

## **Childhood – Biographical Information**

**Marshall W. Nirenberg is best known for his work on deciphering the genetic code by discovering the unique code words for the twenty major amino acids that make-up DNA, for which he won the Nobel Prize in Medicine or Physiology in 1968.**

**Nirenberg was the first government scientist to win the Nobel Prize. The National Library of Medicine and the Office of NIH History has amassed a collection of correspondence, laboratory administrative and research materials, and publications that documents Nirenberg's career as a researcher in biochemical genetics at the National Institutes of Health.**

**Dr. Nirenberg is featured in The Profiles in Science web site of the National Library of Medicine celebrates twentieth-century leaders in biomedical research and public health. Students appreciate the history, and share some of the excitement of early scientific discoveries in molecular biology. The National Library of Medicine is digitizing and making available over the World Wide Web a selection of the Marshall W. Nirenberg Papers, for use by educators and researchers.**

**In 2007, the Archives and Modern Manuscripts Program, History of Medicine Division completed a Finding Aid to the Marshall W. Nirenberg Papers, 1937-2003 (bulk 1957-1997). Individuals interested in conducting research in the Marshall W. Nirenberg Papers are invited to [contact](#) the National Library of Medicine.**

**The NLM digital materials and references provide the background for the series of six interviews conducted with Marshall W. Nirenberg, Ph.D., by Ruth Roy Harris, Ph.D., between September 20, 1995 and January 24, 1996.**

**The “Harris Interviews” took place in Nirenberg’s laboratory on the campus of the National Institutes of Health (NIH) in Bethesda, Maryland. Harris also conducted several supplemental interviews, both by telephone and in person, with individuals either involved in the breaking of the genetic code or personally acquainted with Nirenberg: James Pittman, Joan Geiger, Philip Leder, Thomas Caskey, Sidney Udenfriend, and Perola Nirenberg. Interviews with Pittman and Geiger are now in the Marshall Nirenberg Collection at the National Library of Medicine (NLM). Notes from other interviews are held at the Office of NIH History.**

**A number of individuals and institutions worked on editing the interviews for clarity and content: Sarah Leavitt, Victoria Harden, Caroline Hannaway, Alan Schechter, Robert Balaban, and Alan Peterkofsky. Caroline Leake, Katrina Blair, and Mary Alvarez provided administrative and technical assistance. In 2008, Deborah Kraut edited and formatted the interviews to correspond to the NLM digital materials.**

**Each Section begins with the NLM digital summaries summaries and references. Additional references, when appropriate are added:**

Marshall W. Marshall W. Nirenberg Papers. 1937-2003. Located in: Modern Manuscripts Collection, History of Medicine Division, National Library of Medicine, Bethesda, MD; MS C 566.  
<http://www.nlm.nih.gov/hmd/manuscripts/ead/nirenberg566.html#a2>

The Personal and Biographical Series of the NLM Nirenberg papers includes high school yearbook, his notebooks from his coursework at the University of Florida and the University of Michigan, as well as drafts of his masters and doctoral theses. The Personal Papers sub-series of his papers includes a notebook in which a young Nirenberg recorded some of his observations on the Floridian flora and fauna which sparked his scientific inquisitiveness.

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*From NIH Profiles in Science – Biographical Information:*

<http://profiles.nlm.nih.gov/JJ/Views/Exhibit/narrative/biographical.html>

**Marshall Warren Nirenberg was born in New York City on April 10, 1927, to Harry and Minerva (Bykowsky) Nirenberg. In 1941, young Marshall developed rheumatic fever, so the Nirenberg family moved to Orlando, Florida to take advantage of the subtropical climate. Surrounded by "a natural paradise," during his teens Nirenberg developed a scientific and aesthetic appreciation for the natural world and became an adept observer of plant life, insects, and birds. He captured these observations through carefully written and maintained notes; these sketches and notes presaged a career in which scientific diaries filled with thorough documentation provided a constant source of inspiration for research and analysis.**

**In 1945, Nirenberg graduated from high school and enrolled at the University of Florida in Gainesville, earning his B.S. degree in zoology and chemistry in 1948. In 1950, he resumed his studies at Florida and took a M.S. degree in zoology in 1952, writing a master's thesis on caddis flies. Later that year, Nirenberg moved to Ann Arbor to attend the University of Michigan. He earned a Ph.D. in biological chemistry in 1957 by writing a dissertation on the uptake of hexose, a type of sugar, by tumor cells. This work served as the basis of his first published article and shaped the direction of his initial studies after graduate school.**

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*Additional Notes* From: Orlando – A Visual History <http://www.cfhf.net/orlando/military/pinecastle.htm>

In 1940, the United States Army Air Force acquired 2,216 acres (9 km<sup>2</sup>) of scrubland southeast of Orlando to build a training base. Pine Castle Airport was developed in 1940 for commercial use while the Army transformed Orlando Municipal Airport into Orlando Army Airfield. When the need arose, the Army Air Force took over the new civilian field as well and spent \$500,000 getting it ready for military use. Most of this land is now part of the Orlando International Airport.

