium that will illustrate the use of stereophonic sound are an orchestra number, a vocal solo with the soloist walking from one side of the stage to the other, a skit, and a trumpet solo.

Birthday Celebration

Dr. Wayne B. Hales will be in charge of the committee that has prepared the program to honor the 21st birthday of stereophonic sound and Dr. Fletcher, one of the pioneers in its development.

Other members of the committee are Prof. Stewart Grow, Dr. John Halliday, Dr. Harold I. Hansen, Leland Perry, Francis Boyer, Arch Madsen ,and Pres. Harvey Taylor.

Mathematical Music

From the long, shallow box came the vibrant diapason of an organ, so strong that it shook the walls of the McMillin Theater at Columbia University. It was followed by the boom of a drum, then the deep voice of a cello, and the ringing tones of a big bell.

These sounds, precise in tone and quality, were not created by standard instruments. They were reproduced mechanically and mathematically by the tone synthesizer, an electronic device demonstrated last week at the conference of the American Physical Society in New York by Dr. Harvey Fletcher of the Bell Telephone Laboratories.

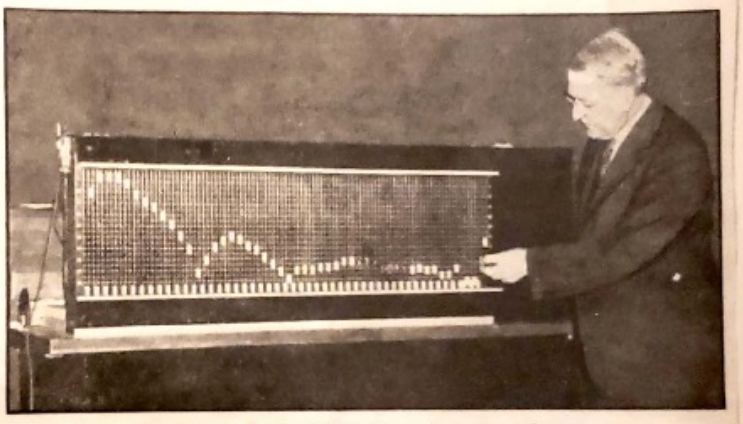
The machine contains 100 variable potentiometers, connected by wires with electronic tubes. Each represents a different tone quality, so that not only every known instrument, plus the human voice, can be accurately reproduced, but also many new tones not made by musical instruments.

From a practical viewpoint, the synthesizer is of value chiefly as a purifier of musical sound. Instead of depending on the human ear, notoriously imperfect, physicists can now select the sound of an instrument and by analyzing the physical factors involved and reproducing these factors on the machine, produce a perfect tone.

The Synthetic Cello: For instance, to reproduce the tone of a cello playing the note A, the operator sets the first potentiometer at 440, the number of cycles in a single vibration of a cello string. The second potentiometer is moved to the position of the first harmonic, 880, and the third potentiometer to the next harmonic, 1,320. All the sounds are then transmitted by electric wires to a rotating smooth shaft which records them magnetically, so that when a button is pushed, the sounds registered by the potentiometers are all played at once. The combination is a perfect reproduction of a cello playing the note A.

Experiments with the tone synthesizer have already indicated certain musical characteristics not usually recognized by musicians. Although it is accepted that loudness depends chiefly on intensity of sound, the synthesizer proves it also varies with frequency of the sound waves and with the individual tone quality of the instrument itself. If you take two notes, one octave apart, and starting at the top of the scale, play each one at the same intensity all the way down, the lower notes will decrease in loudness until the lowest cannot be heard by the human ear.

Pitch varies principally with frequency, but it is also affected by intensity of sound and by the instrument's own overtones. And quality, according to the Bell Telephone scientist, depends not only on these overtones but also to a lesser degree on frequency and intensity.



Dr. Harvey Fletcher demonstrates the tone synthesizer

To Weeds It's a Fiend

For years, Department of Agriculture scientists had experimented with a strange, hormone-like chemical—2,4-Dicholophenoxyacetic acid, or 2,4-D for short. It was a weed poison; yet at the same time it ripened fruit and promoted growth. On vegetation that it destroyed, the chemical acted in a weird manner. Absorbed by the stem and roots, it caused strong organic contortions until the plant literally "died in agony." Leaders of the "poison" experiments in the department's "weed project", who say there is "ample capacity in manufacturers' plants" for production, have announced a wide range of practical uses for 2,4-D:

¶ To ripen bananas more rapidly than after ordinary picking, to speed up the ripening of green apples, pears, and other fruits, and to make apples cling to the

satisfactory. The Bell Telephone Laboratories gave him about three million dollars for his patents on this coil. His patents consisted of three or four pages of mathematics. He had become quite famous over this invention and at the time was the President of the American Association for the Advancement of Science. It was difficult to get an invitation but two of my friends knew him well, so he did invite us up to his house and he also talked with President Smith. The first thing that President Smith did was to hand him a card with the articles of faith on it and then they started to talk religion. Well, Brother Smith knew from Pupin's writings that he was a religious man and that is why he wanted to talk to him. Well, this luncheon went off very well although at the time Professor Pupin was rather feeble, he could hardly stand up, he was getting old. I didn't think much about that until later. I think it was two or three weeks later an article came out in the New York Times. I have it before me now. It is dated March the 14th, 1935. A column on the front page has this title, "Pupin Invisioned Life Beyond the Grave". It's a very interesting statement by Professor Pupin. It sort of astonished everybody that he would write a religious article like that since he was always writing scientific articles. Apparently he had deep convictions that there was life after death and he so stated that in this newspaper article. Well, it was shortly after this that I got a notice from Columbia University that they were going to honor me by awarding an Honorary Doctor's Degree at the spring convocation. I couldn't imagine who at Columbia had suggested my name. I thought it might have some connection with the demonstration the year before at the National Academy of Science but anyway I was very happy to know that they were to give me such an honor. President Butler usually asks the persons getting Doctor's Degrees to have dinner with him the night before the convocation. So Lorena and I were privileged to go to his house and listen to him tell about all the presidential elections for the last 30 years. He was a staunch Republican. Then just as the guests were leaving he came to me and said, "It's our usual practice not to say anything about who nominated our candidates for the Doctor's Degrees, but in your case, it's a little different. Professor Pupin passed away a couple of months ago and he's the one that nominated you for an honorary Doctor's Degree." Well, that was very interesting. But still more interesting was the fact that when I sat down to luncheon the next day after the convocation ceremony, I looked up and I saw that I was sitting right under the life

size portrait of Professor Anton. Well, you know the story of Professor Anton; he's the one whom Martin Harris came to see at Columbia University. He had copied some characters from the plates and he also the translation into English and asked Prof. Anton if these were translated correctly. So this makes quite a story. I was impressed with it and I took a photograph of Professor Anton and I still have that color photograph. I've been going to have it enlarged and send it to the Church history office but I haven't yet done it. It's among the colored slides and I hope to do it one of these days.

Here is another story connected with the awarding of an honorary doctor's I degree. In 1943, during the war, the Case School of Applied Science decided to award an honorary Doctor's Degree to me. Lorena and I went to Cleveland at the convocation time to be so honored and we arrived on Saturday. They had meetings on Saturday, Sunday, and Monday. One of the faculty members, Dr. Shankland, the head of the Physics Department, was designated to take care of us during the time before the convocation and he was very nice. He introduced us around and showed us some of the important activities there. On Saturday night he said, “Now tomorrow morning is Sunday and I'll be glad p to come and call for you and take you to the Mormon Church.” He knew that I belonged to the LDS Church. I said, “Well that will be fine.” I didn't know just where it was; I wouldn't have been able to find it myself. “Oh,” he said, “it’s very conspicuous; it’s one of the nicest churches around here. As a matter of fact I was raised on a farm about two or three miles from where your church stands.” Well that was very interesting to me but I was quite puzzled by that statement. He said, "I think they call it the Kirtland a Temple." His statement then became clear. I had then to explain to him the Kirtland Temple once belonged to the LDS Church and a lot of very sacred history was connected with it. When the prophet Joseph Smith died, his wife, Emma, inherited all of the Church property as it was held in her husband's name. She inherited the Kirtland Temple as well as some property in Nauvoo where the headquarters were later established. He was quite surprised. However, I said I would very much like to visit the Kirtland Temple. He met us and took us over that there in his car. He had made arrangements for the caretaker to meet us. We stood in front of the temple and read the inscription over the main doorway. It says essentially that due to the decision of the Supreme Court, this temple was awarded to the Reorganized Church

Dr. Harvey Fletcher

Battery Commander; Lieutenant R. E. Rohleder is Executive Officer. I would like to express the thanks of the Laboratories and of the audience to the officers and men of this Battery for their participation in this program.