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### **1995-1996 Harris Interviews**

Marshall Nirenberg (MN): I was born in New York City on April 10, 1927. My father's name was Harry Edward Nirenberg, and he was one of six children. His father, my grandfather, came to the United States from Odessa, Russia, when he was about twelve years old. He came by himself to avoid being drafted into the Russian Army. He went to work in a shirt factory. He was very successful, finally bought the shirt factory, and had a nationally distributed shirt line. Actually, though, Nirenberg is rather an unusual name. There aren't that many Nirenbergs. I have had people ask me if I am related to them. An orchestra conductor whose name was Nirenberg once called me and a Nirenberg from Moscow wrote to me once to see if we were related.

My father had four brothers and one sister. He graduated from Cornell University and went to Cornell Medical School. But, he dropped out after two years, married my mother, and went into the shirt business with his brothers. My guess is that he always regretted that he dropped out of medical school because he was interested in science and biology, and I think he liked that type of thing much more than he liked the shirt business. I was told that somebody on my father's side of the family in Europe was a master brewer of beer, but that is the closest link to biochemistry I have; this interest is not inherited.

My mother's parents came from Vilna, once part of Poland, now Lithuania. My grandmother's maiden name was Bykowsky. I knew both my grandmother and my great-grandmother. My great-grandmother didn't speak any English, so I had a hard time communicating with her. I had to have translated whatever I talked about. For awhile, there was somebody interested in genealogy on my mother's side of the family who used to compile newsletters about the family.

They used to meet every year for a reunion. Everything was listed in those newsletters—what the people did, where they lived, what they were doing and the latest news about them, but I never met any of them. On my mother's side of the family I have a large number of relatives whom I have never met, at least 800 relatives. I know that on this side of the family I had some uncles who were named Raphaelson, including an uncle who wrote screenplays in Hollywood. I would see some movies that he had written occasionally in the 1940s and 1950s, but I have never met him.<sup>1</sup>

Ruth Harris (RH): How did your parents meet?

MN: That is an interesting question. I really don't know how they met. It must have been in the 1920s— they got married very young. I have one sister, Joan Geiger, who is a year and a half older than me. She and I were close growing up. My sister and I were inquisitive. We had sibling rivalry, as you might expect, but we always had affection for one another. I became even closer to my sister when I became an adult after the sibling rivalry disappeared. So, I used to tease her a lot, I guess. She went to the University of Alabama, and she got a job there working at a radio station, writing commercials and doing other kinds of work. She married and had four children. Eventually, she got divorced. She lives in Dallas now. She became a social worker, and she worked for a number of years with elderly people—patients with Alzheimer's and others needing help. She recently retired. Now she travels all over the world.

RH: Please describe your early life in New York City.

MN: In New York, we were upper middle-class people. I was not aware that there was a Depression when I was growing up. I think my father was very fortunate, so it didn't affect us. I had a happy life from the earliest time in Brooklyn. Later, we moved to Manhattan, overlooking the Hudson River, and then from there to Mount Vernon, New York. In Brooklyn and Mount Vernon we lived in houses. In Manhattan, we lived in an apartment. I went to public schools. There were books all over the house and my father subscribed to lots of magazines, so we came into contact with a lot of different things. I would read anything that was within reach.

Some summers my mother and sister and I went to a cottage in the Catskill Mountains. My father came up on weekends to join us. That was wonderful, and it was beautiful. I collected fossils there. I remember going fishing with my father once. We got up at four-o'clock in the morning, and I was seasick the entire time and lay on a bench and got sunburned on half of my face. We went to the park. We went to the zoo. We went ice skating once in a while. My parents went to plays occasionally.

I remember that when I was very small, *my parents* went on a vacation to Cuba and left my sister and me in the care of a nurse. I didn't know where they had gone, and I was glad when they came back. My parents also entertained occasionally and went to other people's houses once in a while. They took me to the museums and to art galleries and did other kinds of things, too. I liked roller skating a lot and also football and hockey. We played hockey on all the streets at the time. *My father paid for me to take private piano lessons and also lessons at the Juilliard School of Music for violin lessons. But, I considered the other Juilliard students so talented that I felt that I could not compare to them, so I just continued the piano lessons.*

### ***Rheumatic Fever***

MN: One of the major events in my childhood occurred in the middle of winter when I was about seven years old. A group of some other boys and I were watching some golden carp being taken out of a pool. One of the boys pushed me into the pool. I ran home as fast as I could. By the time I got home, my pants were so frozen that even after I took them off, they stood up. I came down with rheumatic fever because of that.

At that time nobody knew what caused rheumatic fever. We now know that it is related to a bacterial infection, and later on the bacteria can adhere very well to the valves of the heart and ultimately will destroy the valves and kill people. Rheumatic fever was then a major killer of children. The only thing they knew back then was to keep the children in bed and to give aspirin to alleviate joint pain. So I spent long periods in bed. I had successive attacks in different years, and the last one lasted a year: I was in bed for a year. I really didn't mind it that much as long as I was kept busy. I had a private tutor who came in for an hour a day so I didn't lose any school work: I didn't even need him to come in for an hour a day for that. I have always thought that most of school is a waste of time because the work can be done so much faster if you don't go to class.