Dr. Harvey Fletcher, Director of Physical Research, Bell Telephone Laboratories, then took over the speakers' rostrum:

It is probably a common notion that to fire a gun so as to hit a target it is only necessary to point the gun at the target. This, of course, is true in most small fire arms where the target is near so that the time of flight of the projectile is only a few seconds. However, when firing a gun at a target moving with the velocity of an airplane, to follow this procedure would result in misses of two or three miles. It is therefore evident that in order to control anti-aircraft gunfire so as to score hits, it is necessary to make calculations as to how far ahead of the airplane to shoot and how high above it so that the projectile traveling in its curved flight will meet the fast-moving target. In order to do this it is evident that one must take into account the velocity of the projectile as it leaves the gun and the forces acting upon it after that. To perform these computations by the usual methods, even though all the information could be obtained quickly, would require so long a time that the result would be obtained too late to be of any use. Consequently means must be provided for obtaining the pertinent information and making the calculations very quickly so that the gun may be fired at the earliest possible moment and continuously thereafter.

The apparatus which we are demonstrating today, called the electrical gun director, is a combination of devices for obtaining the necessary information and making predictions for controlling the gun so that projectiles fired from it will meet the moving airplane and explode in its path. As you have heard, these directors are now in production and are being sent to many fighting fronts. We understand they have gone to Fiji, Caledonia, the Aleutians, Sicily, New Guinea and Panama. Thus is fulfilled a dream that some of our engineers had more than three years ago.

It was the defeat of the Allied armies in France that started a number of Bell Labs engineers and research workers thinking about new military devices that might prevent these conquests from spreading. It was then that the idea of the electrical director was born; and within a short time plans were on paper for apparatus which would automatically make anti-aircraft fire control calculations. It has been a long, hard road from those early engineering sketches to the finished directors now coming off the production line.

I wish to add my tribute to that of Dr. Buckley's to this group of experts who were gathered together to do this job, for their wonderful performance, their devotion and enthusiasm in carrying this project to a successful conclusion. During the more critical periods of the work these men were organized into three shifts so that work could proceed continuously 24 hours a day. At all times hours meant nothing to them—they were intent on getting the job out at the earliest possible moment.

The electrical director is associated with a battery of four guns and an optical height finder such as you will see today. It consists of four separate units which are transported in a trailer, namely, the tracker, the

of Jesus Christ of Latter-day Saints. I explained that this was not the church to which I belonged. It had the same name without the reorganized in it. We were very interested in seeing the inside of the temple and I was struck with the similarity of the Kirtland Temple with the room in the Salt Lake Temple, on the top floor, the Solemn Assembly Room. The Aaronic priesthood pulpits are on one end and the Melchizedek priesthood pulpits on the other end. Also the colors were almost the same, black and white. The guide took us up to the third story where very sacred things took place. He showed us the room where Joseph and Sidney Rigdon had that great vision of the Savior in which they gave the very forceful testimony that we find recorded in the Doctrine and Covenants. I was very much impressed by this interview at this time. There were many others things that were interesting. I had a discussion about where the prophet's mother was buried, whether it was in the cemetery there back of the temple or elsewhere. I understand she started west and was buried on the way, I think at Winter Quarters. This can be easily checked in our Church history, however there’s one more story which I would like to include here. Barkhausen is a well-known name to physicists because he was the one who first noticed what is called the Barkhausen effect. It's a noise produced by the magnets turning when a piece of iron is placed in a magnetic field. He was the president of the Hoch Shule in Dresden which was an institution somewhat like the Massachusetts Institute of Technology and when we went abroad in 1937, Lorena and I were invited to his home. This was when the Nazis were in full power before the war. He took me through the Institute. He showed me a tube which was not as powerful as the radar tubes we use now but it would give a much larger output than anything then known in America. I brought this information back to the laboratories and they thought I had misunderstood his figure because its power capacity was so large. Later in the war, tubes with greater power were developed here. The thing that I wanted to tell about happened at the dinner table. There was quite a commotion and he started talking in German and we couldn't follow it but he told us later that the Nazis had just abducted their son who was about 13 or 14 years old and put him into one of those Hitler boys’ camps. He obviously did not like the Nazis but he couldn't do anything about it being in one of the Government schools there.

Well, so much for that introduction. Now here comes the part after the war. After the war, I got a letter from him about three or four months after the war, the first winter. He told me about the terrible bombing of Dresden. They went over it three times, the allies, I think the U.S. Air Force. Since they had no resistance, they had complete control of the air so they went over and dropped the blockbusters. When they fell to the earth, they exploded and blew up the houses. They went over it with a lot of oil and saturated as much as they could of the city with tons and tons of oil. They went over it next, a third time with a fire brand and set the whole city on fire at once. I haven't the accurate reports, but he reported that there were over 100,000 people killed not because they were blown up or wounded but because the oxygen was all burned up and they suffocated, they couldn't breathe. He was away the time this happened. He came back after the war and tried to get into his house and of course the windows were all shattered. The University library was completed burned up, and most of the buildings. But they tried to start the school again but with great difficulty. They had no fuel, the fuel lines had been all blown up and they had no lights, they couldn't get any kerosene or anything. The Russians let them have candles for about an hour and a half each day. But since the windows were broken they had to board them up so it was dark in the house all the time. So that was the situation. Well, he wrote that he had frozen his feet and frozen his nose because they had no heat. They cut all the trees down from the campus and distributed them to the teachers and the students. That only lasted part of the first winter. He didn't care so much about that but all the books in the library had been burned and he was in the process of writing a book when the war started and he wanted to get some more books on that subject. Well, I got some of the literature together and sent it; and I also got a bucket full of tallow, candle tallow, which they said would burn for four or five months with a wick in it and I sent this to him and he got all these things. It was before the relations between the U.S. and Russia became rather tense and he wrote me a letter thanking me for it. Then he said that all the neighbors gather around this candle because the Russians didn't object since it had been sent in there from the USA. After this the curtain was drawn by Russia and no letters or books were permitted to reach their intended destination.

Another story which I will call, “The story of the Sacred Quilt," is as follows:

When Lorena was a young girl she noticed her mother had a prized quilt which she used only with important guests. It was made in St. George by the Relief Society. They used the raw silk which was processed there in St. George. Each member sewed a small piece and then embroidered their name across it. So it was a beautiful spread. When Lorena's mother and father died, Lorena finally inherited the quilt. She took it back to New York and guarded it there with particular care. She didn't know just how they happened to get such a unique bed cover.

When Lorena was president of the Women Engineering Club in New York, they decided to have a fashion show. Lorena suggested that they try to get Bonwitt Teller to give it and they all agreed. As fate would have it, a woman who was born and raised in St. George was now owner and president of Bonwitt Teller and came along with the girls giving the fashion show at the Engineering Women's Club house. Her name was Hortense McQuarrie as a girl. I have forgotten her married name. Lorena knew this so she took the prized quilt to the fashion show with her. She thought Hortense might know something about the quilt, so when the fashion show was over Lorena told Hortense she had something to show her. She then proudly spread out the quilt for Hortense to look at. Hortense then exclaimed, "Oh, Oh, Oh, I know all of these ladies and there is mother's name." She then stopped abruptly and looked at Lorena and said, "Who are you?" Then Lorena gave her name. "But what is your maiden name. She then said, "Chipman." "Well, well," she exclaimed, "I was engaged to your brother Howe, and my mother was nearly engaged to your father." Of course this was all new to Lorena. Hortense then asked Lorena if she could take the quilt home to show her mother who was then living on Long Island. Of course Lorena consented. Two days later a fine limousine drove up in front of our house in Broadway, Long Island. The chauffer helped an elderly lady out who came to our house and rang the bell. I was home at the time and she introduced herself as Ella McDuarrie Hatch, and was the mother of Hortense.

She told us that she and her daughter had laughed and cried for a long time looking at this quilt, and recalled many incidents that happened while they were making it. The Relief Society took it to Cedar City and sold it at an auction sale and Brother Chipman bought it. She then told the love story of her and Stephen L. Chipman--a story Lorena had never heard before.

office of the president

BONWIT TELLER

fifth avenue new york

November the ninth
1 9 3 9

Mrs. Harvey Fletcher
3206 - 161st Street
Flushing, Long Island, N.Y.

Dear Mrs. Fletcher:

This is rather a belated note, I know, to tell you how much I enjoyed meeting you at the American Engineering Women's Luncheon and how delighted I was with your thoughtfulness in giving me the quilt.

I feel sure you will be interested in knowing that Mother and I sent the quilt to the Museum in St. George, with a little note explaining the circumstances. I know they are just as delighted and grateful as I am.

With my thanks, again, and with kindest personal regards, I am

Sincerely yours,

Hortense M. Odlum

HMO:r

She and brother Chipman--then Ella and Steve were going to school at the BYA. Steve wanted to take Ella to the Chipman Reunion which was being held in American Fork. He had to get the consent of Brother Maeser before he could do this. So they both went into his office and Steve explained what he wanted. Brother Maeser said, "Stephen do you love Ella?" Steve replied, "I believe I do." He then turned to Ella and said, "Do you love Stephen?" and she said, "Yes, I certainly do." Brother Maeser then said, "Stephen I think you better go alone." So Steve did go alone and met at this reunion a girl named Sine Neilson, who later became Lorena's mother. Ella claimed that Brother Chipman bought the quilt because her name was on it.

Mrs. Hatch certainly beamed as she was telling this story. She also said her daughter Hortense also kept company with young Steve for some time but finally broke up. Hortense, the President of the Bon Wit Teller had already started a museum down in St. George which houses some of the things that were precious to the early settlers there. Hortense and Ella both asked Lorena if they could put this quilt in the Museum and Lorena consented. It is supposed to be there now.

After the last demonstration of Stereophonic in Hollywood, the last world war was already begun. Germany, England, France and Russia were already involved and it was obvious that we would soon be involved. Recruiting from the Bell Labs and other parts of the country for war research had already begun. During the war period, my research was in the general field of acoustics and was under the general supervision of O.S.R.D. I had charge of groups working at:

Harvard University, California Institute of Technology, University of Pennsylvania, North Carolina State College, Rutgers University, Stevens Institute of Technology and three or four groups at the Bell Labs.

Most of this research work was secret and a group effort. I received several citations for this work, one signed by President Truman. See appendix B.

After the war was over there was only three years left before my retirement. All the free time from executive work during this time was spent on two projects. One was the finishing the work on an "Empirical Theory of Telephone Quality". I had worked on this off and on for nearly 25 years. The complete theory was published in the last edition of "Speech and Hearing in Communications."

Bell Labs' Transistor Marks Twentieth Year of Service

Just 20 years ago the transistor was invented at Bell Telephone Laboratories, research and development unit of the Bell System.

On December 23, 1947, Bell Labs scientists John Bardeen, Walter Brattain and William Shockley showed that a small piece of the element germanium could be made to amplify a speech signal about 40 times. Later, in 1956, the trio was given the Nobel Prize for discovery of the transistor effect.

The invention has resulted in the growth of a multibillion-dollar transistor industry with scores of companies employing hundreds of thousands of people. Transistors are everywhere—in homes, banks, automobiles, factories—even on the ocean floor and in outer space. They activate hearing aids, and television sets, TV sets, hearing aids, and telephones. They control industrial equipment. They drive wristwatches and power tools; they even drive locomotives. They make complex calculations in giant computers and process TV pictures from the moon. They even prolong life with "pacemaker" heartbeats.

Transistors have played a vital role in communications and information processing. In telephony the undersea cables, central offices and radio transmission are either made possible or greatly improved by transistors. Today's giant computers contain over 100,000 transistors, connected together to enable the machine to make millions of calculations per second.

Transistors are able to perform all of the functions of vacuum tubes. They can amplify electrical signals, act as oscillators or control and combine pulses of information. For practically every application they are less expensive, more reliable, smaller and consume less power than vacuum tubes.

The transistor is not only one of the great inventions of the twentieth century; it has also led to a host of advances in other scientific fields. For instance, zone refining was invented at Bell Labs by William Pfann to purify transistor materials, and made ultra-pure materials available to all sorts of technical and scientific uses. The increased interest in the properties of solids has led to other "quantum electronic" devices, such as lasers, masers, amplifiers and light modulators. The study of surface properties of materials, vital to transistor technology, has progressed to a point where active atoms can be deposited in single layers in one-in-a-million concentrations.

Today, transistor technology has been applied to making "integrated circuits"—complete electronic circuits fabricated on one paper-thin wafer of material. An integrated circuit containing 50 to 100 transistors and other circuit elements can fit on the head of a pin.

From vacuum tubes, to transistors within protective cans, to tiny integrated circuits—a short history of increasingly efficient amplification of electrical signals. The silicon integrated circuit on the right, one of the latest designs of Bell Telephone Laboratories, contains a total of 22 transistors and other components and helps generate the musical dial tones in the new Touch-Tone telephones. The newest integrated circuits have protective coatings and do not need the protection of a can.

This miniaturization is important for compact equipment like the telephone; moreover, along with size it means reduction in cost and increase in operating speeds. Today, tiny transistors and other components in an integrated circuit can perform a function at 100 times less cost and with 1,000 times the reliability of doing the same job with vacuum tubes.

Through the invention of the transistor and its resulting development, the future of our society has been profoundly affected. Better worldwide communications, automatic control equipment and the ability to process large amounts of information are vitally necessary to modern life.

Vol. 1
No. 1

The MESSENGER

Dec., 1951

A Brief Report from Brigham Young University

A Famous Scientist Comes Home

When Dr. Harvey Fletcher, noted scientist, takes up his duties as research director at Brigham Young University next September, one of the university's most famous alumni will be coming home to his alma mater.

The great acoustics engineer was graduated from BYU in 1907 with a bachelor of science degree. From there he went on to Chicago University where he received his Ph.D. degree, summa cum laude, in 1911. After teaching at BYU until 1916 he joined the Western Electric Company's engineering department which later became a part of Bell Telephone Laboratories. And in that position he has become one of the most honored scientists in the nation.

The important appointment is in line with the policy of President Ernest L. Wilkinson to strengthen the BYU faculty and develop the academic service of the university to the students, Church, industry and the nation.

Dr. Fletcher will headquarter in the new $2,000,000 Physical Science Building, the finest of its kind between the Mississippi River and the Pacific Coast. The building was largely planned and fostered by Dr. Fletcher's brother-in-law, the late Dr. Carl F. Eyring, who made ample provision for accoustical and other research.

Dr. Fletcher's presence on the campus will mean the advent of a new era in BYU research. Undoubtedly the famous scientist will attract much research to the university which is now well equipped to serve.

Dr. Harvey Fletcher, appointed research director

Recognized throughout the world as one of the leading accousticians, Dr. Fletcher has patended 18 inventions which have been of incalcuable value to the radio, telephone and motion picture industries and to the U. S. military services They have assisted the deaf to hear and the dumb to speak. He has written 52 major works for professional publications and his new book "Speech and Hearing Communication" will be off the press in 1952. He is undoubtedly one of the most honored living scientists with recognition from numerous learned societies and universities.

For nearly half a century, Dr. Fletcher has contributed immeasurably toward an understanding of the fundamental nature of speech and hearing. The results of his work appear in the design of microphones, equipment for electrical recording of all nature of sounds, and the development of loudspeakers which reproduce sound with high fidelity.

An impressive number of "firsts" run through Dr. Fletcher's career. He was first physics student at Chicago University to receive the high honor summa cum laude; first member of the Church of Jesus Christ of Latter-day Saints to be elected to the National Academy of Sciences; first and only member of the Bell Telephone Laboratories (8000) persons to be elected president of the American Physical Society; first president and co-organizer of the Acoustical Society of America; member of the first executive committee and co-organizer of the American Institute of Physics; first to introduce the group audiometer into the school room and thus start the program of testing the hearing of school children, a practice which is now going on in most schools of the nation.

Dr. Fletcher's work has brought him numerous awards for scientific contributions. These include the Louis Edward Levy Gold Medal presented in 1925 for physical measurement of audition; honorary membership in the American Otological Society; honorary membership in the Acoustical Society of America; the Motion Picture Engineers Progress Medal Award in 1949, and recognition by the Audio Engineering Society, Franklin Institute, American Society of Speech and Hearing, the U. S. Navy and the U. S. Army. President Harry S. Truman recently honored the Utahn for his scientific contributions to the nation's defense.

Dr Fletcher comes to BYU convinced that he can do much good for the Church university, and has expressed the desire to do his part toward helping a great institution fulfill its destiny.

Tentative
In Sessions Th

A department of engineering science
Brigham Young University.
President Ernest L. Wilkinson announced
closes this week that the Board of Trustees has a
ahead on a study for the institution of engineeri
The addition represents one of the most
ments in Utah education in recent years. With
the new BYU department, engineering training
all three major colleges.