But I like to read, and I also like to build things. As long as I could have books to read, I was perfectly happy in bed. But my folks couldn't supply me with enough to read. Simply for the lack of space, in my bedroom there was this great big bookcase *that stretched from the floor to the ceiling filled* with books that we couldn't store anyplace else in the house. They were just

stored there, so I read them. There were some wonderful ones like the Harvard set of classics and the works of Mark Twain and Shakespeare. I remember in that Harvard classic set I read Darwin's *The Voyage of the Beagle*. That was a wonderful adventure story. I still have the book. In the book I copied down the words I didn't understand and looked them up in the dictionary afterwards, and they were not words that were particularly useful—"crepuscular," "infusoria," — words like that. It was a wonderful book because it was an adventure story, and I really enjoyed it.

I also read at least part of *The Origin of Species*, which I didn't understand. There were many other books that I liked that I read simply because they were there, and I didn't have anything else to read. Whatever was there I read. We had *The Book of Knowledge for Children*, which I must have read ten times over. My parents would go to the library and come back with a stack of books, and I would have read them all within a day or less than a day. I was very lucky that my illness didn't really hurt me and didn't leave any permanent damage to my heart.

But that experience was a big, formative influence in my life. I built the beginning of a pattern of behavior. As a scientist, you spend a lot of time alone. We spend a lot of time also interacting with people in the lab, but at nights and weekends, what do we do? We spend the nights and weekends reading and thinking about things.

### ***Orlando, Florida – the College Park Dairy***

RH Was your illness the reason that your family moved to Florida?

MN: Yes, after the last attack of rheumatic fever (which began a year after the first one), my father decided to move to Florida. It was known that warm weather was good for rheumatic fever, and there was less of that disease in the warm places. That is why we moved to Florida, but it was a tremendous dislocation for the family.

When we moved to Florida, it was quite hard for my father. He decided to start in a different business. My father went through three stages: first, he bought a dairy. He had a tough time making a living with that — basically, he was sold a bill of goods down there by somebody. He didn't know anything about dairy operation or cows or anything else, but he learned.

Then, during World War II, he took a course in candy making, and he wanted to use the milk for something, so he thought that candy would be a good thing. He built a little factory for making fudge. At that time during the war, sugar was hard to get — it was rationed, so any kind of candy sold well, and this was actually pretty good fudge.

The land became quite valuable because the dairy was just outside the Orlando city limits, so he sold the cows and used all the land from the dairy to build offices, small manufacturing plants, warehouses, and buildings of that sort. So, his third phase was when he became semi-retired after the land was developed and took care of problems that arose with the care and maintenance of the buildings and the roads.



It (the farm) was called the College Park Dairy. We lived at the dairy: there was a house right on the grounds with orange trees and grapefruit trees. I picked pecans. It was right across the street from a 40-acre commercial orange grove, and there were lakes all around nearby. It was a very interesting place. One time a little plane landed in the pasture, and the pilot asked me, "Which way is Miami?" So I told him and I also told him where he was, and he went off.

I worked around the dairy. I shoveled fertilizer and picked something called bitter-weed, which makes the milk bitter. As for the cows—when we filled the silo with chopped up corn and stalks for the cows. I was inside the silo, first watering it down and then walking around to tamp down and compress the mixture. The compressed corn and stalks mixture ferments in the silo. When you feed it to the cows, I think, it is mildly alcoholic. The cows love it and really like to eat it.

Orlando was totally unlike what it is now. It was a town of about 35,000 people in the middle of Florida, and it was a natural wonderland. It was filled with bird life and biology. It was magnificent. Within a half a mile of our house there was a large tract of land that was mostly swamp. It was scrub pine and swamp, and you could walk for about 20 miles without crossing a road or coming upon a house. It was totally wild. That was my favorite place because after school I would hop on my bicycle and go out to tramp around the woods and the swamps. I was very much interested in the living things there. I had always been interested in biology from the earliest I can remember. I don't know where the interest came from. But, I recall collecting butterflies and pressing them when I was maybe five years old. When I went to summer camp, I always won the nature award.

I thought it was wonderful to have the opportunity to grow up in an environment like that because Florida at that time was not developed, and it was an out-in-the woods place with water and cypress swamps, which I used to wade through. Also, in Florida I talked my parents into giving me a gun to go hunting, which I loved—at first with a .22 and then with a shotgun. I liked the wild country—going out in the swamps—there was nothing there. It is all built up now.

*I think the move to Florida* was a tremendous dislocation for my mother. She was a very sociable person and had friends and family in the New York area, so adjusting to life on a dairy was a major change for her. My mother never worked *at a job* for money. Actually, during World War II, she took a course that she really liked in structural drawing. She learned how to draw machine parts in three dimensions for plans for assembly of machines. It was a course that was given because of the war and because many women worked then. She took that course, and she would bring home drawings of bolts and screws and pieces of machinery. She enjoyed doing it. But she never took a job using what she had learned in the course. I don't think that there was a job that I am aware of that she could have gotten in Orlando, at least, where she could have used that skill. But, she liked the drawing aspect very much.