Dr. Harvey Fletcher, head of
Bell Telephone Research Labora-
tories and lecturer at Columbia
University, is expected to partici-
pate in setting up the new depart-
ment. The world-celebrated scien-
tist has been appointed director
of research at BYU and will take
up his duties at the beginning of
the regular school term next
autumn quarter.

Fletcher Visits Campus

He visited the campus this
week for a preliminary survey
and expects to visit several times
during the summer to direct pre-
paratory activities for research
and the new engineering school.

The plan now envisioned by the
university faculty would be some-
what of a departure from the us-
ual engineering school setup. Dr.
Wilkinson explained that BYU en-
gineering students would receive
a liberal arts education as well as
technical engineering training.
The accent will be on a broad
scientific background instead of
narrow specialization.

More Liberal Education

"We do not wish to turn out
more technicians," Dr. Wilkinson
explained. "We hope to give the
BYU-trained engineer better train-
ing in liberal education and equal
training in engineering subjects."

In order to accomplish this end
he pointed out, the course would
extend five years. A bachelor's
degree would be awarded after
four years in engineering science
but the fully-trained engineer
would have to attend another
year to obtain the equivalent of

PLAN ENGINEERING SCHOOL—Dr. Harvey Fletcher
and Pres. Ernest L. Wilkinson confer on future plans

BRIGHAM YOUNG
UNIVERSE

Vol. 4, No. 26 Thursday, Jan. 31, 1952 Provo, Ut

The other project was the formulation and exposition of the "Dynamic of the Cochlea". This is also in the last edition of my book.

I retired from the Bell Telephone Laboratories October, 1949. From then until January 1, Lorena and I had a vacation and spent most of the time in Utah. From January, 1950, to January, 1952, I took a position in the department of Electrical

Engineering at Columbia University. During this period I started a department on acoustics. When I left, I recommended that Cyril Harris be made head of that department. He has been head of it from that time until now (1967). The Bell Tel Labs donated the elaborate stereophonic equipment to Columbia University and I had it set up and working before I left. I had hoped to transfer the sound recordings on the four tracks on the motion picture film to magnetic tape tracks. At that time there were no four track magnetic tape machines made so I had a company develop one for me. It took longer to develop it than I had expected and it was delivered only a short time before I left Columbia. During the short time I had to work with it the machine did not function properly. . So I was never able to transfer these fine records to magnetic tape. Dr. Harris and other executives at Columbia tentatively promised to have it done. Their interest soon turned in other directions and it was never done. The records and apparatus including the three loud speakers are still at Columbia University, probably in storage. It was during this period at Columbia that I was able to complete the text for the book, "Speech and Hearing in Communication." This book appeared in print in 1953, during my first year back at BYU in Provo.

The Bell Labs spent considerable money in helping me produce the two books, "Speech and Hearing," published in 1929, and "Speech and Hearing in Communication." While I was still an employee there, the company collected the royalties. However, after I retired they kindly granted all the financial returns from the sale of these books to me. I have been receiving royalties ever since that time.

So the latter part of June, 1952, we came back to Provo and BYU. We moved into the house at 1615 N. Willow Lane. Two years later we purchased the lot just west of us and made it into a beautiful garden. Also we changed the cement driveway, and enclosed the back porch with glass. So we were very comfortable and proud of our home at 1615 N. Willow Lane. Lorena and I lived here for 14 1/2 years before she died January 2, 1967. We made and cherished many friends during this time. Lorena and I had lived together more than 57 years.

My first assignment at BYU was director of research. I found that small grants from commercial companies had occasionally been made. I was amazed to find that there was a policy of the University that no money from such grants could be paid as a salary

to research workers. The money could be used only to buy supplies and apparatus. During the first year I was able to change this policy. I made a vigorous effort to obtain more and larger grants, which always provided that part of the money was used as a part-time salary of the faculty member research worker and his assistant. This has been the policy since that time.

Before the first year was over I was asked to join a group called together by President Wilkinson to consider the formation of a department of engineering. After explaining what I thought should be the program in such a department, President Wilkinson asked me to be head of it and organize the faculty and the courses of study. So at the end of the first year I held two positions; namely Research Director and Chairman of the Department of Engineering Science. I was not released from position as Director of Research until the fall of 1955, when Dr. Tracy Hall took the job. During the first year we outlined courses for the various engineering branches. Glen Encke helped in this work. So a department of engineering was announced to commence in the fall of 1953. This could be done as nearly all of the first year courses were al- ready being given. During this year I hired Jens Johnson to head Electrical Engineering, Harry Hodson for Civil Engineering, Leland Baxter for Mechanical Engineering, and Billings Brown for Chemical Engineering. With the help of these four men we set up the courses and ordered the laboratory equipment so that at the beginning of the third year 1955-1956 we were a going concern.

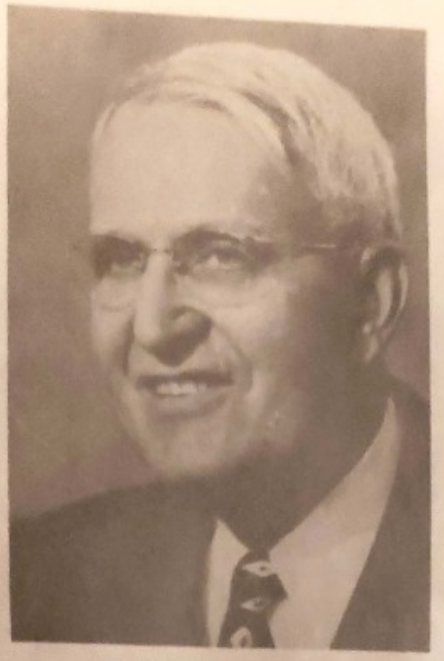
During the second year the University was divided into an entirely new set of colleges. I worked with President Wilkinson and others in this. As a result one of these colleges was the College of Physical and Engineering Sciences.

In the fall of 1958 I was able to induce Dr. Armin J. Hill to be the Dean of this college and he still holds this office.

I taught mathematics and acoustics for two years then turned my attention exclusively to research. From 1961 to 1965 I was able to obtain funds from the National Research Foundation to support the research work on Musical Acoustics. From 1965 on I have tried to continue it without funds or salary. As a result of this work I and my various research assistants have been able to publish five papers as follows:

Quality of Piano Tones

Man — Noblest Work of God"



DR. HARVEY J. FLETCHER
Guest Speaker

Men's Week

April 27 – May 2, 1964

RICKS COLLEGE REXBURG, IDAHO

ASSOCIATED MEN'S STUDENTS

Men's Week Devotional Assembly

April 27, 9:30 A.M. – Oscar A. Kirkham Auditorium

Organ Postlude ..... Ruth Barrus
Welcome Remarks ..... John L. Clarke
President of Ricks College
Conducting ..... LeRoy R. Cobia
President of A.M.S.
Men's Choir ..... "Jesus My Savior True"
Conbined Men of Ricks and A Capella Choir
Murell K. Johnson, Director
Invocation ..... Steven Nadauld
Men's Choir ..... "Rise Up Ye Men of God"
Introduction of Speaker ..... Gordon A. Dixon
Head of Department of Mathematics and Natural Science
Guest Speaker ..... Dr. Harvey J. Fletcher
World Renowned Scientist, B.Y.U.
Presentation ..... Artell G. Chapman
Chairman of the Division of Mathematics and Natural Science
Benediction ..... Barry Craven
Organ Postlude ..... Ruth Barrus

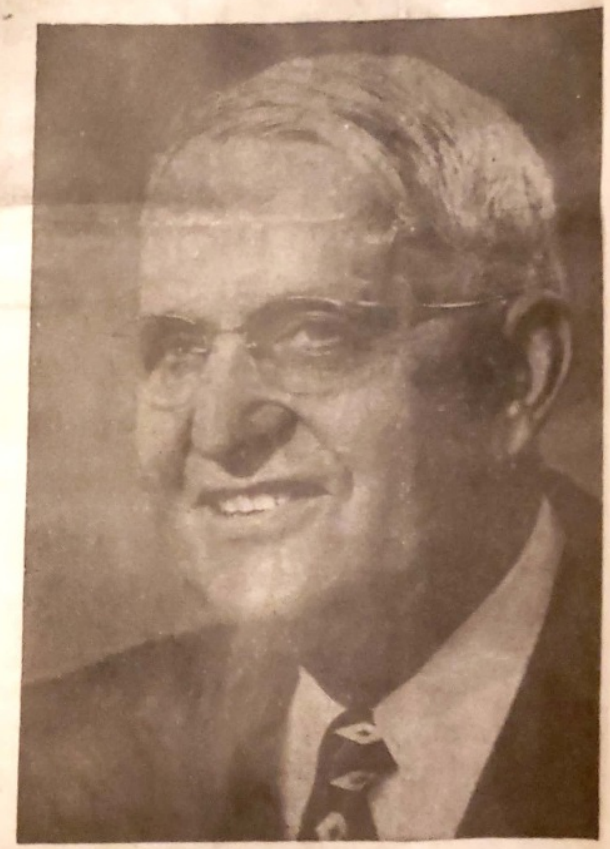
Dr. Harvey Fletcher to be Honored As Ricks College's 'Man of the Year'

Dr. Harvey J. Fletcher, currently professor of mathematics at BYU, will be honored today as the Ricks College Man of the Year.

Harvey J. Fletcher was born in Provo, Utah, September 11, 1884, the son of Charles E. and Elizabeth Miller Fletcher. He obtained his bachelor of science degree at the Brigham Young University in 1907. That same year he went to the University of Chicago to do graduate work and there at the Ryerson labortory with Professor Robert A. Millikan, he worked on the history-making Oil-Drop Experiment which determined the charge-to-mass ratio of the electron. This was the first empirical proof that electricity is composed of particles having a definate mass and ultimate charge.

In 1911 the University of Chicago granted Dr. Fletcher his Ph.D degree. Following his graduation of University of Chicago he joined the Bell Telephone Laboratory where he took over as director of physical research in 1961. In 1953 he retired and came west to lend his experience and teaching to B.Y.U.

He has been awarded the Louis Edward Levy medal for physical measurements of audition, in 1924, and was the author of **Speech and Hearing** in 1929. He has contributed to papers on electronic charges and theories of hearing.



Dr. Harvey Fletcher, who will be honored as Man of the Year.

Natural Frequencies of a Stiff Piano Wire

Quality of Organ Tones

Quality of Violin, Viola, Cello, Bass Viol

Tones Without Vibrato

Quality of Violin Tones with Vibrato

These were all published in the Journal of the Acoustical Society of America. During the summer of 1958 Lorena and I joined 18 other persons and made a tour around the

word. There is a large collection of color slides and memorandum elsewhere so I will not include it here.

Soon after arriving home from this trip we celebrated our 51st wedding anniversary. The two back lawns were beautifully decorated with lights and flowers. Most of our family were here and a large number of friends. Everybody seemed to have a good time and it was a notable occasion for us. A large number of color slides will remind you of this occasion. Also the numerous photographs will show the size of each of the grand children at that time.

In the summer of 1960 we went again to Europe to see the festivals and principally to see the Passion Play in Oberammergau. Four couples under the guidance of Dr. Harold went together on this trip; Preston and Maurine Hughes, Jean and Lewis Crandall, Gene and Mrs. England, Lorena and I.

a set of pictures which describes it. [note- this was a dangling sentence in the original]

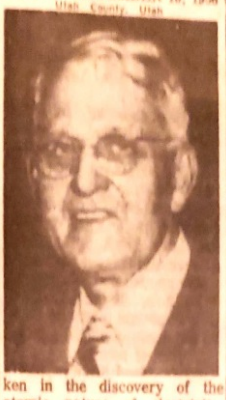
One of the most important things that happened in our life together was in 1965 when Lorena was chosen as the American Mother of the Year. Jim was chosen president of the University of Utah in 1964; Steve was made Vice President of Western E1ectric Company in January, 1965; and Bob was made Vice President of Sandia in April 1965; and Harvey and Paul both had excellent positions. So it looked like a fine opportunity to propose their mother as Mother of the Year. I found out what was required to propose her as a candidate. I found the scrapbook to be the most important part. So Lorena and I started in January, 1965 and worked almost continuously for four months. The detailed information is in the scrapbook itself. Fay has promised me that she would help me duplicate the scrapbook so that each of our children may each have a copy.

Filed also in Book II are 70 or 80 original copies of letters written to Mrs. Rasmussen endorsing the candidacy of Lorena for Mother of the Year. Some very nice things were said about her in these letters. Some of the principal ones are also filed in her scrapbook. In book IV there is also a file of newspaper clippings from all over the world concerning her selection.

6 Sunday Herald SUNDAY, DECEMBER 18, 1966
Utah County, Utah

DR. HARVEY FLETCHER

Fletcher Accorded High Award



An international Founders Award has been conferred upon Dr. Harvey Fletcher, BYU professor-emeritus and world-recognized electronics and acoustics authority, by the 150,000-member Institute of Electrical and Electronics Engineers, Inc. He will receive the award on March 22, 1967, in New York City at the annual international convention of the organization.

Dr. Fletcher, still active in research at 82, founded BYU's School of Engineering, coming to direct it in 1952 from the post of director of acoustics research at Columbia University and director of physical research at Bell Telephone Laboratories. His research for the government in World War II ranked him as one of the top scientists in this field.

A native of Provo, he received the B.S. degree at BYU in 1907 and the Ph.D. degree at Chicago University in 1911. Since then seven universities have conferred honorary doctorates on him for his achievements.

He has been called the father of stereophonic sound and was associated with Nobel Prize winner Robert A. Milliken in the discovery of the atomic nature of electricity, which opened up the entire world of electronics.

The Harvey Fletcher Engineering Sciences Laboratory at BYU is named in his honor.

One of the nation's most honored scientists, he has patented a score of inventions which have been of incalculable value to radio, telephone, motion pictures, and the U. S. Military service. They have enabled the deaf to hear and the dumb to speak. Many professional societies have awarded him medals and citations, and President Truman honored him for his scientific contributions to the national defense.

His wife, Mrs. Lorena Fletcher, was chosen American mother of the year in 1965. One of their five sons, Dr. James Fletcher, is president of University of Utah.

16 A The Salt Lake Tribune, Thursday, Dec. 29, 1966

BYU Physicist to Receive Top Engineering Honor

Dr. Harvey Fletcher

Special to The Tribune

PROVO — One of the top international engineering wards has been won by Dr. Harvey Fletcher, professor emeritus at Bringham Young University and one of the most decorated men in the field of physics.

The 1967 Founders Award of the Institute of Electrical and Electronic Enginers will be presented at the institute's annual meeting March 22 in the New York Hilton Hotel. It is the highest award of the international organization of 150,000 engineers.

Creative Contributions

Dr. Fletcher will be cited "for creative contributions to the science of physical acoustics, electrical engineering and for management skills in the operation of a leading research laboratory."

He is still active in research at BYU at the age of 82, the same school he won his bachelor of science degree from in 1907. He took his doctorate at Chicago University in 1911.

He has been called the "father of stereophonic sound" and was associated with Robert A. Milliken in the discovery of the atomic nature of eletricity.

Director of Research

For some years, Dr. Fletcher was director of acoustics research at Columbia University and director of physical research at Bell Telephone Laboratories. In 1952 he came to BYU as the first dean of the College of Physical and Engineering Sciences and later as director of research.

He has won seven honorary doctorates, has patented numerous electronic inventions, been given numerous professional society medals and citations and Pres. Harry S Truman honored him for scientific contributions to the national defense.

His wife, Lorena, was named American Mother of the Year in 1965. One of his five sons is Dr. James Fletcher, president of the University of Utah.

Damage Suit Filed in Lift Mishap

PROVO (AP) — A third damage suit has been filed in Provo Fourth District Court in connection with a summer ski lift accident which killed two persons and injured several others.

Filed for Girl

The suit was filed on behalf of Valerie Dunford, 13, Provo, one of the persons injured in the mishap.

It asks $75,000 in damages and names as defendents Timp Haven Corp.; Security Leasing Co., Hjorth Brothers Construction and four private citizens.

Rex Dunford, the girl's father, filed the suit.

Lift Broke

The Dunford girl and a companion were injured when a ski lift at Timp Haven Ski Resort north of Provo apparently broke and tossed the youngsters to the ground, some 30 feet below.

A Provo woman and another girl were killed in the accident.

DR. HARVEY FLETCHER

Fletcher Accorded High Award

An international Founders Award has been conferred upon Dr. Harvey Fletcher, BYU professor-emeritus and world-recognized electronics and acoustics authority, by the 150,000-member Institute of Electrical and Electronics Engineers, Inc. He will receive the award on March 22, 1967, in New York City at the annual international convention of the organization.

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African tribes, early in the 11th century, used electric [illegible] fish to treat various ailme[illegible]

Dear Dr. Harvey.
It warms our hearts when one whom we admire and respect so much receives recognition & honor
Congratulations
Lucille
Harvey

History of the Founders Award

The progress of a profession rests not only on the technical abilities of its members but on the qualities of leadership and dedication which they possess. It is therefore highly appropriate that among the major awards of the Institute of Electrical and Electronics Engineers there is one which brings deserved recognition to these all-important attributes.