I went back to New York City in the summers and stayed with my aunt, Sadie Safer, my mother's sister. I was a nature counselor at a camp for a summer or so. When I was about thirteen years old, *just* before I went up to New York for the summer, I caught some spiders and put them in a vial to use as an entrée to meet the curator of arachnids or the entomology at the American Museum of Natural History. I went to the museum with my little eleven-year old cousin, Claire Safer, a pretty little girl with long blond pigtailed and blue eyes. I asked to see the

curator to get these spiders identified. What I really wanted to do was to meet the curator and to ask him if I could collect some specimens of spiders for the museum. As somebody took us back through some rooms to meet the person, there was a man who was mounting a fantastic, huge tiger in a leaping position. When he saw my little cousin, who was such a sunny, bright, smiling little girl, he pulled a whisker from the tiger and presented it to her as a present. I thought that was a wonderful gesture.

I met the curator. He gave me a box of vials and some alcohol and tags for labels for these things so I could collect spiders for the museum. I got all my friends to collect spiders for the museum. I found that that was an interesting experience.<sup>2</sup> They continued to send me all the materials I needed to collect them—the alcohol, the vials, the labels. I collected the spiders and filled in the information and sent them back, and they would send me more materials. I filled up each box very fast, and they sent me more vials, so we collected a lot of spiders for the museum.

But there was one spider, a rare specimen that I didn't collect. I was up to my waist in swamp water and I saw on a cypress tree the biggest spider I had ever seen in my life. It was bigger than my hand. I knew it was a tarantula. I looked at the tarantula and the tarantula looked at me. The other spiders I would catch with my hands, but he was so big and so hairy that I wouldn't dare. So I thought of various ways of getting him, but none of them seemed very practical. After five or ten minutes I just walked away and left him there. It was the only tarantula I have ever seen in my life.

I would do the kinds of things that the Boy Scouts do all the time. Everyday, almost, I would go out to roam the woods to look at birds and plants and whatever else —fish, snakes. Just for the fun of it. I used to catch cottonmouth moccasins. I would put them in a bag and bring them home. If my mother knew, she would have fainted. I remember one time she walked in the room and said, “What’s that smell?” And I said, “What smell?” Then, I would release the snakes afterwards. So I didn’t keep them very long, and I don’t think I took them to the house very frequently. But I had a little snake bite kit, which was, basically, a tourniquet and a razor blade and a little rubber bulb so that you could try to suck out the venom. I thought I was protected by having that. But I never got into trouble, luckily.

RH: Tell me about your school life in Florida.

MN: Regarding public schools, Florida was quite different from New York in that, it seemed to me that they were about a year behind the New York City curriculum. But, I adjusted perfectly well, and I liked Florida and made friends there. I was a member of the Hi-Y [a YMCA group for teenaged boys] and I was an officer in ROTC [Reserve Officer Training Corps].

When I went to Orlando High School and to the University of Florida, especially as an undergraduate, some of my friends were interested in science. Both of my good high school friends—[James] Jim Pittman and [James] Jim Boyles—went into science careers. Jim Boyles became a professor of biology at the University of South Alabama, Mobile, and Jim Pittman was dean of the Medical School at the University of Alabama. He recently retired. He is a remarkable person and has a wonderful way with people.<sup>3</sup>

I took chemistry, physics, mathematics, algebra, and geometry. I took English and literature. Mostly it was the standard courses that almost everybody took—college preparatory courses. I took German and Spanish, too.

About ten years ago I was invited to go back to Orlando to give a talk at the hospital there. It was fantastic because the people who came to the talk were all the people I had known as a boy—people who were friends of my parents and/or my friends. It was almost like a homecoming. I immediately recognized their faces, but in many cases I didn't know their names. My teachers from junior high school came. The principal of the school was there. It was a wonderful occasion, and I really enjoyed meeting those people and seeing them again.

RH: Were there any particular teachers in Florida who had an influence on your life?

MN: Before the atom bomb was created, there was one teacher I remember, a chemistry teacher, who was telling us that if you could harness the energy that is in atomic energy, it would be an immense source of power. He said that nobody thus far had succeeded in doing it. Then he looked at the class—I thought he looked at me—and said, “Maybe one of you will find the answer to that.” That kind of raised goose pimples on me! He was a wonderful teacher.<sup>4</sup>

### *Air Force Scientists*

MN: When I was in the tenth grade, [Benjamin Franklin] Frank McCamey, who was a lieutenant in the Air Force, came to the high school and gave a talk on birds. He was a professional

biologist.<sup>5</sup> There was a very big Air Force base in Orlando at the time. There were lots of soldiers and sailors and a totally different atmosphere—the whole country working together to win the war. This was in the early 1940s, during World War II. The Air Force base had a jungle survival course for pilots who were going to the South Pacific, so they had professional biologists from all over the country as teachers. Colonel George Sutton, the ornithologist, was the head of it. There were entomologists, ornithologists, and various kinds of biologists.<sup>6</sup>

After his talk, I went up front to talk to him because I was interested in this. There were two other boys who also went to talk to him afterwards, Jim Pittman and Jim Boyles. All of us were interested in birds, and he introduced us to the other members of the teaching team at the air base part of this jungle survival course. They took us on field trips all over, particularly over to the Atlantic coast and to Merritt Island, which later became associated with Cape Canaveral. At that time it had a little bit of a broken down shack on one end of the island and then there was nothing else on the island. It was pretty wild, and there was a rare species of bird that lived there that could only be found in two places, Merritt Island and one other place in Florida — the dusky seaside sparrow. So we went there to see this sparrow, which now is extinct, I understand, and the other birds there. They introduced us to biologists who were passing through, such as the one who wrote the books on bird identification, Roger Tory Peterson.<sup>7</sup> Peterson was terrific. He had a 16X pair of binoculars, and he could identify birds at a distance. I remember that in one case he identified a bird sitting on a post that was out in the water. I couldn't even see the post. The Air Force professional biologists took us on field trips and on overnight camping trips all over Florida. That was a wonderful experience.

We traveled all over, thanks to Jimmy Pittman and his father, who was in the lumber business. During the war gasoline was rationed, but because his dad was in the lumber business, I think, he had an extra allocation of gasoline. Jimmy was really interested in natural history, and his father would let him take the car. Everybody would pile into it so that we could travel over to the coast. The Pittmans had a summer place on a lake, which I visited, and I went swimming and canoeing with them on a number of occasions. I became very good friends with Jimmy. He was a terrific boy. I mean, he was the kind of boy that every other boy wished he could be like. He was sort of a natural leader and had a wonderful ability to talk to people, and he made friends wherever he went.

We once drove to a place near Tampa where somebody had found a limestone cave. To get down into it, you had to lower yourself in by ropes and crawl through passageways on your hands and knees in muddy, almost running, water. We finally reached a passage, a place in this cave that was about the size of a room, and it had a little stream flowing through it. The floor was covered with large fossils, and fossil bones were sticking out of the walls. I had never seen anything like that before. It was a collection of fossils of large animals, and we collected about a bushel basket full of fossils. One turned out to be a saber-toothed tiger skull, and I understand that later a paleontologist from Harvard came down and went through the specimens that we had collected and collected additional specimens there. It was a wonderful experience.

We would go camping overnight with these professional biologists from the Air Force. They were wonderful people, and very knowledgeable. They really knew the birds. For example, George Sutton helped me one time. I was hunting out in the woods and had shot some birds, and

a game warden caught me. I didn't have a license, so I had to come up before a judge. Sutton—I don't know how he heard about it because he was in Ohio at the time—sent the judge a telegram telling him that I was collecting specimen birds for the jungle survival course. So I was let off with just a talking to.

### *College and Graduate Studies*

MN: During the war they accelerated the high school so that if you wanted to, you could start college earlier. When I was seventeen, I decided that I was going to be drafted. I finally got my parents'—my father's—consent to join the Merchant Marine. I was sure I would be drafted, and I thought it would be much more exciting to try to be in the Merchant Marine, which probably was not a wise idea at all because the losses in the Merchant Marine were even higher, I think, than the losses in the European theater of war. But, my father agreed to sign the papers allowing me to go into the Merchant Marine if I would tell them in my physical examination that I had had rheumatic fever, and I agreed. When I went for my physical examination the Merchant Marine rejected me and then the draft board rejected me because of having rheumatic fever. So I decided to start college.

RH: So you decided to enroll at the University of Florida.

MN: Gainesville was maybe 300 miles from home, so that is why I went there. I liked learning, and so I enjoyed college very much. When I went to the University of Florida, it was a marvelous experience. The school was all boys at that time: now it is coeducational. It is much



better to have a coeducational school. Florida State, at that time, was only for women. I went out for the track team. I was a runner. I didn't do very well. I later became a manager. But I was a little active in sports there as well as in the fraternity.

First, I lived in a dormitory, and then I joined a fraternity [Pi Lambda Phi]. The fraternity actually was very nice because it provided a set of friends that was kind of ready-made. I became close friends with those in the fraternity. It was a very broadening experience. The school was monastic (males only), but the fraternities held parties and everybody invited their girlfriends to come and visit for the weekend, so this was a very important thing. They came from all over the state for this. I was the social chairman at one time. I enjoyed that. They were tremendous parties. They were a lot of fun. As a matter of fact, a number of my former roommates from Pi Lambda Phi got together a number of years ago in St. Thomas and we had a reunion. One of the boys had a house on the island Culebra. We have kept in touch with one another—a few of us, at least. I get visits occasionally from some of the friends that I made in Florida.

RH: And your undergraduate classes? Which professors and courses had a special influence on you?

MN: I was a zoology and chemistry and pre-med major. I think the courses I took in the biology department had an influence. I taught comparative anatomy and some other courses that also had an influence. I made friends with the faculty. I was working in the biology department, so I knew the professors. There weren't that many people attending the University of Florida at

that time. Because of the war, very few people were there, only 500 or 600. After the war there were thousands of people.