The Founders Award was established by the Institute of Radio Engineers in 1952. It derives its character and purpose from the inspiring example of leadership and service set by the three founders of the Institute, Alfred N. Goldsmith, now Director Emeritus and Editor Emeritus of the IEEE, and the late Messrs. John V. L. Hogan and Robert Marriott. This purpose is perhaps best expressed by the citation that accompanied the first award, which read in part: "for outstanding contributions to the profession and to the Institute through wise and courageous leadership in the planning and administration of technical developments."

The recipient of that first award was David Sarnoff. In the thirteen years that followed only eight other men have been similarly honored: Alfred N. Goldsmith, R. A. Heising, W. R. G. Baker, Haraden Pratt, Ralph Bown, F. E. Terman, Andrew G. L. McNaughton, and Elmer W. Engstrom.

The IEEE will confer the Founders Award annually with the original concept of the award remaining unchanged. This year's recipient, Harvey Fletcher, continues to demonstrate that our profession owes much to the contributions, leadership, planning, and administration of our outstanding engineers.

Chairman, 1966 IEEE Founders Award Committee — John N. Dyer

HARVEY FLETCHER

1967 FOUNDERS AWARD RECIPIENT

"For his creative contributions to the science of physical acoustics, electrical engineering, and for his management skills in the operation of a leading research laboratory."

You have heard us tell how she was told that she had been selected as American Mother of the Year 1965.

She was first appointed from this local district, then competed in the state and became Utah Mother of the Year. We then went to New York City to compete with all the state mothers of the USA. We arrived at Hotel Astoria in time to attend the social party that was given by the President of the American Mothers Association. There we met most of the other state mothers. Lorena had met some of them when she was president of Engineering Women's Club in New York. We went to our room and was undressed ready for bed when someone knocked on the door and seven of the committee who selected the American Mother for 1965 walked into our room. They were smiling, so we knew they had some important message. They soon told Lorena she had been selected as the new American Mother. It was a real shock and for a moment Lorena could not speak. So the chairman asked if she was not pleased. She soon recovered her speech and told them how much she appreciated the honor. She worried most of the night because she now knew she must give a talk at the Awards Banquet where a great many important people would be present.

I am so thankful that all our children could be present and heard her talk and saw the presentations. Also it is fortunate that we had the photograph of the family at the hotel before the award ceremonies. This was the last time that we all will be together here on earth.

Lorena and I had a wonderful time together going around the country fulfilling invitations for Lorena to speak, but I could see before the year of being Mother of the Year was over her health had begun to fail. I made reservations in New York and Washington to attend the award ceremonies for the 1966 mother of the year. A few days before we were to go I was sent to the hospital. So Deah very kindly said she would accompany Lorena, which she did. While in New York she had a rather bad sick spell.

When they returned Lorena seemed to be rather weak. When she would sit down on a low chair or sofa she could not get up without help. She was very proud and very embarrassed when this happened with other people present besides myself.

Phyllis came for a visit during September. She came on September land left on October I. It was comical, if not so tragic, to see these two invalids helping each other. One day while Lorena was taking a bath, she let the water out of the bath tub, and then tried to stand but slipped back into the bottom of the bathtub and could not get out. Phyllis tried to help her but her strength was not sufficient. Phyllis called me. When I arrived they were still laughing at the funny situation. I had to get some large towels and wrap around her under her shoulders before I succeeded in getting her up. Regardless of these difficulties we had a wonderful visit together. Toward the end of the visit Phyllis told us that she would not see us again. We tried to “kid” her out of this notion but she remained silent. I was thankful that so many of her lady friends were at the airplane station to see her off to California.

The day after Phyllis left Lorena went to the Utah Valley Hospital for diagnosis and treatment. They were not successful in finding the trouble and she came home just a short time when she went to University Hospital on November 4, 1966. She was there until Thanksgiving, without any definite diagnosis. She was permitted to come home for three days. We spent Thanks- giving at Deah and Harvey's. The next day she visited Fern at the hospital and was there when Ina Brown, her cousin, died. The next day she went with me to Chipman Merc and was able to walk around very slowly. But on Sunday she was worse; we called Dr. Dayton and he came and told us to rush her back to the hospital which we did. She remained there until she died on January 2, 1967.

I was so thankful that all her children and most of the grandchildren and numerous other friends and relatives came to see her in the hospital. She never complained but the nearest to a complaint was on the day before she went into a coma. She said, “If ever I get back into my own home I will have a long cry.” Since then I have been somewhat dazed. No one knows what this experience is unless he or she has had a similar experience. Since that time I have done little constructive work, but I have got started doing some research work on the bass drum. I have done considerable work on Lorena's estate and hope to have it finished in about one month. This is Christmas time, 1967.

APPENDIX A

Dr. Harvey Fletcher, distinguished scientist and engineer, trail blazing investigator of the nature of speech and hearing, noted for his contributions in acoustics, electrical engineering, speech, medicine, music, atomic physics, sound pictures, and education.

Born and raised in Provo of pioneer parents, he received his early training at the Brigham Young University, and graduated in 1907. Continuing study at the University of Chicago, he, with Robert A. Millikan, measured the charge of an electron. This fundamental research contributed greatly to the field of electronics which led to the development of the radio and television industry. Upon completion of his studies at the University of Chicago he was awarded a Ph.D. summa cum laude, which was the first ever granted by the Physics Department of that University. Showing his loyalty to his church and alma mater he returned to the Brigham Young University and was appointed Chairman of the Physics Department. At that time he was the only faculty member at BYU to have a Ph.D.

After five years teaching he was advised by Joseph F. Smith to accept an offer at Western Electric Company in New York. Here he was assigned to do research in sound. His genius began to blossom and he was appointed Director of all Physical Research at Bell Telephone Laboratories. He published 51 papers, 19 patents, and two books, Speech and Hearing, and Speech and Hearing in Communication which are the accepted treatises on the subject. He guided the development of the Western Electric Hearing Aid, the first such device to use vacuum tubes. The hearing aid has given comfort and increased capacity to hundreds of thousands all over the world. He developed a group survey method using recorded sound of decreasing volume which has wide acceptance in schools throughout the nation. He aided in making the telephone a pleasant and useful tool for mankind. He was the first to demonstrate stereophonic transmission and stereophonic recording. In 1939while working with Leopold Stokowski, he presented a concert featuring stereophonic recording to a capacity crowd in Carnegie Hall in New York. The Salt Lake City Tabernacle Choir was heard singing in three dimensions to this vast audience.

Dr. Fletcher has an enviable record of achievement and honor. He helped found the American Acoustical Society and became its first president. He was elected an honorary

member of this Society - an honor which at that time was shared by only one other man - Thomas A. Edison. He was president of the American Society for Hard of Hearing, an honorary member of the American Otological Society, an honorary member of the Audio Engineering Society and an honorary member of the American Speech and Hearing Society. He was awarded the Louis E. Levy Medal for physical measurements of audition by the Franklin Institute in 1924. He was president of the American Physical Society which is the leading physics society in America. He was elected vice-president of the American Association for the Advancement of Science in 1937. He is co-organizer of the American Institute of Physics. He is a member of the American Institute of Electrical Engineers, Phi Beta Kappa, Sigma Xi, and an honorary member of Sigma Pi Sigma. He was the first Utahn and Latter- day Saint to become a member of the National Academy of Sciences. He is also a member of the National Hearing Division Committee of Medical Sciences. He was given the Progress Medal Award by the American Academy of Motion Pictures in Hollywood. He acted as National Councilor for the Ohio State University Research Foundation eight years.

Few men of American science have been so widely recognized. He has received honorary degrees from Columbia University, Stevens Institute, Kenyon College, Case Institute of Technology, and the University of Utah.

Dr. Fletcher's greatness does not lie in the field of science alone. Being endowed with deep humility and faith in God, he served for ten years as president of the New York Branch of the LDS Church and in 1936 was set apart as president of the New York Stake. His guiding hand has been responsible for generating a spirit of enthusiasm, integrity, and spirituality in the lives of thousands of young students and scientists who have directly or indirectly felt the influence of his work. Dr. Fletcher attributes much of his success to his wife, the former Lorena Chipman. They have five boys and a girl. Stephen received his degree in Law at Columbia University. James, Robert, Harvey, and Paul have each received Ph.D.’s.

APPENDIX B

RESUME OF HONORS GIVEN TO

HARVEYFLETCHER

SOME FIRSTS

- First physics student to be given the high honor summa cum laude at the University of Chicago.
- First LDS member to be elected to the National Academy of Science.
- First and only member of the staff of the Bell Telephone Laboratories (8000 members) to be elected President of the American Physical Society.
- First president and co-organizer of the Acoustical Society of America.
- Member of the first executive committee and co-organizer of the American Institute of Physics.
- First to introduce the group audiometer into the school room and thus start the program of testing the hearing of school children which is now going on in practically all of the schools in the country.

HIGH HONORS HAVE BEEN GIVEN BY THE FOLLOWING NATIONAL SOCIETIES:

- Acoustical Society of America - See Item #1.
- Otological Society of America
- Audio Engineering Society
- Society of Motion Picture Engineers
- Franklin Institute
- American Society of Speech and Hearing
- United States Navy
- United States Army
- President of the United States - H. S. Truman

(See Item #2)

(Picture #1)

HONORARY DOCTORS DEGREES HAVE BEEN CONFERRED BY THE FOLLOWING UNIVERSITIES:

- Columbia University
- University of Utah
- Kenyon College
- Stevens Institute of Technology
- Case School of Applied Science
- Brigham Young University

(See Item #3)

GOLD MEDALS RECEIVED FROM:

- Franklin Institute
- Society of Motion Picture and Television Engineers
- Acoustical Society of America
- Audio Engineering Society

PRESIENT OF THE FOLLOWING NATIONAL SOCIETIES:

- American Physical Society

Citation

"Harvey Fletcher, Director of Physical Research has been elected President of the American Physical Society for the 1945 term.

One of the foremost authorities on speech and hearing, Dr. Fletcher directed the Laboratories' pioneering work in this field. His book Speech and Hearing is a classic, and he is author or co-author of numerous professional papers on various acoustical subjects. He is a member of the National Academy of Sciences and was the first President of the Acoustical Society of America."

March 1945

Acoustical Society of America

American Hearing Society

APPENDIX C

RECORD OF PROFESSIONAL EXPERIENCE AND HONORS OF HARVEY FLETCHER

Age	Year	
23	1907	B.S., Brigham Young University
25	1909-1910	Instructor of Physics at University of Chicago
26	1910	Elected member Sigma Xi
	1910-1911	Research work with Professor R. A. Millikan on the Determination of the Elementary Electrical Charge and other problems of Electron Physics
27	1911	Elected associate member American Physical Society and to Society of Phi Beta Kappa Ph.D. Summa Cum Laude, University of Chicago (first in Physics)
	1911-1916	Head of Department of Physics, Brigham Young University
31	1915	Elected member American Physical Society
	1915-1916	President Utah Academy of Science
32	1916-1949	(June 1) Engineering Staff of Research Department of Bell Telephone Laboratories (formerly Engineering Dept. of Western Electric Company). Director of Physical Research
36	1920	Elected Fellow American Physical Society
37	1921	Elected Fellow American Association for Advancement of Science
38	1922	Elected member American Institute of Electrical Engineers
40	1924	Award of the Louis Edward Levy Gold Medal for paper entitled "Physical Measurements of Audition", published Sept. 1923, Journal Franklin Institute, 197, 708, 1924.
42	1926	Elected member Board of Managers of American Federation of Organizations for the Hard of Hearing
45	1929	Elected President American Federation of Organization for the Hard of Hearing (June) 1929-1930 Elected as first president of the Acoustical Society of America (May) 1929-1931
45	1929	Member of Noise Abatement Commission of New York City 1929-1932

46	1930	Elected Fellow American Institute of Electrical. Engineers
47	1931	Elected member Executive Committee, American Institute of Physics (first Executive Com. and Co-organizer) (1931-36) Elected member Governing Board (1931- , 1940-6)
49	1933	Elected to the Board of Directors, American Association for the Advancement of Science. Appointed Director of Physical Research - Bell Telephone Laboratories. First Presentation of Stereophonic Sound Transmission and Reproduction in Constitution Hall, Washington D.C. of Philadelphia Orchestra. Elected Member National Research Council (Section-Psychology)
50	1934	Elected member Franklin Institute, Philadelphia, Pa.
51	1935	Elected member National Academy of Science (April) Received honorary degree ScD Columbia University (June 4)
52	1936	Elected to Division of Physical Sciences - National Research Council for period 1936-1939 Elected honorary member American Otological Society
53	1937	Lectured in France and Germany on various phases of Audition. Elected National Councilor Ohio State Research Foundation (1937-) Elected Chairman Section B of AAAS
55	1939	First Presentation of Stereophonic Recording in Carnegie Hall (April) of Philadelphia Orchestra, Salt Lake Tabernacle Choir and other Selections
56	1940-1944	Appointed Chairman Section 5, Division C of NDRC (Oct 31)
58	1942	Received honorary degrees ScD from Kenyon College (May II), Case Institute of Technology (May 17) and Stevens Institute of Technology (May 2) Appointed Chief Section 17.3 of NDRC (December 9)
60	1944	Elected Vice President American Physical Society Received honorary degree ScD from University of Utah (June 6)
61	1945	Elected President American Physical Society (Jan 20) - first one from Bell Laboratories Appointed to Advisory Board of American Physical Society (1945-) Research Council of Rutgers University (Jan 15) Appointed member Division 16, NDRC (March 14)

62	1946	First Demonstration-Lecture on "The Pitch, Loudness and Quality of Musical Tones" (using Tone Synthesizer) at American Physical Society (Jan 25) Given as l5th Joseph Henry Lecture, Philosophical Soc. of Washington, D. C. (May 25) Appointed member of Committee on the John J. Catty Fund (National Academy of Sciences) for 5-year term (June 7) Radio talk on "The Science of Hearing" (CBS) (Oct 6)
63	1947	Repeated Demonstration-Lecture on "The Pitch, Loudness and Quality of Musical Tones" (using Tone Synthesizer) at the Franklin Institute, Philadelphia (Oct 16), at joint meeting of Institute of Radio Engineers, AIEE and Engineering Institute of Canada in Montreal (March 13), at University of Toronto at meeting of Royal Canadian Institute (March 15). Appointed Member Committee on Hearing, Division of Medical Sciences, National Research Council (1947-)
64	1948	Appointed as member of National Research Council assigned to the Division of Engineering and Industrial Research for period ending June 30, 1951 Received USA certificate of Merit from President Harry S. Truman
65	1949	Appointed member of Standing Committee on Meetings of the National Academy of Sciences for 3 years (7/1/49-52) Gave messenger Lectures at Cornell University on "The Perception of Speech and Its Relation to Telephony" (April 11-21 inclusive) Received honorary membership in the Acoustical Society of America (May 6) Talk at Audiological meeting of Fourth International Congress on Otolaryngology, London (July15-16) Received Society of Motion Picture Engineers Progress Medal Award (October 12) (Gold Medal) Elected to Honorary Membership of Audio Engineering Society (Oct 28, 1949) Received the Honors of the American Speech and Hearing Association (Dec 29)
	1949-1952	Appointed Professor of Electrical Engineering at Columbia University
68	1952	Published book entitled Speech and Hearing in Communication Appointed Research Director for Brigham Young University

		Member of Advisory Committee for Council of Physical Medicine and Rehabilitation, for American Medical Association
69	1953	First Chairman of Engineering Department at Brigham Young University Member of Advisory Board on Physics for National Science Foundation Member of National Committee on Hearing and Bio-Acoustics - Armed Forces
70	1954	Dean of new College of Physical and Engineering Sciences at Brigham Young University
71	1955	Member of National Committee to study relationship between teaching of Physics and the engineering sciences by National Science Foundation
73	1957	Engineering Building at Brigham Young University named Harvey Fletcher Engineering Science Laboratory Received Gold Medal from Acoustical Society of America Member of Board American Association for Advancement of Physical Sciences
74	1958	Gold Medal from Audio Engineering Society Distinguished service award - Utah Academy of Sciences
75	1959	Honorary member of Board at the New York League of Hard of Hearing
77	1961	Designed sound equipment for the Mormon Pageant in Palmyra
79	1964	Man of the Year Award - Men Students of Ricks College
80	1964	Honorary Member of ΣAB
83	1967	Founders Award and Medal - The Institute of Electrical and Electronics Engineers

APPENDIX D

PUBLICATIONS OF HARVEY FLETCHER

1911 Causes of Apparent Discrepancies in Recent Work on the Determination of the Elementary Electrical Charge. (with R. A. Millikan) Phys. Zeit., January.

Some Contributions to the Theory of Brownian Movements, with Experimental Applications. Phys. Zeit., January.

The Question of Valency in Gaseous Ionization. (with R. A. Millikan) Phil. Mag., June.