There was a great sense of freedom in college. Working and teaching there made life just wonderful because I could keep my own hours. My hours, though, were always terrible. I always liked to work at night, and I hated to get up in the morning. There was nobody to tell me to get up and nobody telling me to go to sleep—which I really liked. That is when I started being a night owl. That is my natural state except when I lived at home. Before that my parents got me out of bed. They wouldn't let me sleep late in the morning, so I had to go to sleep early, or at a reasonable time, in order to get up early. If you go to school, you have to be in school at a certain hour. But staying up late was my natural preference. I must say it is not too good to be on a different time schedule from everybody else because I am 'out of sync.' Being in Tokyo was the only time in my life that I was perfectly synchronized with everybody else. I got up at six o'clock in the morning and felt like a tiger. I was full of energy. It was perfect there. But here in this country I have always been out of sync, and I have always gotten up late. It is much better to be synchronized with everybody else, I think.

In high school I made mostly As and Bs, but in college, I didn't make Phi Beta Kappa. I just barely missed it because of a couple of courses. One was a C. I earned an A in the course, but the professor gave me a C because I did not attend his lectures, which were early in the morning, but I had read the books for the course,. At the end of the year I took a final examination and the professor told me "Nirenberg, you made the highest grade in the class for this course but I'm going to give you a C because you're almost never in class." It was true.

I graduated in 1948. I had forgotten that I did my undergraduate courses in three years, but I think I went to summer school, and I took a lot of courses. I loaded up my schedule. I liked it very much.

RH: What did you do after graduation?

MN: During that period my father had his candy factory, and I wasn't sure what I was going to do with my life, so I became a salesman for the candy factory products. I traveled all around the state selling candy. I didn't like it, so I went back to the University of Florida for graduate school. I had thought about medical school, and I would have liked to go to medical school, but my father didn't have much money at the time. Really, financial considerations kept me from going to medical school. It would probably have been difficult to get into a medical school since it was said that there were quotas for Jewish people. But that wasn't the major consideration. I think it was financial. So I decided to go into biology instead.

I liked biology, and I liked the university, and my father also thought that my decision to go to graduate school was a very good idea. As I had been working and teaching as an undergraduate in the biology department, I knew everybody there. I had intended to become a zoologist. So I became a graduate student in the biology department and took my master's degree in biology. I wrote a masters thesis on Caddis flies. I never published that thesis.

I had dates where I would go out with my girlfriend and collect Caddis flies. Caddis flies are wonderful little insects that live in water, in streams, rivers, lakes, as larvae. They build complicated houses from pieces of vegetation. They cement sand grains to the outside, so they make beautifully decorated little houses, almost like cocoons, for the larvae. When the larvae metamorphose, they become like little moths, and most of them come out at night. So the way you collect the adults is to hang a rope between two trees, throw a white sheet over it and hang a Coleman gasoline lantern in front of the sheet so they come and land on the sheet and you can catch them. You collect the larvae by going in the water. Collecting them was very pleasant because you would go out by a stream, someplace in the woods. The girls I went with put up with the collecting, at least. I don't know how much they enjoyed it. But it was nice. The girls didn't handle the insects. I handled them. Well, I didn't really "handle" them. I caught them by putting a bottle over them, and they would fly into the bottle.

As for professors, Dr. Lewis Berner was my mentor for my master's thesis in the biology department. He is a systematic entomologist<sup>8</sup>, a very nice person. I picked Dr. Berner as my advisor because I had met him during my work in the biology department where he was on the faculty.<sup>9</sup> While I was taking my master's, I got a part-time job as a technician working in the Nutrition Laboratory (Lab). It was there that two professors also stirred my interest in biochemistry—the Nutrition Lab was a real biochemistry laboratory. Dr. George Davis was head of the Nutrition Lab and Dr. Ray Shirley was a biochemist working in the lab. Dr. Shirley was the person with whom I worked the most and who directed my work in the Nutrition Lab. That was my first exposure to biochemistry. There were no courses in biochemistry offered at that time, so it opened up a new field which I thought I would enjoy doing.<sup>10</sup>

My job as a technician in the Nutrition Lab was to change radioactive samples that were being counted. The counters that they had then were primitive. The sample was in the form of a liquid. A probe, like a pH meter, would be inserted into the vial of the liquid sample, and you could quantitatively measure the radioactivity. I changed two samples in two different counters, so I doubled the output of the counting room. I also did all of the calculations for each radioactive sample; that is, subtracting background and normalizing it according to the weight of the sample. There are machines that do that work now. I liked the people. I liked doing all the calculations and related work and it was my introduction, really, to biochemistry.

They made me a co-author of a paper that was published in *Poultry Science*. I don't even remember the name or the citation or the date. I thought it was very nice of them to make me a co-author. I guess the other authors would have included Ray Shirley and George Davis. I never thought of it as being my own work because I didn't have anything to do with the ideas. To this day, I couldn't tell you what the paper is about, so I never claimed it as a paper of mine. But that was my first published paper.<sup>11</sup>

Then I thought I would become a biochemist. Compared to biology, what I liked about biochemistry was that you could study reactions in biochemistry in one species and whatever you found might be applicable to all living things, rather than simply to one species. That appealed to me a lot. I needed a Ph.D.

RH: So you moved on to the University of Michigan.

MN: I applied to three schools: the University of Wisconsin at Madison; the University of Michigan at Ann Arbor; and Duke [University, in Durham, North Carolina]. I was accepted at all three. Two of them, Madison and Ann Arbor, had teaching assistantships for me. As I recall, at Duke, they said they could give me a teaching assistantship for the following semester, but they didn't have anything for that semester. So the choice was between Madison and Ann Arbor.

Madison had a superb biochemistry department, and Ray Shirley advised me to go to Madison. But I was kind of stupid there. I thought—and my parents thought also—that it would be very cold in Madison, much colder than in Ann Arbor, when actually the two places were just almost identical in temperature. They are not that far from one another. Because I was still a little bit under the influence of my previous rheumatic fever, I think, I chose to go to Ann Arbor.

I lived at the fraternity for a few days when I first got to town, until I could find an apartment to rent. But after that I had no connection with the fraternity because I was a stranger to the undergraduates who lived there. They didn't know me, I didn't know them. It was quite different from the fraternity in Florida where I had lived and where I knew everybody. So I preferred to live in an apartment.

The Biochemistry Department in Ann Arbor was somewhat antiquated when I went there. The head of the department, Dr. Howard Lewis, was a distinguished biochemist, though rather elderly, and within a year or so he had a stroke and eventually died. The new head of the department was Dr. Halvor Christensen, who was studying amino acid transport into cells, the

mechanisms of transport of amino acids. Dr. Christensen changed the department and tried to bring in people who would modernize the department, such as Dr. Minor J. Coon, known as “Judd” Coon, who is an excellent enzymologist.<sup>12</sup>

When I had to pass the language examinations for my Ph.D., although I had studied German in high school, I actually put down French. I had a friend who was fluent in French. I had never taken a course in French, but I asked him to translate some French scientific articles for me, and I recorded them as he translated. So from his recording and then just reading the words, I spent a week on it and then took the test. I passed with flying colors. The person who gave the test told me that I had an excellent command of the language, which I couldn't speak at all, but that was sufficient, at least, to pass this test. I also passed the German test. But I don't speak any foreign language fluently. My late wife Perola [Zaltsman Nirenberg], on the other hand, was fluent in a number of languages—Italian, which is very close to Portuguese [her native language], and French—so I usually relied on Perola when we traveled in Europe.

RH: Please describe your doctoral work.

MN: It was old-fashioned work. Of course, I chose my thesis advisor before all these new people came to the department. I picked Dr. Hogg, an extremely knowledgeable biochemist, and he proposed a problem for me to tackle.<sup>13</sup> I worked on it, I would say, for two years and I got nowhere. It just wasn't working at all. I thought, “If I'm ever going to finish graduate school, I have to find a problem that works.” I felt like I was butting my head against a stone wall. I thought it was up to me to find something.

I had lots of ideas. Most of them, I guess, were pretty bad. As a beginner, I started to test these ideas and, lo and behold, something worked. When I got the data proving that it was working, I brought it to Dr. Hogg. When I showed him the data that I had collected, we ***changed the problem*** to one of sugar transport. Basically, we used different kinds of sugars and looked at their uptake into ascites tumor cells. I showed competition between different sugars for an unknown reaction. That was before the first known reaction of glucose metabolism. This was the first evidence that there was a transport mechanism for sugars being taken up into cells and that there was a reaction for which two kinds of sugars competed.

Hogg could have easily just brought me back to the original problem and pressed me to continue work on it. But he saw that there was something interesting in what I was doing, and he saw some things that I didn't see. We switched right then and there and began to work on the problem that I had found for my Ph.D. dissertation. I think it was an excellent thesis because it was on a brand new topic.<sup>14</sup> It was published in the *Journal of the American Chemical Society*.<sup>15</sup>

I was friendly with everybody in the department. It was a very friendly atmosphere. They all contributed to the work. Dr. Melvin Levine was a young professor there whom I liked very much. Dr. Armand Guarino, a terrific guy, later became a dean down in San Antonio. I liked him very much also. And, of course, Halvor Christensen, the head of the department, liked everybody there. I got along well with people, so it was a good place to work.<sup>16</sup>



I greatly enjoyed graduate school. I liked Ann Arbor very, very much. I liked the school. I liked the people, and I enjoyed being there. *I continued to keep 'terrible hours.'* I would come in at 11:00 a.m. in the morning and I would work until 3:00 or 4:00 a.m. at night. I ate lunch there and I would go out for supper. But at the end of the day, just before turning off the light, I would look at the lab and I would think to myself that this is where I really belong. I had various girlfriends, and there were lots of people to meet, as there were 20,000 students on campus. I enjoyed going out with these girlfriends. I went to concerts. We went to dances and did all the usual things, and I enjoyed it.

**I think that was one of the happiest times of my life.**

The footnotes that appear below will be placed in a separate digital file for linkage to this file.