A Verification of the Theory of Brownian Movements and a Direct Determination of the Value 0f Ne for Gaseous Ionization. Phys. Rev., August; Le Radium, July.

1914 A Determination of Avogadro's Constant N from Measurements of the Brownian Movements of Small Oil Drops Suspended in Air. Phys. Rev., November.

1915 Upon the Question of Electric Charges Which Are Smaller Than the Electron. Phys. Zeit., August.

Relative Difficulty in Interpreting the English Speech Sounds. Phys. Zeit., August.

1921 The Frequency Sensitivity of Normal Ears. Proc. Nat. Acad., November; Phys. Rev., June 1922

1922 The Nature of Speech and Its Interpretation. Journ. Franklin Inst., June.

1923 The Use of the Audiometer in Prescribing Aids to Hearing. College of Physicians, April.

Physical Measurements of Audition. Jour. Franklin Inst., September.

Audiometric Measurements and Their Uses. Trans. College of Physicians, April.

1924 Physical Properties of Speech, Music, and Noise. Bell Telephone System Monograph B-94-1, February.

Physical Criterion for Determining Musical Pitch. Phys. Rev., March.

High Quality Transmission and Reproduction of Speech and Music. (with W. H. Martin) Jour. AlEE, March; Elect. Corn. , April.

Loudness of a Complex Sound. Phys. Rev., September

1925 Useful Numerical Constants of Speech and Hearing. Bell System Tech. Jour., July.

Methods and Apparatus for Testing the Acuity of Hearing. The Laryngoscope, July.

1926 Theory of the Operation of the Howling Telephone. Bell System Tech. Jour., January.

Measuring Children's Hearing, Bell Record, June.

Three Million Deafened School Children. (with E. P. Fowler) Jour. Amer. Med. Soc., December.

(Discussion of paper by C. C. Bunch) Comparison of the Results Made with Two Types of Audiometer. Arch. of Otology, July,

1927 Demonstration of Principles of Talking and Hearing with Application to Radio. Annals of Otology, Rhinology and Laryngology, March.

The Hard-of-Hearing Child. U.S. School Health Studies No. 13, July.

Hearing Aids and Deafness. Bell Record, October.

1928 Book Review. "The Theory of Sound" by Lord Rayleigh. Proc. IRE, May.

1929 Articulation Testing Methods. (with J. C. Steinberg) Bell System Tech. Jour., October.

1930 A Space-Time Pattern Theory of Hearing. Jour. Acous. Soc. of Amer., April.

1931 Physical Characteristics of Speech and Music. Rev. Mod. Phys., April; Bell System Tech. Jour., July.

1932 Can We Scientifically Advise Patients As to the Effectiveness of Hearing Aids? Annals of Otology, Rhinology, and Laryngology, September.

1933 Evaluating Hearing Aids. Bell Record, January.

Loudness, Its Definition, Measurement and Calculation, Jour. Acous. Soc. of America. , October; Bell System Tech Jour., October (with W. A. Munson).

1934 Auditory Perspective - A Symposium. Electrical Engineering, January; Bell System Tech. Jour., April.

Hopeful Trends in the Testing of Hearing and in the Prescribing of Hearing Aids. Proc. Amer. Federation of Organizations for the Hard of Hearing.

Loudness, Pitch, and Timbre of Musical Tones. Jour. Acous. Soc. of Amer., October.

1935 Newer Concepts of the Pitch, Loudness and Timbre of Musical Tones. Jour. Franklin Inst., October.

1937 Relation Between Loudness and Masking (with w. A. Munson) Jour. Acous. Soc. of Amer., July.

1938 Loudness, Masking and Their Relation to Hearing and Noise Measurement. Jour. Acous. Soc. of Amer., April.

The Mechanism of Hearing. Proc. Nat. Acad., July.

1940 Auditory Patterns. Rev. of Mod. Phys., January.

1941 Stereophonic Sound-Film System. A symposium, Jour. Soc. Motion Picture Engrs. , October; Jour. of Acous. Soc. of Amer., October.

1942 Hearing, the Determining Factor for High-Fidelity Transmission, Proc. IRE, June.

1944 Scientific Progress and Civic Responsibility. Univ. of Utah Press, June.

1946 The Atomic Bomb. The Improvement Era, March

The Pitch, Loudness and Quality of Musical Tones. Amer. Jour. Of Phys., July-August.

The Science of Hearing (A radio talk) October 6. Part of "The Scientists Speak," Boni & Gaer, Inc., New York, 1947.

1947 An Institute of Musical Science - A Suggestion. Jour. Acous. Soc. of Amer., July.

1950 A Mathematical Theory of the Perception of Speech in Communication. Jour. of Acous. Soc. of Amer., March.

A Method of Calculating Hearing Loss for Speech from an Audiogram. Jour. Acous. Soc. of Amer., January.

1951 On the Dynamics of the Cochlea. Jour. Acous. Soc. of Amer., November.

Acoustics. Phys. Today, December.

1952 The Dynamics of the Middle Ear and Its Relation to the Acuity of Hearing, Jour. Acous. Soc. of Amer., March.

1962 Quality of Piano Tones (with E. Donnel Blackham and Richard Stratton) Jour. Acous. Soc. of Amer., June.

1963 Quality of Organ Tones (with E. Donnell Blackham and Douglas A, Christensen) Jour. Acous. Soc, of Amer., March.

1964 Normal Vibration Frequencies of a Stiff Piano String, Jour. Acous. Soc. of Amer., March.

1965 Quality of Violin, Viola, Cello, and Bass Viol Tones I, Jour, Acous, Soc. of Amer., March.

1967 Quality of Violin Vibrato Tones, Jour. Acous. Soc. of Amer., June.

BOOKS

1929 Speech and Hearing, D. Van Nostrand & Co., New York.

1932 Modern Communication, Co-author, Houghton Mifflin Company Boston and New York.

1953 Speech and Hearing in Communication, D. Van Nostrand, New York.

1958 Science and Your Faith in God, Co-author, Bookcraft Inc.

1963 The Good Life, Deseret Sunday School Union.

APPENDIX E
U. S. PATENT APPLICATIONS OF HARVEY FLETCHER
February 2, 1948

Case	Serial	Date	Patent	Issued	Subject
1	370,620	4/1/20	1,495,295	5/27/24	Telephone Circuits
2*	396,115	7/14/20	1,386,697	8/9/21	Testing Apparatus (*with F. J. Strassner)
3	430,842	12/15/20	1,461,183	7/10/23	Substation Ccts.
4	515,461	11/16/21	1,548,592	8/4/25	Testing Circuits
5	525,304	12/28/21	1,565,228	12/8/25	Testing Circuits
6	527,581	1/7/22	1,522,294	1/6/25	Electrical Testing System
7	595,503	10/19/22	1,469,271	10/2/23	Testing Systems
8	595,504	10/19/22	1,494,349	5/20/24	Testing Systems
9	601,958	11/20/22	1,522,006	1/6/25	Testing System
10	681,346	12/18/23	1,533,311	4/14/25	Secret Signaling
11	654,803	7/21/23	1,563,924	2/23/26	Secret Signaling
12	682,199	12/22/23	1,613,607	-	Production of Musical Tones
13	740,533	9/29/24	1,624,486	1/11/27	Compensating Networks for Carrier Transmission Ccts.
14	37,050	6/15/25	1,661,751	4/12/27	Binaural Telephone Systems
15	752,323	11/26/24	1,738,289	3/6/28	Acoustical Apparatus
16	110,099	5/19/26	Abandoned 1936	12/3/29	Tactile Reception of Sound
17	665,702	4/12/33	2,232,779	Abandoned, 1936	Sound Reproducing System
18	81,404	5/23/36	2,254,034	2/25/41	Testing Bone Conduction
19	328,071	4/5/40	2,436,384	8/26/41	Sound Rerecording System
20	423,568	12/19/41		2/24/48	Casing or Shell Adapted to be Moved Through a Fluid Medium

APPENDIX F

CHURCH JOBS

Utah Stake

- President Deacons Quorum Provo First Ward
- President Teachers Quorum Provo First Ward
- Counselor to President in Elders - Fifth Ward - 1909, 1910
- President of Ward MIA - Fifth Ward - 1914
- President of Stake MIA (Utah Stake) - 1914 and 1915

New York

- Counselor to President - Manhattan Branch - 1917
- President - Manhattan Branch - 1917-1927
- District Counselor from 1927 until New York Stake was organized (about 1932)
- Senior Member of High Council - 1932-1936
- President of New York Stake - 1936-1942
- Senior Member of High Council - 1942-1952

Since coming back to Provo, he has been in the Presidency of High Priests Quorum.