<sup>1</sup> Samson Raphaelson (1896-1983) wrote over 30 plays for Broadway, Hollywood, radio, and television. His 1921 short story, "The Day of Atonement," provided the basis for the Broadway and Hollywood productions of "The Jazz Singer." Among his plays and screenplays were: "Trouble in Paradise" of 1932," "Suspicion" of 1941 for Alfred Hitchcock and "Heaven Can Wait" of 1943 for Ernest Lubitsch. He also taught at the University of Illinois and Columbia University. His son, Joel, became a writer, and his nephew, Bob Rafelson, wrote screenplays, including "Five Easy Pieces" and "Mountains of the Moon." Samson Raphaelson, Contemporary Authors Online, Gale Group, 2003, Biography Resource Center, Montgomery County Public Library.

<sup>2</sup> The curator was likely Willis J. Gertsch (1906 - ). In 1936 he was assistant curator of spiders in the Department of Entomology. (Correspondence between Ruth Harris and the American Museum of Natural History Library, October 2005).

<sup>3</sup> James Pittman (1927- ) was dean of the University of Alabama Medical Center from 1973 to 1992 and was the author of *Diagnosis and Treatment of Thyroid Diseases* (1963) as well as many articles on endocrinology and metabolism.

<sup>4</sup> Probably Hampton Lee Schofield, Jr., chair of the Orlando High School chemistry department. (Orlando High School yearbook, *The Tigando* (1945). MN Collection, NLM.)

<sup>5</sup> According to Dr. Pittman, "it was probably B. Frank McCamey, the one who really got us started in biology. He was a young zoologist in the Arctic, Desert, Tropic [ADT] Branch. Their job was to write pamphlets for the aviators about how to survive if you were shot down over the arctic, a desert, or in the tropics. . . . [McCamey] came to Orlando High School and gave a lecture on birds. He showed a film about bird migration and other aspects of ornithology. At the end of the film several of us went down to the front of the room to talk and ask further questions: Marshall was one, and I was another. . . . Perhaps the dairy farm also guided Marshall toward nature study and biology. The dairy would, of course, be populated with birds that like that environment, like cowbirds, grackles, and red winged blackbirds." (Interview with Dr. James Pittman by Ruth Harris, 13 December, MN Collection, NLM).

<sup>6</sup> George Miksch Sutton (1898-1982) was a zoologist, ornithologist, naturalist explorer, educator, researcher, illustrator, editor, author, and noted painter of birds.

<sup>7</sup> Roger Tory Peterson (1908-1996) was a prominent ornithologist who published field guides and developed techniques for identifying birds.

<sup>8</sup> *Systematic Entomology* encourages the submission of taxonomic papers on insects that contain information of interest to a wider audience, e.g. papers bearing on the theoretical, genetic, agricultural, medical and biodiversity issues. Emphasis is also placed on the selection of comprehensive, revisionary or integrated systematics studies of broader biological or zoogeographical relevance. Papers on non-insect groups are no longer accepted.

<sup>9</sup> Lewis Berner (1919- ) earned his Ph.D. in biology from the University of Florida and became a professor there in 1954. He edited *Florida Entomologist* from 1950 to 1963.

<sup>10</sup> Ray V. Shirley (1912- ) earned his Ph.D. in biochemistry at Michigan State in 1949 and became a professor of animal science and biochemistry at the University of Florida. George K. Davis, Ph.D., was a professor of nutrition at the Institute of Food and Agricultural Science at the University of Florida.

<sup>11</sup> Nirenberg's first publication was as a co-author with R. L. Shirley, J. C. Driggers, J. L. T. McCall, and G. K. Davis, "The Rate of Deposition and Turnover of P32 and Ca45 and the Tissues of the Laying Hen," *Poultry Science*, 33:5 xbv(1954):932-936.

<sup>12</sup> Howard Bishop Lewis (1887-1954) received a Ph.D. from Yale University in 1913 and spent fifty years researching the role of protein in nutrition. He served as chair of the Department of Biological Chemistry in the School of Medicine of the University of Michigan for 32 years. Halvor Christensen (1915- ) was a professor of biological chemistry in the School of Medicine of the University of Michigan at Ann Arbor from 1955 to 1970. He served as a consultant to the NIH from 1962 to 1968. Minor J. Coon (1921- ) was a professor in the Department of Biological Chemistry at the University of Michigan, Ann Arbor.

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<sup>13</sup> James Hogg (1918- ) was on the faculty of the Department of Biological Chemistry at the University of Michigan, Ann Arbor, from 1947 to 1964.

<sup>14</sup> Marshall Nirenberg's doctoral dissertation was entitled "Hexose Uptake in Ascites Tumor Cells." Between 1956 and 1959 he published five articles in scholarly journals based on that work.

<sup>15</sup> When Howard E. Skipper wrote a review of the field for 1958, he included a mention of Nirenberg's work.

<sup>16</sup> Melvin Levine (1919- ) earned a Ph.D. from the University of California and was on the faculty in biochemistry at the University of Michigan from 1950 to 1961. Armand J. Guarino (1926- ) was an assistant professor in biochemistry at the University of Michigan Medical School from 1955 to 1961.